Interim Project Management Team Report:

Green Line Extension Project

Report to the
MBTA Fiscal and Management Control Board
and the
MassDOT Board of Directors

Submitted May 9, 2016

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I. Introduction and Key Findings

In the wake of major projected cost overruns on the Green Line Extension project (GLX), the MBTA Fiscal and Management Control Board and the Board of the Massachusetts Department of Transportation ("the Boards") jointly and unanimously adopted a resolution on December 14, 2015, that, among other things, set a series of conditions under which the GLX project could proceed. While noting the project's potential benefits, the Boards created a multidisciplinary Interim Project Management Team (IPMT), tasking it to report back with and address a series of key issues, including:

- The ability for the project to be redesigned to reduce anticipated cost while maintaining its core functionality and benefits;
- Methodologies to assure the project could be reprocured to reduce construction costs, increase cost reliability, and limit risks borne by the MBTA and MassDOT;
- Best estimates of a realistic, revised project cost and schedule; and
- Assurances that the provisions of the federal Full Funding Grant Agreement (FFGA) would not be adversely impacted as a result of the redesign.

Concurrent with the team's work, MassDOT and MBTA staff has been addressing other critical issues for GLX to proceed, including:

- The ability for MassDOT and the MBTA to develop a new management structure that will allow the project to be delivered effectively and efficiently while not undermining the fiscal and managerial capacity of the MBTA to maintain and improve its core operations;
- The development of financial contributions to the project from external sources, including the Boston Metropolitan Planning Organization, the corridor municipalities, and landowners and developers benefitting from the project, to fund any remaining gap between available funding and revised anticipated project costs.

This report, including cost and schedule estimates, was developed on a compressed, expedited timeline to address the Boards' concerns. While the IPMT has attempted to answer key questions raised by the Boards, it does not recommend whether the Boards should vote to proceed with the GLX project. The Boards must weigh this report's findings about project redesign, simplification, reduced costs, and proposed procurement and management systems against potential risks and challenges that remain.

Key Findings

As the Boards consider whether to further advance the GLX project, the IPMT sought to answer certain key questions and propose recommendations to help inform that decision.

1. What would a redesigned Green Line Extension project look like?

The redesigned GLX project includes revisions to the stations, the vehicle maintenance facility, the viaducts and bridges, power and signal systems, and the Community Path. The redesigned project is believed to be in conformity with the FFGA as well as the federal Environmental Assessment (EA) and state Environmental Impact Report (EIR) requirements and includes all stations on the Medford and Union Square branches. The station locations, platform size and functionality remain unchanged under the redesign program.

In addition to significantly reducing project costs and schedule, the new and simplified project design presents fewer construction risks going forward.

2. **How much would the project cost to deliver, including monies already spent or committed?**

The IPMT's new total GLX program cost estimate for the redesign is $ 2.3 billion. This total value includes costs that have already occurred. Each month of delay will escalate costs by an estimated $1.6 million.

Should the Boards vote to proceed with the project, the Federal Transit Administration will review, among other things, the revised scope and cost estimates. It should be noted that previous FTA risk evaluation of this project concluded that additional budget needed to be added to the Finance Plan.

3. What would the new project schedule look like, including FTA coordination and approval, reprocurement and construction?

If the Boards decide to move forward with GLX, the project would proceed in three phases, which could overlap to some degree. The first phase would involve submission of the redesigned project and program cost information to the FTA for its review and approval; the length of this process is unknown. The second phase is a reprocurement process that would, if conducted on an expedited basis, take 18 months. Once a Construction Notice to Proceed is issued, the construction package would require between 43 and 47 months.

4. If the GLX project continues, how should the remaining design and construction work be procured and executed?

The IPMT recommends that the redesigned GLX Program be procured using the Design-Build project delivery method, in one overall package, using a new MBTA Design-Build manual and with a specific "not to exceed price" (also known as an upset limit) beyond which the MBTA will not consider bids.

5. If the GLX project continues, how should it be managed, by both MBTA staff and consultants?

The IPMT recommends the "Program Management" system, which applies standardized management and project control systems to the design and construction of complex construction projects for a common owner over time. Details of this approach and system follow in this report.

6. What revenue is available to pay for the revised GLX project?

Pending any possible revisions by the FTA, the gap between the last official program cost of $1.992 billion and the current estimate of $2.3 billion is approximately $300 million. MassDOT has been seeking additional funding from the MPO, the corridor communities, and developers. (See the section, "GLX Collaborative Funding.").

If the Board votes to continue the GLX project, next steps include seeking FTA approval of the redesigned project.

While this report has discussed ways to reduce costs and has suggested procurement and management improvements for the GLX project if it proceeds, some key issues remain for the Boards to consider. The IPMT estimate and schedule is dependent upon the ability of MBTA management to properly implement and monitor the project even as it continues to work on improving the reliability of its core system.

II. Background

The Green Line Extension is a major MBTA project that would provide new transit service to Union Square in Somerville and to College Avenue in Medford. The project would include the relocation of the existing commuter rail tracks, the construction of 4.3 miles of new Green Line tracks and systems, one relocated station (Lechmere) and six new stations (Union Square, College Avenue, Ball Square, Lowell Street, Gilman Square, and Washington Street), a new vehicle maintenance facility, reconstruction of bridges, construction of retaining and noise walls, and a Community Path. The project would also procure 24 new transit vehicles.

The project was conceived to deliver a range of regional environmental, economic, and other benefits, including improved transit options for a dense and underserved area (by 2030, GLX is projected to have about 49,000 boardings and alightings a year.).

Initially, the MBTA chose to deliver this project using the Construction Manager/General Contractor (CM/GC) process. But as the project progressed, the Boards were presented with information that projected the final cost of GLX could be as high as $3 billion, compared to the Budgeted Full Funding Grant Agreement (FFGA) budget of $1.99 billion. That cost did not include finance costs, which this report also excludes.

The IPMT built off a series of studies that were performed in late 2015 after disclosures of major GLX project cost overruns. The Team mobilized, reviewed the previous design, assembled or developed a significant number of cost avoidance ideas, and developed design plans or sketches to describe them. Where appropriate, the IPMT then vetted these ideas with relevant stakeholders, including the affected communities, MBTA operations, and the MBTA Owner's Representative. Finally, the IPMT developed a cost estimate and schedule for the entire GLX project based on the redesign. Some of the GLX scope (notably the commuter rail tracks and the Green Line tracks) remain largely unchanged in this redesign.

During the process, the IPMT held a robust stakeholder process. The Team and MBTA staff participated in six public meetings, including two meetings with the Design Working Group, and multiple meetings with other stakeholders, such as the cities of Somerville, Medford, Cambridge, the Conservation Law Foundation, the Friends of the Community Path, and other groups.

The cost estimate of $2.29 billion is presented as a total program cost and includes costs that have already occurred. In addition, the IPMT estimate and schedule, in coordination with MassDOT and MBTA, assumed the new GLX will be delivered using the Design-Build procurement method. It is understood that the Team's new program cost estimate will be utilized by the MassDOT and the MBTA Fiscal and Management Control Boards as they decide on the future of the GLX Program. FTA would also need to confirm the cost estimates as part of its review of the redesign.

The accuracy of this new construction cost estimate will ultimately be measured from the comparative results of a solicitation of bids for a future Design-Build contract within the newly recommended GLX not to exceed price.

It is important to note that the IPMT has actively engaged the FTA and its Project Management Oversight Consultant throughout this process. The Team diligently sought to assure that the redesign effort would not negatively impact the spirit or intent of the FFGA and that the core functionality of GLX would be maintained. MassDOT recently forwarded a letter to FTA that documents this position. (See Appendix A.)

The FTA New Starts capital funding program is competitive. Including the GLX project, only ten New Starts projects are under construction nationally[1], with $2 billion generally allocated each year for the program. The FTA awarded the FFGA for the GLX project based upon a comprehensive review of its mobility improvements, congestion relief, environmental benefits, and cost effectiveness, as well as its land use and economic development effects. These benefits are largely dependent on the number of transit trips produced by the project. Factors that affect potential trip generation include the number and location of stations and platform size, as well as span of service and service frequency. As recommended by the IPMT, the project includes all stations on the Medford and Union Square branches. The station locations, platform size and functionality remain unchanged under the redesign program.

[1]Footnote 1: Federal Transit Administration, *Annual Report on Funding Recommendations, FY 2017, Capital Investment Grant Program, 2016*

Given that the basic functionality and service plan are the same, the team is confident that the redesigned GLX project will achieve the same forecast ridership and therefore the same project benefits upon which the FFGA was awarded. In addition, the New Starts economic development and land use benefits associated with the stations remain unchanged, as the same number of stations and their original locations are retained.

In addition to being consistent with the FFGA, the IPMT, in its GLX evaluation, also considered the terms and conditions of both the Environmental Assessment for FTA and the Environmental Impact Report for the Massachusetts Environmental Policy Act.

While the ability to improve the project schedule was reviewed as part of this report, the main focus was on reducing costs without violating the FFGA requirements. The Team feels that the success of the recommended GLX project delivery depends greatly upon ensuring the development of very detailed design criteria and promotion of innovation during the prime contractor procurement phase.

The Team did not provide a look back analysis or an opinion of the prior studies of the CM/GC Delivery Method. However, based on its observations, the Team believes that the Design-Build methodology would be best suited (compared to CM/GC or Design-Bid-Build) were the project to proceed. This method would help the Boards secure the earliest competitive bid-price in order to determine the validity of current cost estimates. With most permits and right-of-way takings in-hand, the Team believes that MBTA should be able to perform a Design-Build process that will promote competitive pricing and an expedited schedule. Various tools and confidence measures have been included in this report, including:

- Competitive bid, best practices Design-Build process for reprocurement;
- Reduced and/or simplified scope;
- Reduced schedule durations;
- Best practices estimating, with appropriate contingencies; and
- New MBTA Program Management plan for project delivery.

III. Redesigned Project Scope

The IPMT held several design workshops with the designer, FTA, PMOC, and the Owner's Representative to vet the many cost saving ideas that had been developed. The IPMT reviewed the redesigned scope items with the appropriate MBTA departments (i.e. Operations, Power, Commuter Rail Operations, etc.) to ensure the acceptability of the individual ideas.

The IPMT developed a list of additional cost reductions beyond those noted in this report that have merit but could not be pursued at this time due to time constraints. These items primarily involve the project's design criteria and include such items as viaduct train loading criteria, station lighting level criteria, stray current criteria, pile design criteria for Broadway Bridge, geotechnical design criteria, and excavated material disposal criteria. The IPMT believes that the future inclusion of these criteria revisions could yield additional savings in the Design-Build process beyond those in the redesign budget estimate.

This section describes the main elements of the redesigned scope. Further detail is provided in the Functionality Chart in Appendix B.

III.1 Stations

The previous design of each of the seven stations included escalators, redundant elevators, fare arrays, personnel rooms, toilets, drop offs for The RIDE, canopies, and equipment rooms most of which were housed within a station structure. Inclusion of these elements at each station resulted in stations' scope and amenities well beyond that normally found on light rail systems.

The IPMT approach to downsizing the stations was to develop a recommended concept that maintained basic functionality at each station, with a few important amenities added to each station, using the current MBTA Riverside Line as an example. The Team defined the recommended functionality as providing ADA access within each new station, fare vending, simple open air platforms with three bus type shelters (except Lechmere which received four), station lighting and CCTV, an emergency egress route where required, bike storage and required equipment rooms.

Function	Previous Design							Redesign						
	Lechmere	Union Sq.	Washington	Gilman Sq.	Lowell St.	Ball Sq.	College Ave	Lechmere	Union Sq.	Washington	Gilman Sq.	Lowell St.	Ball Sq.	College Ave
Elevators	3	2	2	2	2	2	2	2	N	N	1	1	N	2
Escalators	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N
Stairs	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	Y
Ramp	N	N	N	Y	Y	N	Y	N	N	N	Y	N	N	N
Fare vending	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fare arrays	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N
Canopies	Y	Y	Y	Y	Y	Y	Y	Weather Shelters	Weather Shelters	Weather Shelters	Weather Shelters	Weather Shelters	Weather Shelters	Weather Shelters
Platforms	4-Car	3-Car	3-Car	3-Car	3-Car	3-Car	3-Car	4-Car	3-Car	3-Car	3-Car	3-Car	3-Car	3-Car

In several cases, the scaled-down stations eliminated elevators, escalators, fare gates, personnel rooms, toilets, extra structure for The RIDE drop-offs, and canopies. For stations with large access grade separations (Gilman and Lowell) the redesign includes an elevator and access stairs. For the stations at Lechmere and College Avenue, the design includes redundant elevators (due to the large elevation differential between the street and the platform level), toilets and accommodations for MBTA personnel.

Features of the redesign for each station, which are detailed in the chart above and the Functionality Chart in Appendix B, include:

1. **Lechmere**: Reduced North Headhouse, with redundant elevators, platform with four weather shelters, South Headhouse includes emergency egress and stairs with The RIDE Drop Off and bike storage area retained.
2. **Washington Street Station**: Open air station, platforms with three weather shelters, at grade crossing of track, bike storage area retained.
3. **Gilman Square Station**: Open air station, one elevator and stair provided, platforms with three weather shelters, bike storage area retained.
4. **Lowell Street Station**: Open air station, one elevator and stair provided, platform with three weather shelters, bike storage area retained.
5. Open Air station, platforms with three weather shelters, bike storage area retained, at grade crossing of track. Included as Figures 3.1 and 3.2 are the before and after plans of the Ball Square Station. This is representative of the type of station modifications typical to all the stations in the redesign.
6. **College Avenue Station**: Reduced structure (Tufts future development preserved), platforms with three weather shelters, redundant elevators, The RIDE drop off is retained on Boston Avenue, bike storage area retained.
7. **Union Square Station**: Open Air station, Platform with three weather shelters, the RIDE drop off retained as part of the future development, bike storage retained, no escalators or elevators.

Although the Union Square branch contains only one station, it is projected to have the third highest ridership of the GLX stations after Lechmere and Gilman Square stations, with approximately 3,645 inbound daily weekday boardings. In addition, the Union Square station location within a designated redevelopment area contributes to the GLX project ratings for economic development.

The IPMT did investigate an option that eliminated the Green Line Union Square branch and Station as a cost saving measure, providing a commuter rail station in its place. The Team determined, however, that such elimination would likely require reevaluation of the project with respect to the FTA criteria as well as possible additional federal and state environmental review, thereby delaying the project and potentially requiring reentry into the New Starts process, with no guarantee of a future FFGA. The elimination option also did not result in significant enough cost savings due to costs already incurred on that section, as well as costs associated with upgrading the redesigned Union Square Green Line station to a full commuter rail station. Therefore, the IPMT does not recommend eliminating the Green Line Union Square branch. The IPMT recommends the adjacent developer incorporate elevators into its design.

III.2: Vehicle Maintenance Facility

The previous design included a 94,000 square foot Maintenance Facility, which called for:

- Outdoor storage for 88 Green Line vehicles;
- Parking for 80 maintenance personnel;
- Parking deck for 99 cars (for operators);
- A double-ended maintenance building;
- Transportation Building of 8200 square feet;
- One service and clean bay;
- One flat floor bay;
- Two component change out bays;
- Four service and inspection bays;
- One wash bay;
- Administrative and employee offices and facilities;
- HVAC shop and storage;
- Sand storage and automated equipment;
- Truck shop;
- Two five-ton and one seven-ton crane servicing three bays;
- Traction Power Sub Station fed by two independent utility feeders; and
- Storage and shop for two Maintenance of Way Trucks.

By contrast, the redesigned maintenance facility includes a 55,000 square foot maintenance building, a capacity to store 44 vehicles outside, a modular transportation building of 1200 square feet, surface level parking, four service tracks, a seven-ton and a 10-ton crane, and two inspection bays. All other features have been deleted though certain foundation and structural elements have been sized for potential future expansion should funding become available.

III.3: Viaducts

The previous design included elevated structures carrying eastbound and westbound tracks to Union Square Station, portions of the Community Path and Green Line Track north of Lechmere Station. To reduce project costs, the IPMT pursued several concepts to reduce the cross-section and structural components of the structure, including:

1. Direct fixation of the track on the viaduct;
2. Deleting the Community Path portion of the viaduct;
3. Utilizing Center Overhead Catenary System poles instead of side-mounted poles on the viaduct;
4. Reducing the size and depth of the foundation shafts;
5. Minimizing the structural width of the viaduct; and
6. Eliminating the eastbound viaduct.

However, based on operational issues related to retaining only a single elevated track as well as sunk costs due to already purchased steel elements, the redesign retains the east and west bound tracks and both viaducts but deletes the viaduct section of the Community Path. Reductions in the foundation shafts are included in the redesign.

III.4: Bridges

Bridge	Previous Design	Redesign
Medford Street	Full replacement	Keep existing Bridge WB GLX tunnel behind abutment
School Street	Full replacement	Keep existing Bridge WB GLX tunnel behind abutment
Lowell Street	Full replacement	Revise GLX alignment, remove south abutment earthwork, and avoid bridge reconstruction
Broadway	Full replacement of 2 lane bridge plus 1 parking lane, sidewalk, and 2 bike lanes. Partial closure during construction	Replace with 2 lane bridge, and 2 bike lanes. Parking lane and sidewalk removed. Full closure during construction
College Ave	Widen bridge structure to accommodate right-hand turning lane	Maintain right-hand-turn lane on existing bridge, remove sidewalk, and add new pedestrian bridge

The previous design required modifications or replacement of the College Avenue, Broadway, Lowell Street, Washington Street, Medford Street and School Street bridges. The redesign scales back much of that work while retaining functionality for the project.

The recommended redesign for the bridges (where revised) are as follows:

1. College Avenue:

The previous design included a partial demolition and reconstruction of the bridge to accommodate bike lanes and a right hand turn toward the station.

The redesign retains and modifies the current bridge, allowing for two through lanes and a right-hand turn lane from College Ave onto Boston Ave utilizing the space occupied by the current walk. It also includes the construction of a separate independent light bridge to the north for pedestrian and bike traffic; however, the IPMT recommends that the MBTA consider deleting this requirement in its negotiations with Tufts regarding future air rights and use the Tufts plaza to provide that function.

2. Lowell Street:

The previous design included a complete demolition and reconstruction of the bridge since the current clearance below the existing bridge does not provide sufficient space for the two Green Line tracks and the two commuter rail tracks.

The redesigned station makes adjustments to The RIDE drop off and reduces the station configuration allowing for the existing Lowell Street Bridge to be retained. Preservation of the bridge however will require removal of an existing old abutment and the construction of a retaining wall in its place. Removal of the existing old abutment will provide sufficient space for the fourth track thereby avoiding replacement of the existing bridge. This is illustrated in Figure 3.3 at the end of this section.

3. Broadway Bridge:

The previous design called for the complete demolition and replacement with a new bridge. It called for two through lanes, a right-hand turn lane with significant storage and parking on the bridge. The previous design required the bridge to be built in two phases in order to maintain street traffic; this complicated phasing would have added significant cost and time.

The redesign includes replacement with a narrower bridge that includes two through lanes but deletes the on-bridge parking and limits the right turn lane to an area beyond the bridge. The IPMT also recommends closing the bridge to traffic during construction, an idea to which the City of Somerville has committed support.

4. Medford Street and School Street Bridges:

The previous design called for the complete demolition and reconstruction of these bridges in order to provide sufficient clearance under the bridge for two Green Line tracks and two commuter rail tracks. Clearance between the existing abutments can only accommodate three tracks.

The redesign of the Gilman Station (discussed previously) allows the project to consider options that avoid complete reconstruction of these bridges.

The redesign allows for both bridges to remain in place. The fourth track (Green Line inbound) would be accommodated in a tunnel structure that would be constructed behind the existing bridge's southern abutment. Hence two tunnels would need to be constructed, one at Medford Street Bridge and one at School Street Bridge. Due to the proximity of the two bridges to each other, the tunnel option must be pursued at both bridges concurrently.

All remaining bridges remain mainly unchanged by the redesign effort.

III.5: Power and Systems

Several items related to Power and Systems were considered for redesign:

1. Removal of the second AC Power feed to the stations (this was agreed to with MBTA Operations); the redundant feed will be provided by a street connection;

2. Elimination of Load Center 12 (also agreed to with MBTA Operations). This is allowable due to the previously agreed to deletion of Yard Leads 1 and 5;
3. Maximize the use of center OCS poles: this idea was dropped due to limited cost savings, offset by MBTA Operations safety and maintenance concerns;
4. Elimination of the negative return cable was pursued by IPMT, but MBTA Operations suggested a similar alternative that is being pursued;
5. Modifications to the Ring Feeder layout was agreed to with MBTA Operations and results in reduction of significant amounts of electrical cable;
6. Redesign of the Traction Power Substations at Gilman Station, Ball Station, and Red Bridge agreed to with MBTA Operations and results in significant cost savings; and
7. Modifications to the breaker system were agreed to with MBTA Operations and results in reduction of significant amounts of electrical cable.

III.6: Community Path

The Community Path, a significant feature of the GLX project, has been the subject of extensive coordination and participation with the affected communities. An existing community path intersects the GLX alignment near Lowell Street and the previous design met that path and then essentially followed the west side of the GLX alignment towards Boston. The previous Community Path was designed to follow the alignment directly adjacent to the railroad cut, from Lowell Street station to Washington Street Station. Beyond Washington Street Station, the previous path design alignment included a viaduct in order to go up and over the Fitchburg Main Line tracks and the various yard tracks. This viaduct essentially followed the alignment of the GLX Lechmere Viaduct until it finally touched down to ground near Water Street in Cambridge.

This previous Community Path design has been identified as a potential major driver of the forecast project cost increase. After its own review, the IPMT concurred with that assessment. The IPMT found that the path's costs were driven by two factors:

- The retaining walls between Lowell Street and Washington Street Stations had to be significantly increased in order to align the path at street level adjacent to the west side of the railroad cut;
- The viaduct section near Lechmere Station was also determined to be very expensive.

Function	Previous Design	Alternate Design
Length of Path	10,000 feet	7,000 feet
Start/ finish	Lowell Street to Water Street, Cambridge	Lowell Street to Washington Street, Somerville
Width	11-foot average, 8-foot minimum	11-foot average – 8 foot minimum
Street Access Points	Central Street Sycamore School Street Medford Street Walnut Street Chester Street (2) Washington Street West Boulevard	Central Street Sycamore Street School Street Chester Street (Possible) Washington Street

The FFGA includes a line item (Standard Cost Code 40.06 – Pedestrian / bike access and accommodation / landscaping) for $27.1 million. This number appears to have not included the full cost of the necessary retaining walls, which were included in a separate SC Code.

To reduce Community Path costs, the IPMT pursued two options: Complete elimination of the Path and an Alternate Alignment for the Path.

A. *Elimination*: An early activity of the IPMT was to redesign the GLX corridor without the Community Path. This included revisions to the cross sections and viaduct structures. This was done at a preliminary level to ensure this would work from an engineering perspective. The IPMT was satisfied that the GLX could be built without the path, with significant cost savings over the previous design. The IPMT felt that nothing in the redesign would preclude a future construction of the previous designed Community Path, although it may be even more expensive to add it in later while GLX was operating adjacent to the path alignment.

B. *Alternate Alignment:* While elimination of the Path would result in the greatest savings, the MBTA, the affected community, and other stakeholders expressed significant concern over the potential of no path at all. Therefore, the IPMT sought to identify what a very low-cost redesigned Community Path might look like. The IPMT used the "no path" corridor redesign as the base (i.e., greatly reduced walls and no viaduct). By looking at the alignment in sections, the IPMT designers identified the potential to include a path along the railroad cut from the existing terminus at Lowell Street to Washington Street Stations From there, users headed to the Charles River parks would need to follow the existing street system.

The Alternate Alignment has been located to minimize the need for additional walls between Lowell Street and Washington Street, by (1) moving it laterally away from the railroad cut where possible, for example between Lowell Street and Central Street through an existing city park; (2) switching from the west side to the east side and back again between Central Street and School Street, and, (3) revising the grade to lower it to track level beyond School Street. This is further illustrated in Figure 3.4 and Figure 3.5 at end of this section.

Beyond Washington Street, the path ends and people would need to use existing streets (including McGrath Highway) to reach the Charles River parks, in lieu of the previous design's viaduct structure. The IPMT estimate for the additional cost necessary to include this Alternate Path is approximately $20 million and this budget for the Community Path is included in the overall projected GLX cost estimate.

The IPMT presented this Alternate Alignment at a community meeting on April 13, 2016. Based on the feedback from the public at that and other stakeholder meetings, there were two major comments. First, the 90-degree turns to get from the east side of the cut to the west side of the cut need to be engineered to optimize the ability of path traffic to cross those streets. Second, to get beyond Washington Street, people were concerned about the need to use existing streets, including McGrath Highway. While these issues may not be solved to everyone's satisfaction, the IPMT believes the next phase of implementation can, for minimal additional cost, make improvements to the current Alternate Path design.

III.7: Retaining Walls and Noise Walls

With the Alternative Community Path, the remaining retaining walls can be greatly simplified and reduced in size and extent. In some cases, the remaining retaining walls are used to support noise walls where economically justified as part of the same structure. Where more economical, a separate noise wall will be constructed. In some instances, it may be more economical to provide sound insulation at the receptor (residence). As an additional cost saving, the IPMT is recommending a change in the material type for the noise walls.

Station Schematics

Figure 3.1 Ball Square Station: Previous Design

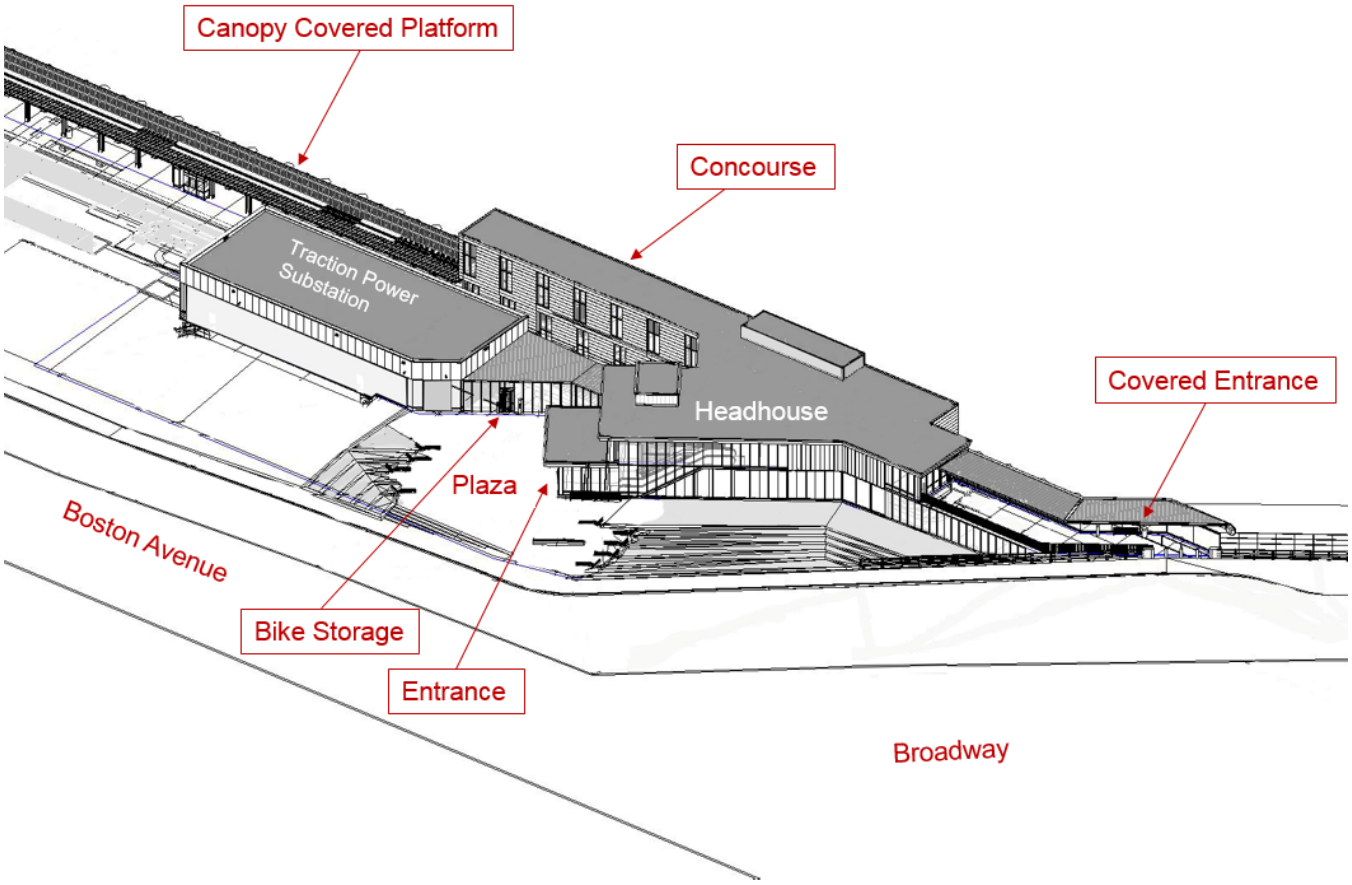
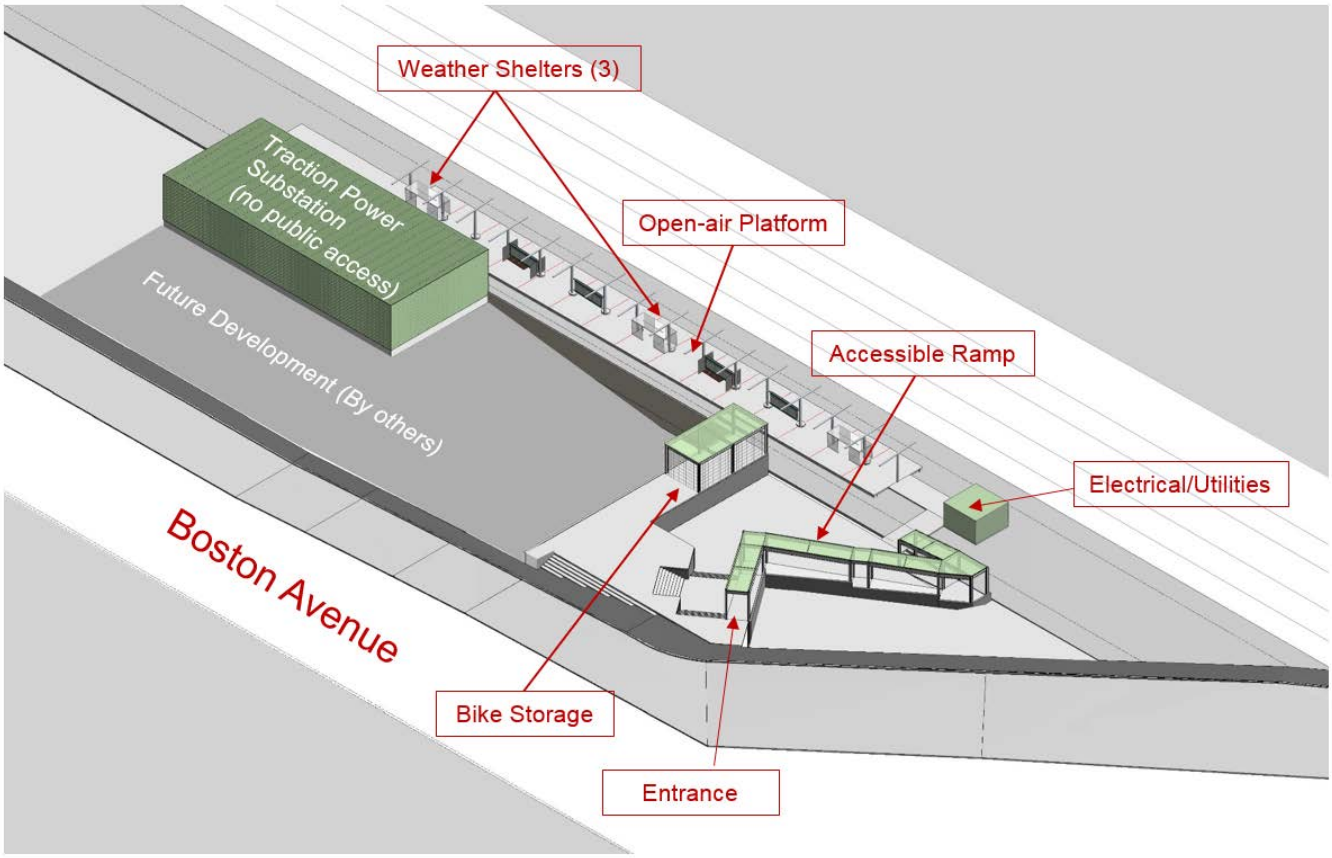
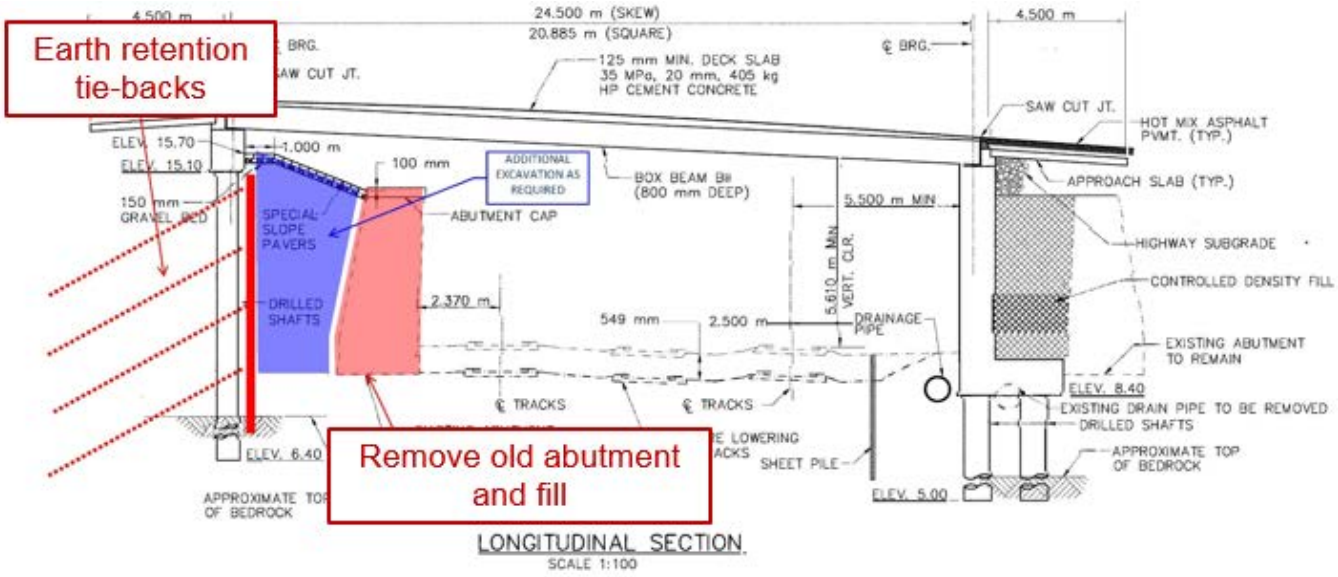


Figure 3.2: Ball Square Station: Redesign



Lowell Street Bridge (Representative Bridge Schematic)

Figure 3.3: Lowell Street Bridge



Community Path schematics

Figure 3.4: Previous Path Design

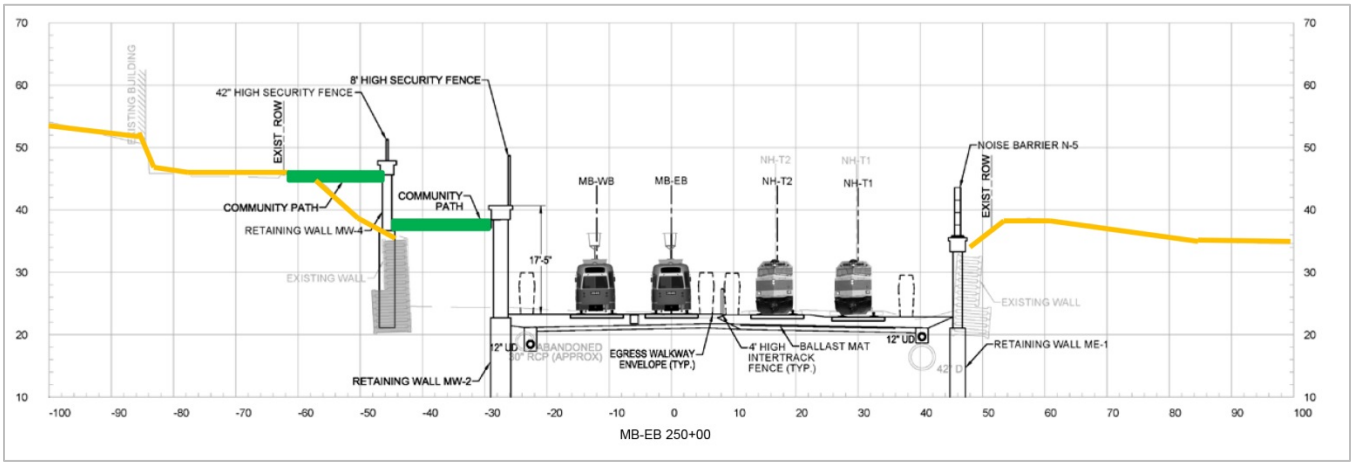
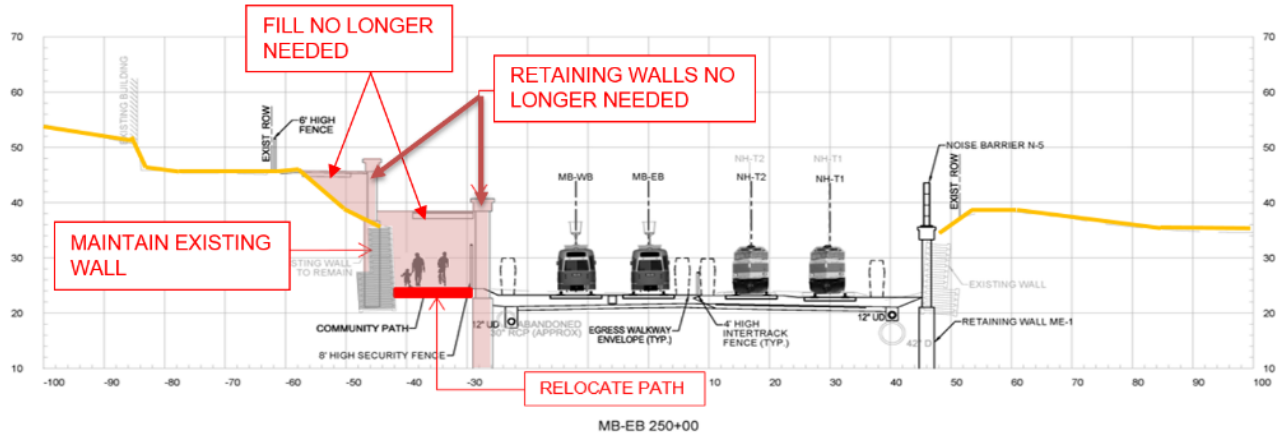


Figure 3.5: Alternate Path



IV. Cost Estimate

The decision of the Boards to create the IPMT was driven in large part by rising and unexpected costs of the project. The cost estimate and the alternative scope evaluation were thus considered one of the most important components of the IPMT scope.

In order to evaluate the effectiveness of the redesigned GLX, the IPMT initiated an estimate process to provide the overall conclusions as expeditiously as possible. The IPMT also provided a revised cost estimate for "other cost centers," namely real estate, vehicles, and professional services. Finally, the IPMT considered and recommends a reasonable unallocated contingency. The cost estimating process used by the IPMT is further detailed in Appendix E, Estimate Narrative.

At the start of the redesign process, the IPMT determined the best course of action was to utilize the work that was previously generated by the previous GLX Independent Cost Estimator. Typically, as the design phase of a large transportation program progresses an Independent Construction Cost Estimate (ICE) is developed concurrently with the public agency's own engineer's estimate. The independent cost estimate is most often generated by a team of experienced construction cost estimators who are free of contractual conflict since the ICE team is precluded from bidding on the work competitively.

The previous GLX ICE was not tasked with preparing an overall budget; rather, they priced the same previous scope against the proposals of the previous CM/GC contractor. Under the previous CM/GC estimating process, the contractor had to provide a price/estimate that was within 10 percent of the ICE's estimate of that same scope. The estimates for the scope of previous iGMP#4 were never successfully delivered within that 10 percent range before the negotiation process was halted.

To support the expedited time frame, the IPMT estimate has utilized many of the previous organization aspects of the ICE estimate for the iGMP#4 package. This entailed extensive structured information within the full estimate detail that was provided by the ICE including items detailed in the appendix F narrative.

The IPMT did not solely rely upon the information provided within the extensive ICE documentation. Rather, the IPMT construction cost estimators reviewed and modified that documentation to generate a new construction cost estimate that reflects the significant design changes. The IPMT also reviewed the alternative options with the FTA, with representation from the FTA Program Management Oversight Consultant, the MBTA's GLX Owner's Representative (HMM), as well as staff of MassDOT and the MBTA.

The IPMT concluded that all other alternatives, such as a new detailed bottom-up cost estimate methodology, were either not feasible within the IPMT reporting deadline of May 9, 2016 and/or did not offer any significant increase in price certainty. Part of the reason for choosing this estimating methodology is that detailed engineering drawings of the redesigned concepts were not produced for the IPMT estimators to utilize.

Construction Costs

The previous GLX construction forecast and budgets included some spent costs for work that was completed under an initial design-bid-build construction contract (called Phase 1) and CM/GC construction contract for ongoing work in what was called the Interim Guaranteed Maximum Price contract packages (iGMP 1, 2, 3, and 4A). In addition to those executed contracts, cost estimates were generated at various levels of completeness for the previous scope of work within what was the remaining scope (iGMP 4, 5, 6, and 7). The previous estimate for iGMP 4 was based on a 100 percent complete design. An initial estimate for the scope of work in the package for iGMP 5 was based on a design that was approximately 90 percent complete. Both iGMP4 and iGMP5 packages were mainly comprised of track work, retaining walls, stations and bridges. The remaining previous scope (iGMP 6 and 7) was partially estimated based on a design that was approximately 60 percent complete.

The following is an overview of the aspects and processes that the IPMT estimators utilized to complete the new construction cost estimate:

Unit/Quantity

The estimating team generated new quantities for the major commodities of the redesign of the GLX project. These were based on the preliminary sketches and narrative provided by the designers. This saved the IPMT estimating staff valuable time. The IPMT then provided hundreds of adjustments to the estimate to reflect the redesign. As an example, the IPMT reduced the square footage of the retaining walls to the new redesigned wall quantities. The IPMT now has a new tabulation of the wall locations and the new wall locations that can be utilized to establish the base technical concept of the new core

Design-Build bid documents.

Pricing

A typical/detailed ICE construction cost estimate contains prices for labor, materials and equipment. When prices are applied to anticipated production rates and crew compositions, this formulates the basis of what is called a production-based cost estimate or a bottom-up estimate. The previous GLX ICE had provided a great deal of information with regard to prices that were part of the iGMP estimate. The IPMT reviewed the prices for the major commodities that were contained within the previous ICE estimate and adjusted the detail to best reflect current market prices and the benefits of the GLX redesign concepts. This was performed using various pricing references, including the use of "comparables;" in other words, the IPMT reviewed the most recent MBTA costs over the last several years for similar stations. This exercise increased the confidence in the station estimates. A market conditions assessment was also generated as one of the final steps of the new program estimate to help reflect the price risk due to market conditions as of 2016. See also the escalation section below.

Production Rate Adjustments

Production rates are factors that are established by utilizing past experiences, engineering judgment, historical records, time-motion studies and evaluations of anticipated construction crews that will be working in a particular area. For any of the aspects of the previous estimate that were maintained in the IPMT estimate, the most significant commodities were reviewed and/or adjusted to reflect the production changes in the scope of the work and/or what the IPMT determines to be a reasonable and necessary adjustment, up or down.

Estimate for the Reduced Vehicle Maintenance Facility (VMF)

Since the redesign scope is drastically different from the previous design, the IPMT generated a new estimate for the reduced VMF using a unit price approach. Due to the level of detail for the modified design, major assemblies of construction elements were priced as groups that compare to aspects of similar building types. Examples of this are the price per square foot of a wall façade that is comprised of wall framing, insulation, masonry units, waterproofing and paint. This estimating methodology allowed the IPMT to provide a reasonable budgetary projection of what is a significantly scaled-down version of the VMF.

Estimate for the Reduced Stations

Similar to the VMF, each of the seven Green Line stations was priced utilizing the same unit-priced approach for the major assemblies of the construction elements. An example was to provide a price per cubic yard of concrete that will be placed for the platforms. This represents an in-place comparative price that has been utilized on past/similar transit projects. Additionally, to gain further confidence in the new estimates, the IPMT gathered past MBTA historical bid results for similar stations. These results favorably compared the past stations' costs to the new redesigned stations' estimates. Where appropriate, escalation factors were utilized to account for a current day comparison of those past MBTA projects.

Limitations-of-Operations Adjustments

The term Limitations of Operations is used to describe the conditions and restrictions that the contractor is required to account for in executing the work. These are contractual restrictions that are most often specified by the known restrictions of the work. Examples include noise restrictions, railroad operational restrictions, environmental requirements, and traffic restrictions. The IPMT was tasked with evaluating some of the most restrictive aspects of the past GLX planning effort and making recommendations to modify aspects that will be most beneficial to a future contractor's production rates. This was intended to be offered up as significant cost avoidance in the new construction cost estimates for the GLX. The IPMT revised estimate was updated to reflect some enhancements to allowable working hours, constraints related to shut down periods and the overall work within the GLX corridor.

The new estimate and new schedule were coordinated to reflect the benefits of allowing a future contractor to work within the corridor, without the commuter rail service operational, for a total of 25 weekends per year. This greatly helped the IPMT prepare a schedule that reasonably completes the entire scope of the redesigned GLX within 43 months. The cost of paying labor to work over the weekends was included in the estimate and the overall duration improvement was accounted for with an escalation adjustment at the conclusion of the IPMT estimate. It should be noted that this initiative also significantly mitigates a specific high-risk item, namely the need for flagging resources to support the contractor.

Indirect/Overheads/Profit

A typical contractor detailed bid estimate contains hundreds of line items to forecast and budget for the supporting operations for the execution of the direct cost aspects of the estimate. These are clear allocations of labor, materials and equipment to specific construction operations. Indirect costs (also often called general conditions or overheads) support those direct cost elements. Examples of indirect costs are non-manual supervision, insurances, temporary facilities, construction vehicles, home and office support. As is done in a contractor-generated, detailed bottom-up estimate and an ICE, indirect costs are most often estimated based upon the direct costs of the particular project, along with the overall time constraints and completion deadlines.

Rather than rely on the ICE for indirect costs, the IPMT developed a new estimate build-up of these costs; a major reason for this decision was to account for the greatly reduced scope and complexity due to the redesign. The pricing was updated to reflect the IPMT's current understanding of the project timeline and adjustments were be made to the assumptions around construction schedule, production rates, a competitive bidding environment, contractor profit, and risks.

Since the recommended reprocurement is via Design Build, the cost of performing the final design was also included in the construction costs. A profit factor, as well as a factor for home office expenses, was applied based on the anticipated bidding climate at the time of the redesigned GLX project commencement and a significant level of risk that the bidding contractors may include in their price submissions.

Review of Escalation and Contingency

One of most important aspects of any program level estimate is to finalize the escalation and contingency values. Escalation is a time-dependent variable that is often a very significant cost of the project. Economic projections are often relied upon to apply escalation factors as a percent onto current pricing to project the cost of purchasing items in the future. The IPMT provided an escalation assessment that is consistent with program budgeting on major federally funded projects.

Additionally, a stochastic probability analysis was performed on the estimating ranges, assessing ranges of all of the major cost centers of the anticipated Design-Build core estimate. This assessment helped the IPMT to provide a recommended contingency range and was based upon what is effectively the 90 percent probability of the stochastic outcome. Although a full risk assessment was not performed as part of the contingency assessment, using a 90 percent probability is conservative (more typically, a 50% probability is used, before contingency is added). This suggests that the IPMT's overall contingency outcome has some reserve built into it.

Review of Sunk Costs

As part of a significant GLX program cost assessment, the IPMT included costs in the overall/revised program estimate to properly account for costs that have been expended (sunk) prior to the Boards' decision to suspend certain aspects of the GLX project. Additionally, the IPMT, the Owner's Representative, and the MBTA continue to monitor the progress of any construction elements within the iGMP1-4A construction packages.

The construction cost estimate provides a predicted bid price of a Design-Build procurement outcome that includes construction costs, cost of final design, indirect costs, contractor profit, home office expenses, escalation, and an appropriate contingency that a bidder is expected to include in the overall submission.

Other Cost Centers

The following briefly outlines the methods utilized to update the other (non-construction) program cost centers for the IPMT's recommended budget.

1. **Real Estate and Vehicles:** The IPMT met with the MBTA's real estate staff and consultant several times to understand the current spending status and trend. A new estimate was developed using that input as well as a reasonable contingency for potential lawsuits.
2. **Professional Services:** The IPMT met with the Owner's Representative, who, as part of their scope, maintained updated costs and had long-term knowledge of previous trends. In addition, the IPMT coordinated with several other consultants performing services, such as Nossaman, to provide a forecasted cost to complete. The major future elements in this category are for the preliminary design/construction phase services, and the Project Management role. The final design services are included in the IPMT's prediction of the Design-Build bid prices. For both of these elements, the IPMT

performed its own independent estimate of the costs of those services, and included a reasonable contingency. See Section VI. Procurement Schedule for additional information on the basis of the design services support.

3. **Contingency:** The IPMT includes in this new program estimate both allocated contingency within the cost centers as well as an unallocated contingency for unknown potential program growth. Once all the estimates for the various cost centers listed above were developed, the IPMT determined the value for the overall program contingency to cover possible unknown costs. To calculate the unallocated contingency value, the IPMT elected to utilize the same percentage as was used at the establishment of the FFGA. The various cost centers include allocated contingency amounts that, in total, also are consistent with the same percentages used in the FFGA. The IPMT notes that these percentages were used even though the risks inherent in the redesign are less than those in the previous design; this translates to an increased level of conservatism, or confidence, in the new estimate.
4. **Other items:** As noted in the previous section, the IPMT identified several other potential cost savings ideas but did not have the time to fully develop them. In addition, the Schedule section of this report identifies efficiencies that result in schedule savings; those cost savings were not fully evaluated. Finally, the cost estimate did not assume any credits for real estate negotiations with developers. The IPMT believes these items will reflect a further cost savings in the Design Build procurement process.

The three charts below summarize the cost estimate developed by the IPMT.

Figure 4.0 provides the main summary of the new program estimate – showing approximate previous 'sunk-costs' that are included within the proposed budget.

Figure 4.1 provides a summary cost comparison of the major construction cost centers. The IPMT estimate is compared to previous estimates (trend) to show the benefits of the redesign.

Figure 4.2 provides a summary of the major cost centers, compared to the FFGA estimates. This chart also shows the variation on the IPMT's estimate ranges.

Figure 4.0 – GLX NEW PROGRAM COST ESTIMATE SUMMARY

Line Item #	PROGRAM BUDGET COST CENTER DESCRIPTION	New Program Estimate IPMT	Sunk-Cost Included in Estimate	
1	**CONSTRUCTION *(D-B Value)***	**$ 1,192,400,000**	$0	
2	**REAL ESTATE**	**$ 112,500,000**	$93,000,000	
3	**VEHICLES**	**$ 182,700,000**	$182,700,000	
4	**PROFESSIONAL SERVICES**	**$ 414,900,000**	$221,000,000	Inc. Force Account
5	**UNALLOCATED CONTINGENCY**	**$ 182,200,000**	$0	
6	*CURRENT CM/GC CONSTRUCTION CONTRACTS*	*$ 203,900,000*	$203,900,000	
7	**TOTAL** (with no Additional Funding Considerations)	**$ 2,288,600,000**	**$700,600,000**	

FIGURE 4.1 – CONSTRUCTION COST REDUCTION COMPARISON

In Figure 4.1, the 'New 90 Percentile IPMT estimate" provides the initial predicted bid price (prior to Alternative Technical Concepts) of a Design-Build procurement outcome that includes construction costs, cost of final design (designer fee), design-builder profit, home-office expenses, escalation and an appropriate amount of contingency.

MAJOR COST REDUCTION INITIATIVES

Line Item #	Construction Cost Centers	Previous GLX Estimates	New Program Estimate ('90 percentile') IPMT	Variance COST AVOIDANCE (previous - new)
A	**Stations**	$409,500,000	$121,200,000	**$288,300,000**
B	**Bridges**	$86,200,000	$51,300,000	**$34,900,000**
F - G	**Retaining Walls and Community Path**	$187,500,000	$64,600,000	**$122,900,000**
	(* New Community Path = $20M +-)		*	
I	**Maintenance Facility (VMF)**	$195,500,000	$80,130,000	**$115,370,000**
J	**All Other**	$935,600,000	$875,000,000	**$60,600,000**
TOTAL		**$1,814,300,000**	**$1,192,230,000**	$622,070,000

These partial cost estimates are for relative cost comparisons between the previous project and the redesigned GLX only.

Previous GLX Estimates = generated from the Independent Cost Estimate for iGMP#4 and proportioned to iGMP#5 and other past estimates for the VMF and other components)

"All Other" = track, power, signal, and all other required program infrastructure.

FIGURE 4.2 – GLX BUDGET COMPARISON SUMMARY

GLX BUDGET COMPARISON SUMMARY

(in Millions)

		A	B	C*	C**	< VARIANCE RANGE > D	
Line Item #	PROGRAM BUDGET COST CENTER DESCRIPTION	Available Funding FFGA	Breakdown of Previous Project	New Program Estimate IPMT 50 Percentile	New Program Estimate IPMT 90 Percentile	COST AVOIDANCE (rescheduled, redesigned, re-procured) B - C*	COST AVOIDANCE (rescheduled, redesigned, re-procured) B - C**
1	CONSTRUCTION (D-B Value)	$ 1,068	$ 1,814	$ 1,135	$ 1,192	$ 679	$ 622
2	REAL ESTATE	$ 113	$ 113	$ 113	$ 113	$ -	$ -
3	VEHICLES	$ 166	$ 166	$ 183	$ 183	$ (17)	$ (17)
4	PROFESSIONAL SERVICES	$ 393	$ 393	$ 415	$ 415	$ (22)	$ (22)
5	UNALLOCATED CONTINGENCY	$ 252	$ 252	$ 182	$ 182	$ 70	$ 70
6	*CURRENT CM/GC CONSTRUCTION CONTRACTS*	→	→	*$ 203*	*$ 203*		
7	**TOTAL** (with no Additional Funding Considerations)	$ 1,992	$ 2,738	$ 2,231	$ 2,288		

NOTES:

All columns (A, B, C, C*, C**) include escalation

No figures include 'Finance Charges'

A Available Funding = Full Funding Grant Agreement + New Funding Sources (as May-16). Included $181M in Allocated Contingency --- in addition to the $252M in Unallocated contingency

B Breakdown of Previous Project = The forecasted over-run that was provided to the Board in Nov/Dec 2015
Was projected from trends to the budget that were influenced by CM/GC package pricing compared to budget. Was based on finishing program with CM/GC Delivery Model.

C New Program Estimate = The Interim Program Management Team's recommendation for the new GLX estimate (May 2016). Assumes Design-Build Delivery with a revised schedule.

V. GLX Collaborative Funding

Consistent with the vote of the Boards, the Team was charged with identifying additional non-state revenue sources to fill any gap between the cost for the redesigned project and available $1.992 billion ($996 million from each the FTA and the Commonwealth) funding as reflected in the Full Funding Grant Agreement. With the new project cost estimate of $2.3 billion, this gap is approximately $300 million. Sources available to fill this gap include federal funding controlled by the Boston Region Metropolitan Planning Organization ("the Boston MPO"), contributions from the three cities through which the extension passes and which will receive localized benefits from its ultimate construction (Cambridge, Somerville and Medford), and from developers and landowners along the GLX corridor.

Boston MPO Funding

The Boston MPO is responsible for programming the expenditure of certain federal transportation funds through its Transportation Improvement Program (TIP). The MPO has committed $152.1 million in federal highway funding for the implementation of a project to extend the Green Line Extension from its planned terminus at College Avenue to Route 16 ("GLX2").

Figure 5.1: Boston MPO Funds Allocated to GLX 2

FY 2016	FY 20 17	FY2018	FY2019	FY2020	Total TIP	Post-TIP	All-in
$6.5M	$23.9M	$32.0M	$32.0M	$32.0M	$126.4M	$25.7M	$152.1M

MassDOT has briefed the MPO on several occasions about its desire to have the MPO redirect this funding from GLX2 to the current Green Line Extension project. On April 28, the GLX Interim Project Manager provided the MPO with a detailed presentation on all redesign efforts and on May 5, the MPO approved a proposal to repurpose the funds from GLX2 to the current redesigned project. This proposal is subject to a 30-day public comment period. This allows the Boards to consider the repurposing of the MPO funds while providing the MPO with the option of halting the reprogramming should the Boards vote not to proceed with the project.

Local Funding

The extension of the Green Line from a relocated Lechmere Station in Cambridge to College Avenue in Medford, with a spur to Union Square in Somerville, provides benefits for those communities in terms of access to the system and easy connections to urban core destinations, as well as development opportunities derived from proximity to rapid transit. In public statements on the Green Line Extension, the Boards have consistently expressed the need for these communities and developers within these communities to play a role in filling any identified funding gap. Consistent with the Administration's commitment to partnering with local governments, discussions have focused on the affected cities and have only included developers in joint meetings at a city's request.

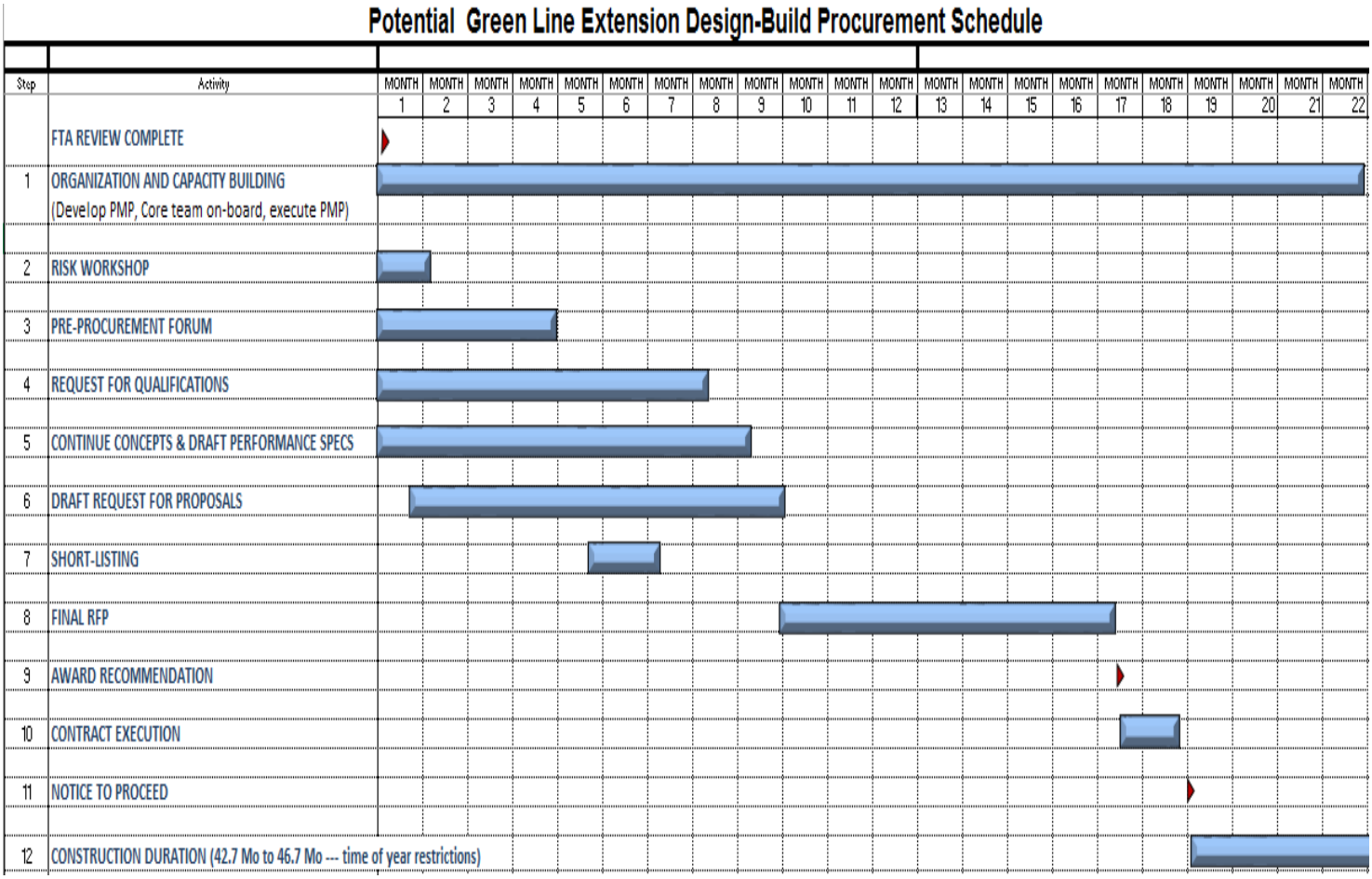
On May 5, the cities of Cambridge and Somerville announced their intention to commit a total of $75 million ($50 from Somerville and $25 million from Cambridge) to the redesigned GLX project. See Appendix D for the letters.

These contributions are substantial and represent an unprecedented partnership between the Commonwealth and two municipalities. However, a funding gap still remains.

VI. Recommended Project Delivery / Implementation Strategy

Identifying a new design scope for the GLX project and developing cost estimates for that redesign was a key responsibility of the Team. But the methods used for project procurement and to manage the project are even more critical if the project is to successfully proceed. This section discusses recommended project delivery; the next section proposes recommendations to manage the GLX project if it proceeds.

Figure 6.1 – Potential D-B Procurement Schedule



Project Delivery

All of the analysis conducted to date on GLX has consistently confirmed and emphasized that a delivery method is only as strong as the procurement tools deployed, the organizational capacity and resources available, and the implementation plan followed.

These critical lessons were reinforced and highlighted in the Look Back Report, provided to the Boards in December 2015, regarding the prior Construction Manager/General Contractor (CM/GC) delivery method previously used on the project. This report offers a series of recommendations to enhance the value and success of this proposed delivery method. An effective Project Management Plan that addresses the requisite leadership, the required internal resources, organizational structure and training is also vital for this delivery method to succeed. As a result, this delivery method recommendation is closely connected to the Project Management Plan discussed in Section VIII.

If the Boards choose to proceed with GLX, the IPMT recommends that they should:

- Package a significant amount of the remaining design and construction work into a single Design-Build contract (the "Core Contract");
- Supplement the Core Contract with one or more carefully defined "early works" contracts, which would permit the MBTA to advance scopes of work that are consistent with and complementary to the Core Contract and to maximize efficiencies on the project; and
- Continue certain ongoing contracts, such as the work in progress with WSK (as recently modified) and the contract with CAF USA to purchase new Green Line cars.

The Core Contract would be procured utilizing national best practices and tools specifically designed to achieve the goals for the GLX project, if it proceeds, including:

- Maximize cost efficiencies;
- Maximize cost certainty;
- Minimize interface risk;
- Reduce administrative costs;
- Preserve modal choice; and
- Comply with the Final Environmental Impact Report/Environmental Assessment and Full Funding Grant Agreement.

Background

In December 2015, following the completion of the Look Back Report reviewing GLX project history, a preliminary analysis of potential project scope refinements to reduce costs and a Look Forward Analysis preliminarily examining legally available delivery options, the MassDOT and MBTA staff offered a series of recommendations to the Boards. This resulted in, among other things, the termination of several professional services contracts, a halt in further negotiation of the additional CM/GC contracts, the reduction in scope of other project contracts, and a decision to re-evaluate the project's path forward.

Shortly thereafter, the MBTA established:

- The IPMT to examine options and make recommendations to reduce the project's estimated costs, taking into account public input, adherence to original budget commitments to the maximum extent possible, compliance with the FFGA and consistency with environmental commitments, including the FEIR/EA; and
- The Project Delivery Team (comprised of Foley Hoag LLP, Nossaman LLP, MassDOT and MBTA legal staff, and MBTA Design and Construction) worked with the IPMT to build on the preliminary Look Forward Analysis and make final recommendations on packaging the remaining project work, the types of contracts and procurement tools to use, and the schedule that could be followed to implement the plan should the Boards elect to move forward.

Project Delivery Team Activities and Deliverables

For this report, the Project Delivery Team has developed recommendations on:

1. The approach to packaging the remaining project work into contracts;
2. The best delivery method for those contracts and related procurement tools, including updated Design-Build procurement procedures for the MBTA and a project-specific Organization Conflict of Interest Guidance; and
3. A potential procurement schedule if the project proceeds.

Additionally, the Team has worked closely with the consulting team to assist in the development of a Project Management Plan for the internal resources, structure, personnel and training needed to successfully manage the recommended delivery method.

Look Back Report and Look Forward Analysis

Delivered to the Boards in December 2015, the Look Back Report detailed the CM/GC methodology, identified issues and concerns and provided a series of presentations to the Boards regarding potential options. Simultaneously, a Look Forward Analysis was developed, including a recommended decision workflow diagram to map out the process and key decision points for the review of the project's CM/GC methodology and to identify the steps that may be followed if the project moves forward. (See Appendix C, Exhibit A).

To aid in the Look Forward Analysis, the MBTA conducted a preliminary market sounding in November 2015. Despite a very tight response timeframe, the MBTA received 18 written responses from many industry leading firms, a majority of which recommended Design-Build as the optimal project delivery method. This response supported the preliminary analysis of legally available project delivery options in the Look Forward Analysis. As discussed with the Boards at the time, Design-Build was recommended on a preliminary basis as the best alternative should the project continue, including:

- Using national best practices to manage the procurement and contracting process and maximize cost certainty, including such tools as a published affordability limit, alternative technical concepts ("ATCs"), competitive dialogue and pricing of a base project and optional scopes; and
- Finalizing contract provisions that reflect the reviews to date and align key project risks appropriately to the contractor to reduce future claims and enhance cost certainty, consistent with the delivery method.

Design-Build Procurement Procedures

Based on the work in the fall of 2015, the Project Delivery Team laid the groundwork to implement the initial Design-Build recommendation.

Pursuant to Section 115 of Chapter 46 of the Acts of 2015, the MBTA is authorized to use Design-Build for projects estimated to cost over $5 million, in accordance with a procedures manual annually approved by the Office of the Inspector General (OIG). The Project Delivery Team determined that a revised Design-Build manual would benefit from the inclusion of national best practices that had been discussed with the Boards in November 2015.

This proposed manual would allow for, among other procedures, the following tools that could be used on the project:

1) A not to exceed price to provide early indication of budget suitability;

2) Alternative Technical Concepts to incentivize private sector innovation during procurement;

3) Competitive dialogue to enable controlled discussions with proposers to identify and reduce cost drivers; and

4) Pricing of a base project and options.

On March 7, 2016, the MBTA presented these proposed revisions to the OIG, which approved them in a letter dated April 29, 2016. The MBTA has also sought comment from key stakeholders. (Appendix C, Exhibit B presents a matrix of best practices incorporated into the procedures.).

Organizational Conflict of Interest Guidance

Based on the unique circumstances of the project (transitioning away from a CM/GC methodology with existing contractual relationships), it is critical to develop and implement a conflicts of interest guidance for any future procurements on the project. In particular, any potential organizational conflicts of interest, under Massachusetts and federal law, must be identified and addressed to enable successful future procurements. In addition, an appropriate balance needs to be struck between protecting the MBTA's, the Commonwealth's and FTA's interest in a robust and competitive market for this project and it must preclude any appearance of unfair competitive advantage or other impropriety under applicable law. As a result, the Project Delivery Team has drafted an Organizational Conflict of Interest Guidance, which has been posted on the MBTA's website to provide transparency to potentially interested companies regarding their eligibility to participate in the project. The MBTA anticipates working with impacted companies, industry groups and other stakeholders to implement the guidance and assist in determining individual company eligibility.

In addition to its internal assessments and other efforts, the Project Delivery Team undertook two additional exercises in developing its recommendations.

Lessons Learned Exercise

The Team conducted a lessons learned exercise on March 28, 2016, to review the MBTA's experience on past Design-Build projects, including the Greenbush Commuter Rail Line, the Wonderland Garage, and the Merrimack River Bridge. The goal of this exercise was to review each Design-Build project, identify what issues or challenges emerged from each project and ensure the MBTA incorporates these lessons learned into any Design-Build project going forward. The Project Delivery Team also has engaged the MassDOT Highway staff on their experience with Design-Build projects to solicit their feedback prior to this report.

GLX Procurement Charrette

The key findings from the Lessons Learned exercise provided a critical foundation for the subsequent GLX Procurement Charrette that was held on April 13, 2016. The five-hour GLX Charrette was facilitated by the IPMT and Nossaman LLP; other attendees included representatives of MassDOT staff, MBTA Design and Construction, FTA, Foley Hoag, and the Owner's Representative. The purpose of the Charrette was to review and vet the initial recommendations made in the Look Back Report and Look Forward Analysis regarding the best alternative. Charrette attendees updated the project goals, finalized recommendations on project delivery and contract packaging and discussed in significant detail the implementation strategy and schedule. A copy of the agenda is attached as Appendix C, Exhibit C.

Contract Packaging Recommendation

The Charrette confirmed the recommendation of the IPMT that the remaining work be aggregated into one Core Contract. Prior to reaching this conclusion, four different contract packaging scenarios were reviewed at the Charrette (see Appendix C, Exhibit D). These four scenarios were then evaluated against the project goals.

The analysis of contract packaging indicated that aggregating all or a significant portion of the remaining work into a Core Contract would provide the most economies of scale, resulting in maximum contract efficiency and the highest level of cost certainty, since all or a significant amount of the remaining work would be priced; and the lowest interface risk since one contractor would have the majority of control at the project site. In addition, a Core Contract would require fewer in-house and consultant staff to manage and thus result in reduced administrative costs. This recommendation is supported by the responses from the preliminary market sounding conducted by the MBTA, where industry participants confirmed that a single package would minimize interface issues on the project, offer a single point of contract for completion of the project, and reduce administrative risk and burden on the MBTA.

Project Delivery Recommendation

Based on the analysis conducted in the Look Back Report and Look Forward Analysis and affirmed at the Charrette, it is recommended that if the project proceeds, it should be with the Design-Build project delivery method. After re-examining the Look Forward Analysis, taking into account the project goals, comparing the design-bid-build, Design-Build and CM-at-Risk options, collecting input at the Charrette, and reviewing the results of the preliminary market sounding, Design-Build for the Core Contract offers the MBTA the best likelihood of achieving project goals, assuming a rigorous implementation plan is acted upon.

Potential Implementation Plan

The IPMT's construction cost estimates and the overall recommended program budget are based upon the recommendation that the GLX project be delivered using Design-Build for the Core Contract. Many of the significant lessons learned from previous projects performed in Massachusetts, along with best practices and recommendations from other projects around the nation, will be incorporated into the project.

Many similar projects at other transportation agencies nationwide have successfully implemented large Design-Build projects

using these best practices, including some that have used a not to exceed price (a partial list is attached as Appendix C, Exhibit F). The proposed GLX Design-Build process contains several new tools and confidence measures designed to optimize the performance of the project, properly allocate risk, and ensure cost containment, including:

Active Industry Outreach

Properly marketing the project permits the MBTA to assess and encourage industry interest in it. The outreach will begin before the procurement process officially starts and will utilize a variety of tools, including a publicly advertised forum organized to educate the industry about the detailed preparations for and key data about the project opportunities and to facilitate Disadvantaged Business Enterprise (DBE) networking; an opportunity for industry participants to respond to key questions the MBTA is considering before finalizing project procurement documents; and offering one-on-one meetings with firms capable of leading teams to successfully propose on the Core Contract. When properly implemented, such outreach efforts can help encourage robust competitive tension, offer innovations to maximize cost efficiencies and shift commercially reasonable risks to optimize contract cost certainty.

Competitive Dialogue

Competitive dialogue entails communicating with short-listed proposers, in accordance with previously agreed protocols, to receive input on draft and preliminary Request for Proposals documents. Such dialogue is used to ensure robust competition, maximize cost efficiencies and cost certainty, and identify solutions to minimize interface risk.

Alternative Technical Concepts

Alternative technical concepts (ATC) encourage innovation by allowing proposers to include pre-approved deviations from technical requirements in their proposals. An ATC must result in an end product that is equal to or better than the product required by the original specifications at the same or at a better price. Including an ATC process in procurement incentivizes proposers to find innovative solutions for a project that had not been previously found. Experience in similar projects across the country and in Massachusetts has shown that ATCs can produce significant value for owners and result in better overall projects.

Stipends

Stipends give the MBTA the opportunity to obtain the right to use work product from the unsuccessful proposers' proposals. Stipends also recognize that significant investments in design, including ATC work, occur prior to proposal submittal. Including a stipend in a procurement can help to ensure robust competition, maximize cost efficiencies and cost certainty (through the use of unsuccessful proposers' work product), and encourage innovative solutions to minimize interface risk.

Not to exceed price

A not to exceed price (also known as an affordability limit) assists with cost certainty as early in the procurement process as possible. The not to exceed price will identify the MBTA's upper cap on contract pricing; the result is that proposals that exceed the cap may not be considered. (See Appendix C, Exhibit F for examples where a not-to-exceed price has been used.)

Additive Scope Options

Additive scope options assist with cost certainty as early as possible in the procurement process and are often used in conjunction with a not to exceed price. In using additive scope options, the MBTA will prioritize scope options that are not included in the base technical scope but which may be added to the project if a proposer's price is under the not to exceed price.

In addition, as part of the RFP documents, the MBTA will provide only a schematic design for the redesigned elements. This is also considered to be a new emphasis point compared to past Massachusetts Design-Build projects, further promoting innovation prior to bid pricing by limiting initial design. It is also recommended that a very clear RFP specification be established with increased emphasis on detailed performance criteria. This best practice allows proposers to tailor their innovative approaches to help meet those performance thresholds versus using a more mature design

concept, possibly causing redesign or limiting innovation.

Possible Next Procurement Steps

Should the Boards authorize work to continue, the GLX project could proceed in three stages: FTA approval, procurement, and construction. These could overlap to some extent,

Phase 1: Review with FTA

The IPMT has been reviewing the scope, schedule, and parts of the cost estimate with the FTA and its Program Manager Oversight Consultant (PMOC). If authorized to proceed further, the IPMT will continue those reviews in much greater detail with the FTA, will facilitate a risk workshop, and will assist in developing an update to the project finance plan. In addition, during this phase the MBTA and FTA will focus on the acceptability of MBTA technical capacity. Also, funding from other sources will need to be finalized so that a new finance plan can be completed. The Board will need to authorize the MBTA and the IPMT to advance these efforts with the FTA.

Phase 2: Near term Procurement needs:

These steps would be needed for the first months to advance the Design-Builder procurement. The IPMT cost estimate assumes this Phase 2 work proceeds concurrently with Phase 1 work. A secondary set of short-term actions involves additional important steps that are unrelated to the Design-Builder procurement. Items with "***B***" indicate possible Board action for early decision-making.

1. Finalization of the Design-Build Procurement Procedures;
2. **B - Identification of the design professional prior to issuance of the Request for Qualifications ("RFQ");**
3. Completion of the Project Management Plan and identification of internal and external resources needed to procure and complete the project as proposed;
4. Preparation for, planning of, and holding a risk workshop;
5. Development of a DBE policy for the project and a review of DBE goals based on the new detailed cost estimate;
6. **B - Drafting and authorizing the Request for Letters of Interest;**
7. Preparation and planning for the pre-procurement forum, including a communications protocol, establishing a data E-room, etc.;
8. Drafting the RFQ and associated materials (including the Statement of Qualifications evaluation manual); and
9. Commence preparing the draft RFP and associated materials (including, but not limited to, the Instructions to Proposers (contract documents, and technical provisions; the proposal evaluation manual; work product letter agreement; one-on-one meeting protocols; and ATC protocols).

Subsequent Procurement Actions

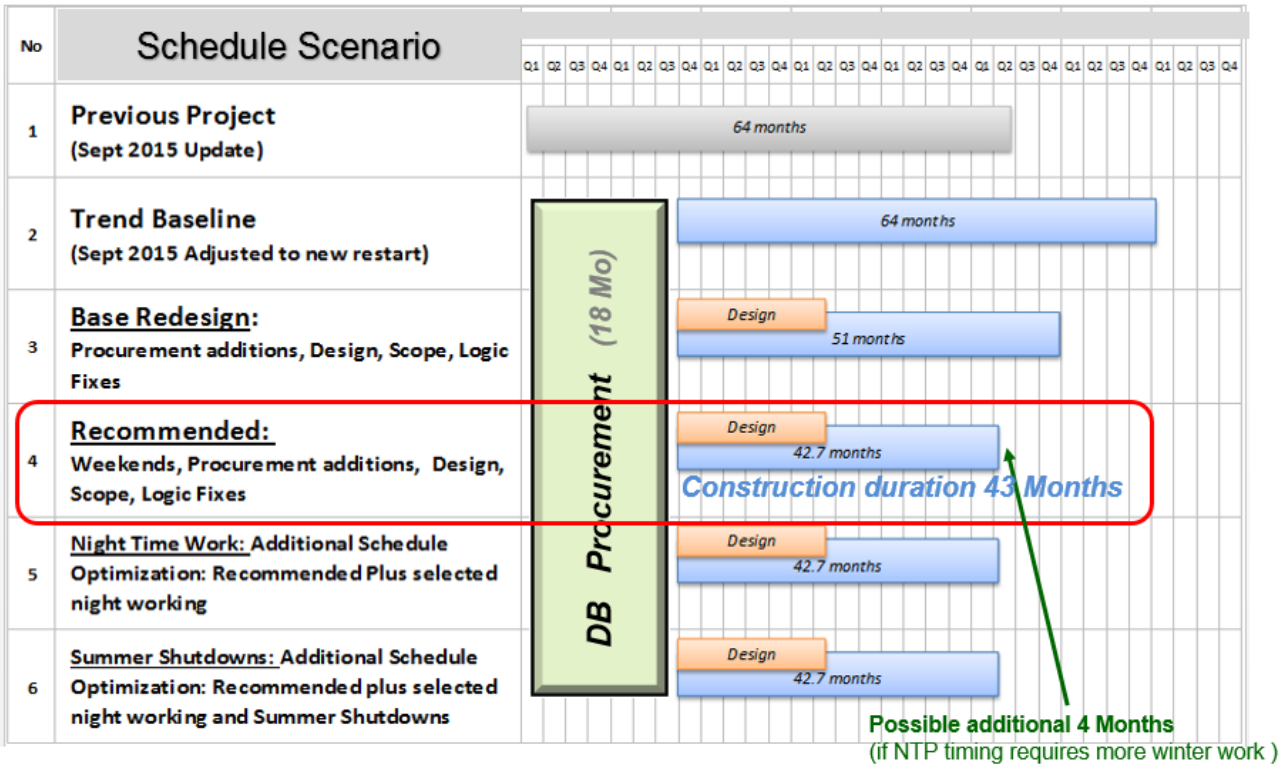
1. Final preparation for and planning of the pre-procurement forum;
2. Continued drafting of the RFQ and associated materials (including the SOQ evaluation manual); and
3. Continued drafting of the RFP and associated materials (including, but not limited to, the Invitation to Proposers, contract documents, and technical provisions; proposal evaluation manual; work product letter agreement; one-on-one meeting protocols; and ATC protocols).

VII. Construction Schedule

Construction Schedule Considerations

In redesigning the GLX, the IPMT has sought to reduce many schedule risk elements in the previous GLX design, such as the stations and retaining walls. Other examples of quantity reduction and simplification are the vehicle maintenance facility and many of the bridge redesigns. This streamlining yielded another major benefit: a construction schedule that substantially overcomes the delay associated with the project reprocurement. This effort, along with an evaluation of potential work process improvements for work near the active track, has eliminated what would have been a potential delay of more than 18 months in what it would take to again start the main body of work.

The next graphic provides a summary of construction schedule components, if the GLX project secures approval of the Boards as well as the FTA.



The IPMT schedule analysis utilized a progression from the schedule data that had been provided within the GLX September 2015 Schedule Update (No. 1 – 64 months). At that time, the program schedule contained a detailed forecast to complete the work for all of the active iGMPs as well as the remaining iGMP packages, including testing and commissioning. The IPMT then created a baseline to compare (No. 2 – 64 months) that accounted for a projected impact for advancing into reprocurement. From this step (No. 3), scope reductions were detailed and translated into new improved construction durations (as a direct result of less quantities being installed (No. 3 – 51 months)). Next, the IPMT reviewed that optimized schedule and generated several adjustments to logic relationships (dependencies) that were necessary. Additionally, the new procurement delivery method timeline was added. That 51-month schedule (No.3) was then optimized further, to about 43 months (No. 4), mainly by introducing a major efficiency improvement that the future contractor will be able to utilize 25 weekends of commuter rail diversions per year. This assumption has been discussed with MBTA Commuter Rail operations, which determined the plan to be reasonable, with conditions. This iteration (No. 4) is the IPMT's recommended construction schedule. Additional schedule options for potential night work (No. 5) and/or summer shut-down (No. 6) of the commuter rail service were also evaluated but did not prove to provide any significant additional schedule savings due to work on other critical paths that are impacted by these same work-process improvements.

One of the most significant risks to schedule is the ability to routinely hire railroad flaggers for the work within the corridor, (including bridges, track, retaining walls, platforms, etc.). For this reason, the IPMT notes a need for senior-level commitments and resources to meet this critical need, including allowing the contractor to provide these resources.

The IPMT has identified and recommends additional efficiencies to potentially further improve the schedule or mitigate risk if the project proceeds. These include:

- Allow for reasonable single-track operations to provide additional access for contractor;
- Follow up on previous MBTA initiative to allow contractor to provide their own flagging services in order to reduce risk of resource constraints on Keolis;
- Follow up on previous MBTA initiative to provide a mid-day shutdown of commuter rail in this area; and
- Wherever possible, piggyback GLX work on shutdowns for other projects, such as the installation of Positive Train Control.

While these items have been discussed and endorsed conceptually, they would need to be fully detailed for Design-Build bids.

VIII. Recommended MBTA Management Plan

Management Model and Best Practices for the Green Line Extension

Overview

As part of the Green Line Extension Review, the MBTA asked the consulting firm ASCENT to recommend an implementable model of the organization, people, and tools necessary to successfully deliver the Green Line Extension project, should it proceed. This section, authored by ASCENT, was performed independently of the work by the IPMT's Weston & Sampson team.

Though ASCENT was not charged to do any forensic analysis of the root causes of failure of the GLX project to date, it reviewed project history and documents and interviewed several MBTA and MassDOT employees and board members. ASCENT concluded that:

- The MBTA staff was ill-equipped to deal with the complexity of managing the project, managing the design, and managing the consultants;
- Too much autonomy and authority was ceded to consultants who took full advantage by charging too much and delivering too little;
- Controls were inadequate to provide early warning of nascent problems; and
- An MBTA culture that valued process over outcomes stifled initiative and diffused accountability.

ASCENT proposed four recommendations:

- Take a program management approach;
- Provide autonomy and provide oversight to and expect accountability from the new GLX program team;
- Create a "core of competence" among the GLX program team staff and leadership; and
- Establish a strong sense of ownership and accountability among project staff and leadership.

BEST PRACTICES

Adopt a Program Management Approach

A Program Management approach for a megaproject is appropriate when there is complexity and risk and when the work is of strategic importance. The GLX project meets these criteria. While good Program Management needs to be technically competent, it also must be capable of performing within the public realm, earning the public's confidence, and protecting the public's trust. Beyond engineering, design, and construction, Program Management must be equal to the demands of the public, the governing boards of MassDOT and the MBTA, elected officials, other stakeholders, and the media. The Program Management team must be counted on for clear and honest communication, transparency, performance measurement, and outcomes. The Program Management team must be equal to, or better than, the architects, engineers, contractors, and consultants it employs. Above all, it must be accountable for outcomes. The advantages of a Program Management approach for the GLX include:

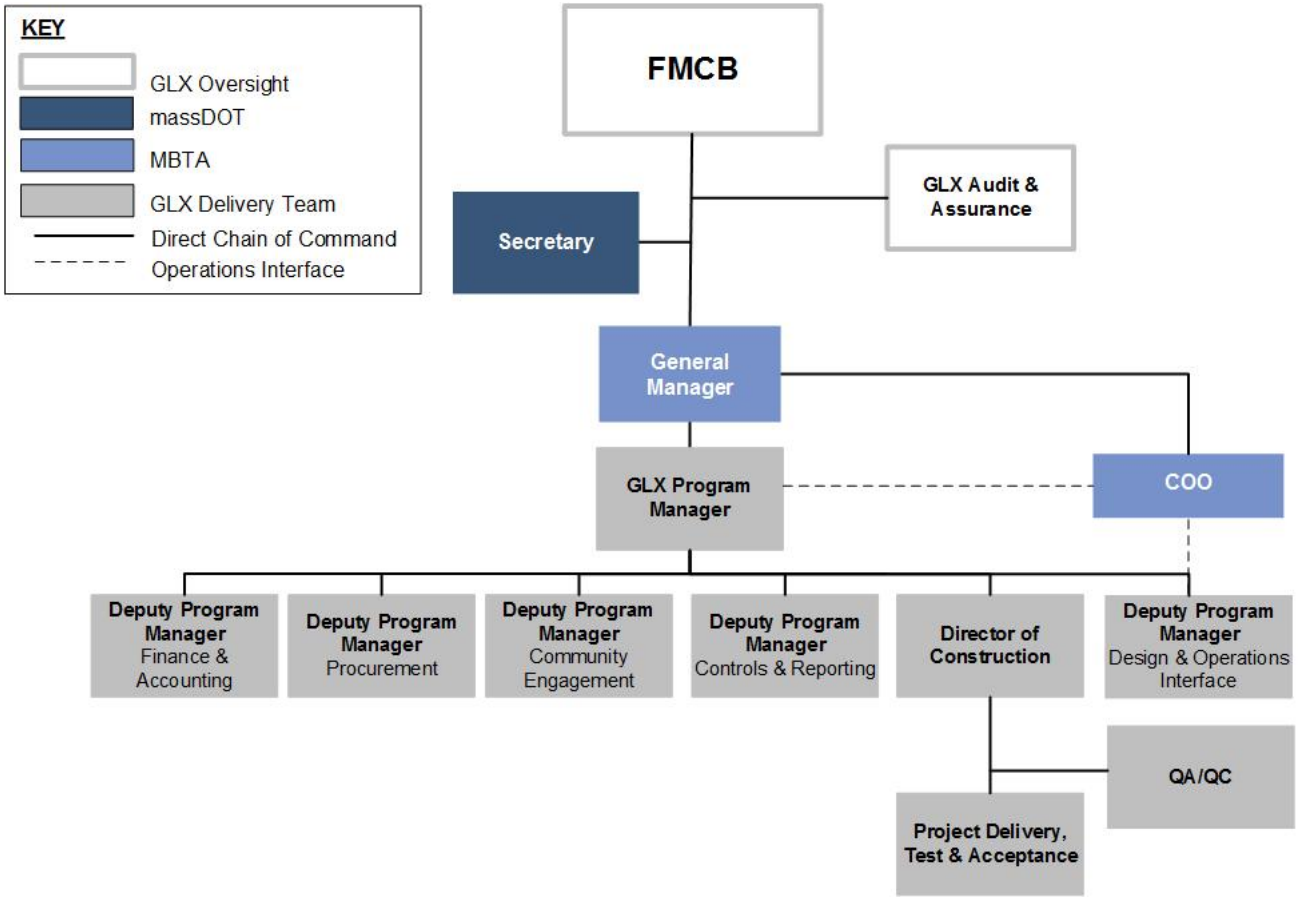
- A single-minded purpose around agreed outcomes;
- A single point of accountability and decision-making;
- Common processes, policies, and procedures developed with set outcomes in mind;
- A full field of vision over a complex enterprise;
- Positive, professional control of contractors, consultants, and the team;

- A clear view of resource requirements over time;
- The ability to anticipate interdependencies, conflicts, and clashes before they become acute;
- Clear, timely, and accurate reporting at the program, project, and construction levels to facilitate decision-making;
- A self-aware culture that contributes to continuous improvement;
- Taken together, these characteristics add up to an increased probability of success for the redesigned GLX project.

Organize with Autonomy, Oversight, and Accountability

With its large, complex, multi-modal transportation mission, the MBTA has problems and challenges that are proportionally large and complex. While new construction is a necessary activity of the MBTA, it is not a core part of its mission. When a project with the complexity and risk of a GLX is managed in-house, it competes for priority, for attention, and for resources with myriad other projects and initiatives. The tendency thus becomes to depend on consultants and outsourced professional services for project delivery in an effort to deliver the atypical project with as little disruption to and investment by the organization as possible. Without adequate competence and controls in place this is a proven formula for failure.

The graphic below represents a suggested new GLX Program Management structure.



The features of a Program Management-based organization for the GLX include:

Autonomy

In this model, the GLX organization reports to one boss, the MBTA General Manager, as the senior responsible owner. The GLX organization is as independent from the MBTA bureaucracy as is practically and responsibly possible. Singularly focused on outcomes, the GLX organization is empowered with all of the authority it needs to act to advance the GLX mission, including procurement, finance and accounting, design, community engagement, and IT systems and controls. MBTA staff can provide support upon request but it cannot overrule, deny, or impede the Program Manager. Administrative processes, policies, and procedures are GLX-specific and developed by the Program Manager as needed.

That said, this type of autonomy is not the same as the hands-off management provided previously by the MBTA organization to the GLX project. In that case, too few MBTA staff were given too little authority and training to try to manage dozens of consultants across a wide and complex field. In this scenario, a much larger core team of MBTA staff would be fully responsible and empowered to make all necessary decisions in cooperation with the Program Management team.

Oversight

ASCENT recommends that the Boards, as the protectors of the public's trust, develop a capability for audit and assurance as a mechanism for self-criticism and self-correction. The "audit" function would address financial as well as performance matters. "Assurance" means verification that processes, policies, and procedures are performing as intended. In other words, "Are we getting what we should be getting? Is the program delivering what it should be delivering?" The GLX Program Manager would develop an Audit and Assurance Plan for the Boards' approval and use. The work could be performed by an outsourced firm, by the Massachusetts Inspector General, or by other competent means as the Boards deem appropriate. Audit and assurance is a cost to the project, but this cost is nominal compared to the returns.

Accountability

With oversight comes accountability. Bureaucracy tends to avoid accountability, so a single point of accountability --the Program Manager – will be at the heart of the GLX Program Management team. Done correctly, this can help start profound cultural and institutional transformation. Accountability is not about punishment or singling out the guilty; it is about delivering the GLX project, in the process regaining and preserving the public's trust.

Create a "Core of Competence"

ASCENT proposed seven key senior positions in its organization, described below. All should be hired as MBTA employees to create an organic "core of competence" to help institutionalize new skills and attitudes within the departments at the MBTA. This is the MBTA's opportunity to create a new culture by hiring the best of the best for these positions. Selected consultants with the requisite skills may be used early in the process to get the organization started but then must be replaced as appropriate new MBTA hires are found. Each new hire will require a level of compensation beyond the MBTA's normal pay scales. But the MBTA must be willing to invest in creating this human capital and the tools and systems that support it.

The GLX project will not succeed without significant investment in new talent. Proposed new roles include:

Program Manager: The Program Manager does not need to be the best, most experienced transit person. S/he doesn't necessarily have to have transit experience at all. But the Program Manager must be someone who has managed large programs of construction in the public sector; who can think broadly; define and articulate a vision; and provide inspirational leadership. The Program Manager should be as adept at solving complex program issues as s/he is at speaking to a large crowd, addressing the Boards, or briefing the press. She is equally at ease talking to the Governor as to a construction worker. Above all, the Program Manager has to be empowered to make decisions and must be fully willing and able to do so.

Director of Construction: This is the project's technical expert and the person responsible for delivering the construction project. The Director of Construction is the inside player as the Program Manager is the outside player. As the center of power within the Program Management structure, the Director of Construction must be a substantial figure who commands respect by virtue of presence, experience, and temperament. This probably should be a person with considerable proven success delivering largescale transit projects. This person knows the architecture, engineering, construction, and

professional services businesses inside-out because s/ he has done it all, preferably with experience in both the private and the public sectors. The Director of Construction "owns" responsibility for the delivery of the GLX and, through the Program Management team, has at his/her disposal every authority required to yield a successful outcome.

Deputy Program Managers: Five task-specific deputies would be needed to support the Program Manager and the Director of Construction. Each is a junior executive with substantial expertise in their respective areas and each of which is considered essential to the success of the Program Management team shown on the organizational chart above. All will be MBTA employees, although initially they may come from the ranks of qualified consultants to get the organization started quickly. All will be 100 percent dedicated to the GLX and will have no other duties or responsibilities in the MBTA. Each will be empowered with the authority required to exercise their roles independent of MBTA ongoing business, though each deputy may receive support from their counterparts in the MBTA. However, the Deputy Program Managers are not subject to the conventional MBTA hierarchy. Chain of command authority flows from the General Manager to the GLX Program Manager to the deputies.

MBTA Chief Operating Officer, as the end-user of the GLX, will necessarily provide input as the operational and maintenance detail of the redesign evolves. The COO's involvement is also essential in anticipating and managing the safety and operations implications of construction. The COO should formally appoint someone from his staff as the GLX Liaison to the GLX Program Management team.

Other staff will need to be assigned to the deputies, some from MBTA, some from consultants, but the seven executives described above are essential for the GLX Program Management team.

The Owner Owns and Controls It

A key failure of the GLX project to date is the fact that the owner (MBTA) failed to truly own responsibility for the project and therefore could not control it. As a practical matter, a public agency operating in the public eye and responsible for the public's trust will always be held accountable for any failings on a public project, no matter the efforts of a public agency to shield itself behind consultants and contractors.

It is one thing to "own" the GLX project as a matter of responsibility and attitude. But can the MBTA deliver the project in a responsible and efficient way? ASCENT recommends that the GLX Program Manager establish a "Framework of Control" under the auspices of the Deputy Program Manager for Controls and Reporting. A Framework of Control is essential for:

- Informed, timely decision-making;
- Clear, accurate, and timely reporting;
- Budget certainty with cost control;
- Schedule certainty;
- Performance measurement;
- Maintaining a clear, documented record;
- Managing risk; and
- Restoring the public's trust and confidence.

A reasonable outline of the nature and characteristics of such a framework has these components:

- GLX-specific Policies and Procedures;
- GLX-specific Control Tools;
- GLX-specific Control Systems; and
- GLX-specific Policies and Procedures.

In establishing GLX specific Policies and Procedures, the Program Manager should be guided by five rules for the policies:

1. They will comply with applicable law in every instance;
2. They will be outcomes focused;

3. They will be respectful of MBTA administrative policies and procedures when these add value;
4. They will draw from industry best practices; and
5. They are not intended to replace the initiative or common sense of the people retained to execute the work.

GLX-Specific Tools

The program manager will develop GLX-specific tools at the program, project and task levels. At the program level, these tools should include:

The Program Execution Plan: This plan is focused on outcomes, not processes. It is a clear definition of what you're going to do, when you're going to do it, how it's going to be done, how much it's going to cost, and what funding source supports the work. The Program Execution Plan would be submitted to the Boards annually for approval and then updated monthly.

The Program Budget: The Program Budget establishes program costs for every possible funded expenditure and identifies the program and project contingencies. Strict cost controls measure the drawdown against every line item, which constitutes the program budget. Funding and outcomes need to match. The Program Budget is aligned with scope and outcomes.

The Program Schedule: This captures every activity on the program, not just construction activity. By defining the Program Schedule in terms of a program completion date, the Program Manager can test the validity of that date, can anticipate conflicts and clashes, and can predict resource allocation (people and cash flow). Strict schedule controls measure the drawdown of every activity in the program against time; and

The Audit and Assurance Plan: This plan is developed by the Program Manager to inform and guide the Boards in executing their oversight responsibility.

At the project level, the Director of Construction will develop tools for the management of his work, including a safety plan, quality assurance plan, risk register, project schedules, supply chain management plan, and a test and acceptance plan.

The task-oriented Deputies would likewise develop plans specific to the management of their tasks. For example, the Deputy Program Manager for Community Engagement may want to consider developing a communications plan, a stakeholder management plan and a community engagement plan.

The Program Manager decides what other tools are appropriate and necessary and identifies the custodian of each of the tools.

GLX-Specific Systems

A Program Management approach requires a Program Management Information System (PMIS), which has the added functionality of rolling up all project data into a program-defining set of formatted information that tells the full picture, not just an incremental one. The purpose of a PMIS is first and foremost to inform leadership and to enable decision-making to achieve program outcomes. Leadership can access the information in real time or at an established frequency (weekly, monthly, quarterly, and annually). The GLX PMIS should enable standardized business processes and create the "source of truth" for all aspects of the project.

Closing Thought

The ASCENT team has cautioned that the MBTA must be realistic about the difficulties of implementing the model described above. Among other things, the ASCENT report noted that:

- MassDOT/MBTA leadership would have to guard against the almost inevitable organizational response: "We'll do enough to appease those who care, but not so much that it affects those who don't or seriously threatens the status quo."
- It is hard to empower a Program Manager with all of the authority needed to act independently of the larger organization, but would have to be done.
- Investing in the right talent and leadership of the Program Management team will cause dislocations and anxiety within the MBTA as well as possible public criticism, but would have to be done.

IX. Risk

Despite substantial efforts to reduce complexity and uncertainty from the design and delivery of the GLX project, the project still carries measurable risk that must be weighed as part of the future overall GLX contingency assessment. Some of these are managerial, such as the ability of MBTA staff to properly manage this complex project while also operating core activities of the MBTA. Others are the kinds of risks inherent in any major construction project.

Some of these risks have been considered in the finalization of the Unallocated Contingency Budget and others have been factored into the Team's evaluation and recommendations. All risk factors, however, must be carefully monitored and managed if the project is to move forward and remain within the cost range estimated in this document.

Should the GLX project continue, a full Risk Workshop would be held early on, most likely with the participation of the Federal Transit Administration. This workshop would assess the cost range estimated here and identify additional risks that could alter those estimated costs.

Upward Pressures on Estimated Costs:

In assessing whether or not to proceed, the Boards should weigh project risks and mitigation measures. A wide range of factors could escalate costs, delay schedules, or both. The following are some of those risks.

1. ***Market Conditions Adjustment****.* Though anticipated market conditions – the likely cost of commodities and other items at the time of construction -- were considered in developing bid estimate and contingency using standard factors, changing and sometimes unpredictable market conditions remain a risk factor;
2. ***Accuracy of the new GLX estimate*****:** Many variables could influence the projected bid price submissions of proposers, including the expedited time used to establish the IPMT estimate;
3. ***FTA approval--*** Delays could cause additional costs; it is also possible that in reviewing the redesign, the FTA may require larger ***contingency*** amounts;
4. ***Lost time*** due to overall GLX suspension from late 2015 until new/future work commences; this affects potential escalation as well as loss of institutional knowledge;
5. ***Ability to commit to the scope and to specific performance thresholds*** *("making them stick")* after bidding; this applies to all stakeholders*;*
6. Similar to above, establishing ***clear design criteria*** to finalize the RFP and, again, being able to resist changes to those criteria and requirements after bid;
7. ***Design immaturity*** is a factor for some components of the revised GLX project, such as the stations and maintenance facility; this may affect the accuracy of estimate, though many other components remain essentially unchanged;
8. ***GLX corridor municipalities*** may change their agreements, such as permits, closures, and truck routes, in ways that escalate costs;
9. Generating a ***true performance-based*** specification procurement document without advancing to final design and with very clear delineation with prescriptive requirements is not typical at MassDOT, though it is typical elsewhere;
10. Necessary ***training for staff*** to understand roles of design reviews and other elements of the Design-Build process; the Selection Committee will also require training;
11. Restricted ***limitations of operations,*** insufficient ***flagger*** commitments and/or *weekend*/night work commitments could all affect the project.

Factors That Could Help Mitigate Risk

1. While the risks above and others are real, a number of safeguards, management skills, and other factors may help mitigate or minimize them. These include:
2. Unallocated Contingency Budget has been established to cover such unknowns;
3. Allocated Contingency included in the IPMT projected program cost estimate;
4. Competitive Bid Results will help foster aggressive pricing by contractors;
5. Single Design-Build contract reduces interface management risks
6. MBTA Management Plan helps focus on executive level support and commitment;
7. Additional Design-Build experiences will help anticipate and manage risks:
    a. Highway Division Lessons Learned
    b. Greenbush and other MBTA Lessons Learned
    c. Nossaman best practices and new MBTA Design-Build Manual
    d. Tools to be used in Design-Build
        (i) Two part Best-Value selection process with modified scoring distribution
        (ii) Limitation of Design development / increased use of performance criteria specifications – allows earlier procurement and innovation
        (iii) Alternative Technical Concepts to incentivize innovation
        (iv) One-on-Ones meetings during RFP phase to incentivize innovation
        (v) “Not to exceed” pricing limits / definition of “Not to exceed price” to ensure bids are within budget
        (vi) 4D requirements (during the best-value submission – requiring time and concepts to be presented in 3D images)
        (vii) Stipend (for the DB Proposers) to help foster innovation
        (viii) Performance Incentives/ Disincentives
        (ix) Robust training program for MBTA staff and its consultant staff
8. Design-to-Budget as part of the RFP preparation (also known as Baseline Control
9. Expected Bid-Price Certainty with the recommended Project Delivery Method
10. Use of Project Partnering among design, construction, and operations; including use of Executive Level Issue Resolution model
11. Consider use of Alternative Dispute Resolution model
12. Simplified Stations , bridges, and track design and other redesign greatly reduce risk and helps cost and schedule
13. Major reductions in retaining wall (quantities, costs, schedule dependencies and risks)
14. Installing Early Action work (including potentially noise walls, drainage, some retaining walls, signal work and some track work), in order to advance schedule critical or resource critical work (for example, flagger resources)
15. Improved roles and responsibilities matrix (definition and understanding) should be developed by the new Program Manager
16. Related to above, improved Quality Control/Quality Assurance requirements for Design-Build must be developed to limit contingencies in bids.

17. Added review work-flows for DB process (document controls from Highway Lessons Learned)
18. Improved Track Limitations of Operations requirements
19. Force Account Work:
    a. The IPMT recommends commitment for contractor supplied flaggers, including adding the option that contractor provides their own flaggers
    b. Early track work to help mitigate risk associated with signal force account resources
20. Project Controls Staff --- recommended involvement from project controls in all phases
21. Additional opportunities for TOD on MBTA-owned parcel formerly needed for large stations
22. Potential of credits for reduced real estate needs

XI. Conclusion

The IPMT appreciates the opportunity to perform this assessment and work with the MBTA and other stakeholders in redesigning the Green Line Extension project. The cooperation and focus on the mission was outstanding by all parties.

The guiding principles used by the IPMT included:

- The requirements of the Boards, outlined in the Introduction to this report, had to be addressed.
- Recommended redesigns must be in conformance with the FFGA and the EA
- Estimating and scheduling had to be performed to the highest achievable level given the time allotted to the task
- Measures had to be taken (e.g. the stochastic analysis) to increase the confidence level in the work product.
- To the extent possible, all stakeholders, external and internal, had to have a voice in the process
- The process had to be as transparent as possible, including close coordination with the MBTA Owner's Representative and the FTA and its PMOC
- The report had to include details around procurement strategies as well as the recommendations as how to best manage GLX should it go forward.
- The report needed to include information regarding MassDOT's efforts to provide additional funding from other sources.

This report provides information that the IPMT believes will greatly assist the Boards as they make their decision about whether, and, if so, how to advance the Green Line Extension project

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Appendix A. – Letter to FTA

Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Stephanie Pollack, MassDOT Secretary & CEO

massDOT
Massachusetts Department of Transportation

April 28, 2016

Mary Beth Mello, Regional Administrator
Federal Transit Administration
Region 1
55 Broadway, Suite 920
Cambridge, MA 02142-2055

Dear Ms. Mello,

As you are aware, the Massachusetts Department of Transportation (MassDOT) and the Massachusetts Bay Transportation Authority (MBTA) are undertaking a reevaluation of the Green Line Extension (GLX) project in order to substantially reduce the cost of the project while still maintaining its core benefits and functionality. Since December 2015, a multidisciplinary Interim Project Management Team (IPMT) has worked closely with the Federal Transit Administration (FTA) and your Project Management Oversight Contractor (PMOC), as well as with the three GLX corridor municipalities, key corridor landowners, and a wide range of project stakeholders both within and outside of the MBTA. The FTA has been a steady and supportive partner throughout these efforts, for which I am grateful.

While the IPMT is proposing significant modifications to some aspects of the original project design – including the stations, corridor retaining walls, a vehicle maintenance facility, and a multiuse path – the IPMT has been guided throughout its efforts by a commitment to preserving the essential project scope, benefits, and mitigation commitments made during the planning and environmental review processes. In particular, the IPMT has used the framework of the Full Funding Grant Agreement to define the limits of what can be modified in the interests of cost-reduction.

This letter describes the results of the IPMT effort and provides an overview explanation of how the revised design of the Green Line Extension project will meet the expectations of FTA for a fully functioning project that will deliver the ridership and other benefits originally promised. We understand that formal FTA review would come later, but wanted to share with you now our findings to date and provide our assurance that the revised GLX project will continue to meet the original purpose and need of the project.

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Redesign and Re-Costing Efforts

The IPMT has identified significant cost reductions to be found through modification of project scope elements, including:

- Redesign of the stations in order to transform them from over-sized enclosed structures to open-air platforms akin to what has been in use for decades on the existing surface Green Line.
- A substantially reduced vehicle maintenance facility, which will provide light maintenance and storage for the additional vehicles required to operate the Extension.
- Preservation of a number of bridges along the GLX corridor that were originally slated to be replaced, as well as the reduced reconstruction of others.
- An alternative version of the multiuse Community Path.
- An alternative and simplified version of the Lechmere viaduct.
- Modifications to retaining walls to reduce height and simplify construction.
- Modifications to the power distribution system, including traction power substations at Red Bridge, Gilman Square, and Ball Square.
- An alternative construction plan and schedule that would allow a construction contractor greater and more flexible access to the work area.
- A reduced construction scope, which could reduce the overall project schedule and risk profile.

In all cases, the IPMT is collaborating with the relevant MBTA operating divisions to ensure that any design changes would not fundamentally compromise the ultimate functionality and promised public benefits of the Extension.

A comparison of the original and revised design of the project scope items is attached.

Maintenance of Core Functionality and Project Benefits

The proposed redesign maintains the functionality and essential purpose of the Project, consistent with the Full Funding Grant Agreement and the New Starts project ratings that supported its award. As with the original project design, the revised design consists of a 4.3-mile extension of the existing MBTA Green Line light rail service to College Avenue in Medford and Union Square in Somerville, relocating Lechmere Station, and providing six new light rail stations in the same locations as originally envisioned. The stations will have the same size platforms as originally proposed and will therefore be able to serve the same number of passengers as originally anticipated. The redesigned project also includes the construction of a smaller vehicle storage and maintenance facility with the capacity to provide light maintenance and storage for 44 vehicles. Heavy maintenance activities will be accomplished at the existing

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Riverside and Reservoir maintenance facilities. The 24 light rail vehicles required for the extension of Green Line service have already been procured.

We understand that the FTA New Starts project justification criteria for the evaluation and rating process – including mobility improvements, environmental benefits, congestion relief, and cost-effectiveness – are largely dependent on the number of transit trips produced by the project. Factors which influence potential trip generation include (1) the number and location of stations, (2) platform size, (3) span of service, and (4) service frequency are the same in the redesign concept as was originally proposed. The Green Line Extension service as redesigned will still provide six-minute headways in the weekday peak period, with service every 8 to 11 minutes in the weekday off-peak period. Service will be provided every 13 to 14 minutes on weekday evenings, and every 8 to 10 minutes on weekends. The station locations, platform size, and functionality remain unchanged.

Given that the basic functionality and service plan are the same, we are confident that the Green Line Extension redesign concept project will achieve the same forecasted ridership of 37,900 daily linked transit trips[1], and therefore the same project benefits. In addition, the New Starts economic development and land use benefits associated with the stations remain unchanged.

It should be noted that the IPMT has found a way to continue to include a multiuse path as part of the revised project concept, even though we recognize that the Community Path was not considered as a factor in New Starts' process in determining the core project benefits nor in estimating the number of future transit trips anticipated for the GLX project.

Consistency with Environmental Mitigation Commitments

As required by the Full Funding Grant Agreement, MassDOT and the MBTA are fulfilling the environmental mitigation requirements developed with stakeholder input through the Environmental Assessment (EA) process and documented in the Finding of No Significant Impact. As part of the redesign process, the IPMT is re-evaluating the cost-effectiveness of noise barriers as a mitigation measure, and is proposing sound insulation as an alternative measure in certain locations to achieve the same mitigation result at lower cost. We understand that FTA would need to concur with the use of alternative mitigation measures, and we look forward to working with you on this.

[1] MBTA, *Green Line Extension Project, FY 2016 New Starts Update and Full Funding Grant Agreement Support Material*, New Starts Travel Forecasts Template, Fall 2014.

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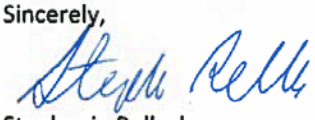
In addition, we are partnering with the City of Somerville to assist in the implementation of mitigation measures, whereby the City would take responsibility for constructing traffic and pedestrian improvements on city streets adjacent to the stations. This is similar to the exiting mitigation commitment for traffic and pedestrian improvements in Cambridge, where the developers of the NorthPoint project are taking on the responsibility of improvements on city streets around Lechmere Station.

The EA contains a commitment to, "complete the final design for the proposed Somerville Community Path between Lowell Street and the Inner Belt area." This design has been completed, meaning that MassDOT/MBTA have met the EA commitment. Nevertheless, the Community Path was intended to be constructed along with the GLX project, with the Path interwoven with the larger GLX rail corridor design. Given the nature of the original design, the Path become extremely costly to construct due to the incremental height of retaining walls and viaduct structure designed solely to support the Path. Because of this, the order of magnitude cost of the Path as originally designed was in the range of $100 million, based on a cost comparison prepared by the IPMT. An alternative, simplified Community Path concept has been developed by the IPMT that reduces the structures required to support the Path and the time required to build it. We believe that the cost of the alternative Path concept is approximately $20 million.

In closing, I would like to reiterate my gratitude to you and your colleagues at FTA for your patience, support, and time as MassDOT and the MBTA have undertaken the Green Line Extension Review. I look forward continuing our close collaboration with FTA as we work towards a resolution on the project. I hope that you will not hesitate to let me know if you have any questions or concerns.

Sincerely,



Stephanie Pollack
Secretary and CEO

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Appendix B. - GLX Functionality Chart

Element	Specific Items	Previous Design	Redesign	Comments
Vehicle Maintenance Facility				
	Building	94000 sq. ft.	55,000 sq. ft.	
	Vehicle Storage Capacity	88	44	Provides sufficient capacity to allow service to be started with spares
	Hoisting Equipment	In plan	In plan	Provides for one set of hoisting equipment and foundation for a second location
	Inspection Pits	In plan	In plan	Inspection Pits on two tracks allowing for 6 cars to be inspected
	Wheel Truing	In Plan	Not in revised Plan	Vehicle maintenance has option for portable operation
	Sanding	Automatic system	Sanding by hand	MBTA has no working sanding systems and does all sanding by hand today
	Storage	Storehouse area with automated system	Rack storage	Large area outside for additional storage
	Facility tracks	Four thru tracks and two heavy maintenance tracks	Four thru tracks	
	Car Wash	Included in plan	Not included	
	Maintenance Staff Parking	Surface parking with 80 spots	Surface parking with about 40 spots	
	Cranes/Hoists	Transfer crane in heavy maintenance area and in truck rebuild section, 3 total	Two track 10 ton crane and 7.5 ton crane in truck inspection area	Cranes match basic functions in revised facility
	MOW Facility	Two track facility with offices and storage	None	Complete MOW facility removed from plan.
	Traction Power Substation	In plan	Power to Maintenance facility only	Traction Power routed to be handled from Red Bridge Substation

Transportation Building				
	Building	8,200 foot facility with offices, locker room and kitchen area	1,200 square foot facility with offices and kitchen area	New facility to be modular construction
	Operator Parking	Parking deck with 99 spaces	Surface parking for 99 vehicles	
Element	**Specific Items**	**Previous Design**	**Redesign**	**Comments**
Stations				

Lechmere Station	Elevators	Redundant	Redundant Elevators in North Headhouse	Original plan had 3 elevators (2 North HH - 1 South HH)
	Escalators	In Plan	Not in revised Plan	
	Stairs	In Plan	North and South Head houses	
	Fare Vending	In Plan	In Plan	
	Fare Arrays	In Plan	None	
	Canopies	In Plan	Weather Shelters	Bus type shelters to be provided (1 per Green Line Car)
	Platforms	Four car Platform	Four car platform	Lechmere only station with full four car platform
	Emergency Egress	In Plan	In Plan	South Head house is the secondary means of emergency egress
	Ride Drop Off	In Plan	In Plan	

Washington Street Station	Elevators	Redundant	None	At Grade Entrance
	Escalators	In Plan	None	
	Stairs	In Plan	Ramp	Ramp from Washington Street sidewalk to Entrance
	Fare Vending	In Plan	In Plan	
	Fare Arrays	In Plan	None	
	Canopies	In Plan	Weather Shelters	Bus type shelters to be provided (1 per Green Line Car)
	Platforms	3 car with foundations for a fourth	3 car with alignments for a fourth	
	Emergency Egress	In Plan	In Plan	Egress off end of platform to the community path
	Ride Drop Off	In Plan	None	Ride drop off more than 100 feet from entrance

Element	Specific Items	Previous Design	Redesign	Comments
Gilman Square Station	Elevators	Redundant	Single Elevator	
	Escalators	In Plan	None	
	Stairs	In Plan	In Plan	Access the station off of the sidewalk on Medford Street Bridge
	Fare Vending	In Plan	In Plan	
	Fare Arrays	In Plan	None	
	Canopies	In Plan	Weather Shelters	Bus type shelters to be provided (1 per Green Line Car)
	Platforms	3 car with foundations for a fourth	3 car with alignments for a fourth	
	Emergency Egress	In Plan	In Plan	
	Ride Drop Off	In Plan	None	Ride drop off more than 100 feet from entrance

Lowell Street Station	Elevators	Redundant	Single Elevator	
	Escalators	In Plan	None	
	Stairs	In Plan	In Plan	Ramp from platform to Lowell Street Bridge sidewalk
	Fare Vending	In Plan	In Plan	
	Fare Arrays	In Plan	None	
	Canopies	In Plan	Weather Shelters	Bus type shelters to be provided (1 per Green Line Car)
	Platforms	3 car with foundations for a fourth	3 car with alignments for a fourth	
	Emergency Egress	In Plan	In Plan	
	Ride Drop Off	In Plan	None	Ride drop off more than 100 feet from entrance

Element	Specific Items	Previous Design	Redesign	Comments
Ball Square Station	Elevators	Redundant	Accessible walkway	Accessible walkway to at grade track crossing
	Escalators	In Plan	None	
	Stairs	In Plan	None	
	Fare Vending	In Plan	In Plan	
	Fare Arrays	In Plan	None	
	Canopies	In Plan	Weather Shelters	Bus type shelters to be provided (1 per Green Line Car)
	Platforms	3 car with foundations for a fourth	3 car with alignments for a fourth	
	Emergency Egress	In Plan	In Plan	Egress via accessible walkway on north end to public ROW
	Ride Drop Off	In Plan	None	Ride drop off more than 100 feet from entrance
College Avenue Station	Elevators	Redundant	Redundant	
	Escalators	In Plan	None	
	Stairs	In Plan	In Plan	
	Fare Vending	In Plan	In Plan	
	Fare Arrays	In Plan	None	
	Canopies	In Plan	Weather Shelters	Bus type shelters to be provided (1 per Green Line Car)
	Platforms	3 car with foundations for a fourth	3 car with alignments for a fourth	
	Emergency Egress	In Plan	In Plan	Area of Refuge north of platform and then accessible walkway to Public ROW
	Ride Drop Off	In Plan	In Plan	

Element	Specific Items	Previous Design	Redesign	Comments
Union Square Station	Elevators	Redundant	None	At Grade Entrance
	Escalators	Redundant	None	
	Stairs	In Plan	Accessible walkway	Accessible walkway at grade
	Fare Vending	In Plan	In Plan	
	Fare Arrays	In Plan	None	
	Canopies	In Plan	Weather Shelters	Bus type shelters to be provided (1 per Green Line Car)
	Platforms	3 car with foundations for a fourth	3 car with alignments for a fourth	
	Emergency Egress	In Plan	In Plan	Egress east of platform to Public ROW
	Ride Drop Off	In Plan	In Plan	To be provided by Developer
Community Path	Lowell to Central Street	Path along corridor	Part of path moved into park	Reduced wall requirements
	Central to School	Path along corridor	Path moved to East side	Reduced wall requirements
	School to Walnut	Path along corridor at raised elevations with connections to Medford Street	Path ramped down into corridor	Reduced wall requirements
	Walnut Street	At grade crossing	Box tunnel behind abutment	Reduced wall requirements
	Walnut to Washington Street	Raised path with connections to McGrath and Cross Streets	Path at Grade-possible connection to Cross Street	Reduced wall requirements
	Washington to Cambridge	Viaduct structure	On City Streets	Viaduct requirements removed

Appendix C. - Procurement Exhibit

Procurement Schedule

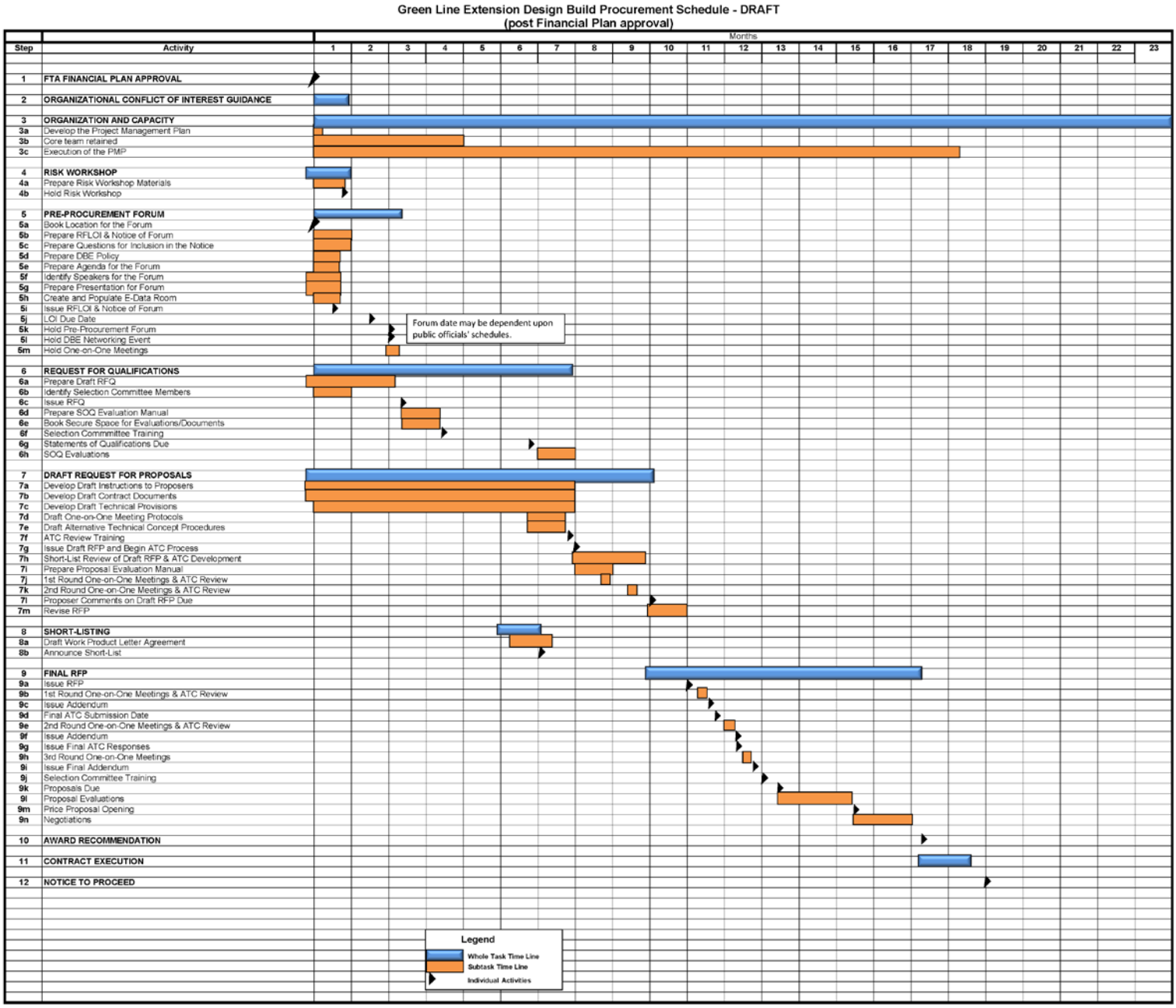

Exhibit A. Decisiion Making Procees

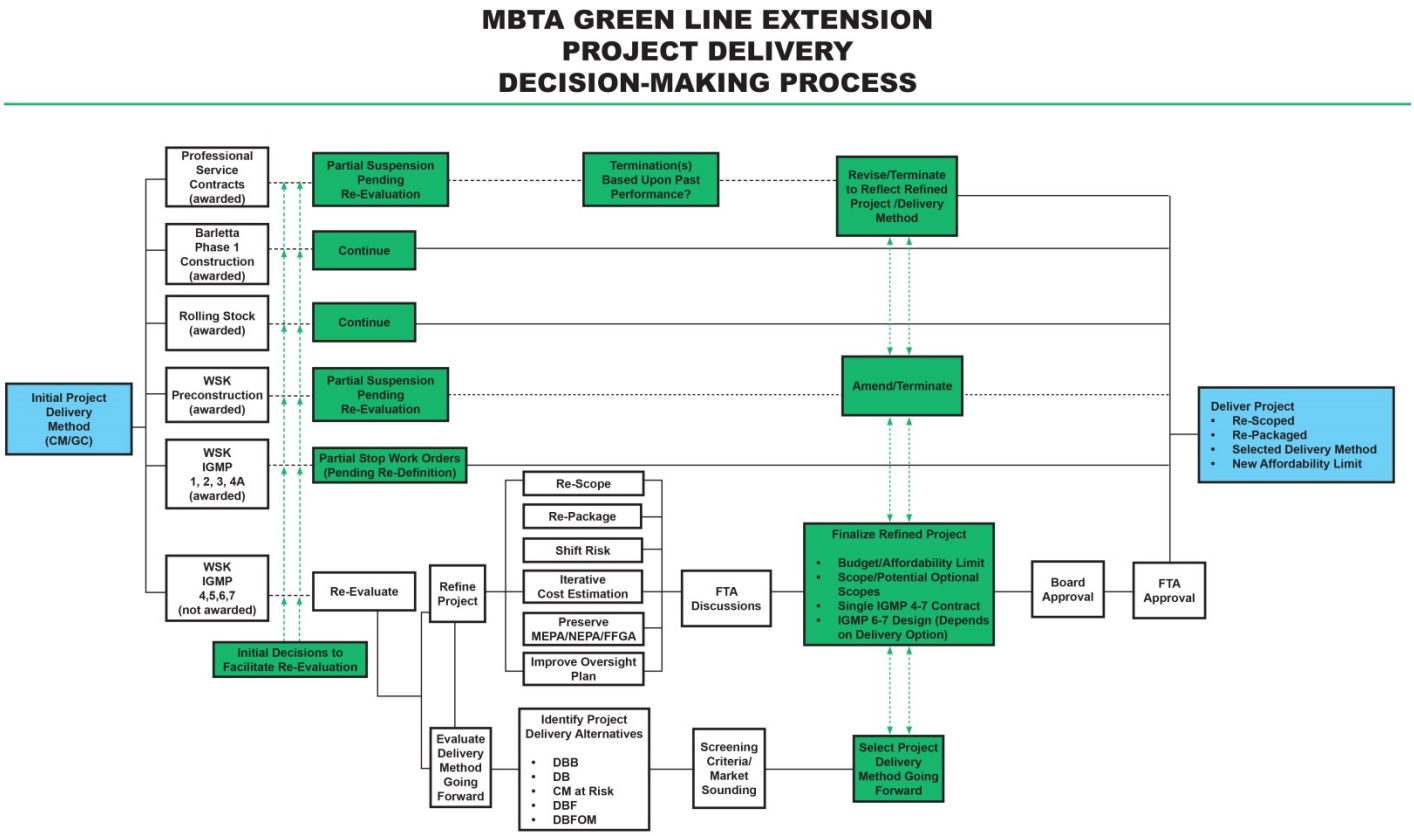

Exhibit B. Procurement Tools Matrix

PROCUREMENT TOOL	DESCRIPTION	DESIGN-BUILD PROCUREMENT PROCEDURES
Project Delivery Analysis	Occurs prior to completion of preliminary engineering. Compares all legally available options to make an informed decision on the optimal method for delivering a project. Uses the owner's project goals as screening criteria. Takes into account a project's complexity, the extent of opportunities for private sector innovation, the appropriate degree of risk transfer, and optimization of competition.	Section 3.1
Risk Workshop	Provides a forum for the project team to focus on identifying major project risks and responsibilities, to consider possible means of mitigating and avoiding risks (including setting up task forces to address different risks), and to consider how best to allocate risks and responsibilities to meet the owner's goals.	Section 3.1
Industry Outreach/Market Sounding	Permits the public owner to assess the reaction of the industry to a project, and should begin before the procurement process officially starts. Utilizes a variety of tools, including an industry forum, requests for information ("RFI"), and one-on-one meetings. Provides the owner with the opportunity to consider industry input when developing the procurement. Includes a presentation on the contemplated project scope, procurement timeline, and procurement process.	Section 3.1
One-on-One Meetings with Proposers	Meetings with potential proposers on a confidential one-on-one basis during an industry outreach process before the procurement commences; to receive input from potential proposers prior to issuance of the final RFP; after issuance of the final RFP to obtain input from short-listed proposers regarding the RFP, alternative technical concepts ("ATC"), or Conceptual Technical Submittals; or after submission of proposals in connection with discussions and submissions of best and final offers ("BAFO").	Sections 3.1, 3.8.2 ("Alternative Technical Concepts"), 3.9, and 3.11.3
Short-Listing	Identifies a limited number of proposers that the owner deems most qualified to perform the project. Only the proposers on the short-list are eligible to submit proposals. Requires a two-step procurement process.	Sections 2.18, 2.24, 3.5, 3.6, and 3.9
Draft RFP for Industry Review	Provides a draft version of the RFP to proposers for review and comment prior to the release of the final RFP. Allows the proposers to identify any terms of the RFP that would be "deal killers" prior to release of the final RFP document, allowing the public owner to reconsider and potentially revise those particular terms and conditions. Allows the public owner to incorporate any beneficial comments or ideas that the proposers submit in response to the draft RFP. Provides an additional quality check of the RFP documents prior to their final release. Allows the proposers additional preparation time for their proposals, including ATCs, typically resulting in higher quality proposals. Encourages communication and trust between the public owner and proposers in the procurement process.	Section 3.6
Conceptual Technical Submittals Review	Allows a proposer to submit a concept to the public owner for review prior to submission of the final proposal.	Sections 3.8.2 ("Conceptual Technical

PROCUREMENT TOOL	DESCRIPTION	DESIGN-BUILD PROCUREMENT PROCEDURES
	Allows the proposer to solicit the public owner's opinion as to whether the concept falls within or outside the current technical parameters set forth in the RFP.	Submittals") and 3.9
Alternative Technical Concepts	Encourages innovation by allowing proposers to include pre-approved deviations from technical requirements in their proposals. The ATC must result in an end product that is equal to or better than the product required by the original specifications.	Sections 3.8.2 ("Alternative Technical Concepts") and 3.9
Discussions and Proposal Revisions	Offers a public owner the opportunity to meet individually with proposers through "discussions" after receipt of proposals for the purpose of advising each proposer of any deficiencies (errors, omissions, or weaknesses) in its proposal. Areas requiring improvement may be related to technical and/or price proposals. After discussions are concluded, the owner requests proposal revisions.	Sections 3.8.2 ("Escrowed Proposal Documents"), 3.9, and 3.11.3
Post-Selection Negotiations	Allows the parties to incorporate ATCs from unsuccessful proposers prior to award, make corrections, clarify ambiguities and tailor provisions to the selected proposer.	Sections 1.5, 3.8.2 ("Escrowed Proposals Documents"), 3.12, and 3.13
Stipends	Gives public owners procuring DB contracts the opportunity to obtain the right to use work product from the unsuccessful proposers' proposals. Recognizes that significant design, including ATC work, occurs prior to proposal submittal.	Section 3.8.2 ("Stipend Information")
Affordability Limit	Assists with cost certainty as early in the procurement process as possible. Identifies the owner's upper cap on contract pricing. Often, any proposals that exceed the cap are not considered.	Section 3.8.2 ("Additive/Deductive Scope Options" and "Affordability Limit")
Build to Budget	Assists with cost certainty as early in the procurement process as possible. Identifies a budget for a project. Proposers may propose additional quality and technical elements to the baseline technical scope, so long as the additional elements do not exceed the budget and provide a facility that performs higher than or equal to the baseline technical scope.	Section 3.8.2 ("Build to Budget")
Additive/Deductive Scope Options	Assists with cost certainty as early in the procurement process as possible. Often used in conjunction with an affordability limit. Prioritizes scope options that are not included in the base technical scope, but that may be added into the project. Creates a prioritized list of deductive options, which may be used to eliminate scope if a proposer cannot accommodate the base technical scope within the stated budget.	Section 3.8.2 ("Additive/Deductive Scope Options")
Maximum Payment Curve	For construction projects extending over several years, may be included in a price evaluation to the extent the time-value of money is important to the owner. Includes information regarding the projected cash flow, which is then the basis for the maximum payment curve that limits the total amount payable to the design-builder at any point in time. The owner may incorporate its own payment limitations, if any.	Section 3.8.2 ("Maximum Payment Curve")

Exhibit C. Green Line Extension Project Delivery Charrette April 13, 2016

Agenda

1)	Welcome and Introduction	Jamey Tesler	8:30 to 8:35 a.m.
2)	Scope of Work • Update on the status of the project re-definition process • When will there be adequate definition to prepare the Draft Request for Proposals? • What could some early work packages be? • When do we need to issue Notice(s) to Proceed?	IPMT	8:35 to 9:00 a.m.
3)	Funding and Finance • Discuss cost estimate development • Identification of funding sources • Identification of gaps that may require private financing, if any	IPMT	9:00 to 9:15 a.m.
4)	Decision-Making Process	Nossaman	9:15 to 9:30 a.m.
5)	Project Goals	Nossaman	9:30 to 9:35 a.m.
6)	Contract Packaging • Review of MBTA re-examination of contract packaging	Nossaman	9:35 to 10:00 a.m.
	• Suggestions to maximize economies of scale • Review potential early work packages • Recommendation	IPMT	10:00 to 10:20 a.m.
7)	Project Delivery Options • Review of 2012 analysis • Review of MBTA re-examination of project delivery options • Recommendation	Nossaman	10:20 to 10:50 a.m.
	BREAK		
8)	Implementation Plan • Review of Potential Procurement Schedule • Mitigating challenges	Nossaman	11:15 a.m. to 12:30 p.m.
9)	Immediate Action Items • 30-day • 60-day • 90-day	Nossaman	12:30 to 1:00 p.m.

Exhibit D. Project Delivery Options

Project Delivery Options

- In December 2015 MBTA re-examined project delivery options
  - Goals were revisited:
    - Maximize cost efficiencies
    - Maximize cost certainty
    - Minimize interface risk
    - Reduce administrative costs
    - Preserve modal choice
    - Comply with FEIR/EA and FFGA

Project Delivery Options (cont.)

Criteria	Design-Bid-Build	Design Build	Construction Management at Risk
1. Maximize Cost Efficiencies	- Competitive selection: lowest responsible bidder	- Competitive selection: best value	- Competitive selection: mainly on qualifications
	-Owner retains significant risks; maintains commensurate contingency	- Owner shifts selected risks; requires smaller owner contingency	- Proper risk identification; open book negotiation can minimize contingencies
	- Prescriptive specifications ; minimal contractor innovation	- Opportunities for innovation; ATCs can lead to significant cost savings; less prescriptive specifications permit design-builder innovation	- Early contractor involvement can lead to cost savings through design and constructability reviews
2. Maximize Cost Certainty	- Initial construction costs fixed at 100% design	- Design and construction costs fixed well before 100% design	- Initial construction costs fixed at 100% design and after GMP negotiation complete
	- Conventional risk allocations can lead to greater risk of claims and change orders; less cost certainty after award	- Risk shifting to design-builder maximizes cost certainty by reducing risk of claims and change orders	- Risk reduction through contractor participation in collaborative design and constructability review process increases cost certainty
	- Owner controls design to ensure plans produce construction within budget	- Single source of responsibility for design and construction	- Contractor manages subcontractors to complete work within or under GMP

Project Delivery Options (cont.)

Criteria	Design-Bid-Build	Design Build	Construction Management at Risk
3. Minimize MBTA-Retained Risks	- Standard risk allocations result in greater risk of claims and change orders	- Design-builder as single point of responsibility reduces owner risk	- Risk reduction through contractor participation in collaborative design and constructability review process
	- MBTA and MassDOT routinely deliver projects using design-bid-build	- Large design build projects will require specific experience and training to properly manage	- Large CMAR projects will require specific experience and training to properly manage
4. Reduce Administrative Cost	- Most required staff (in-house/consultants)	- Least required staff (in-house/consultants)	- More required staff (in-house/consultants)

Exhibit F

EXAMPLES OF TRANSPORTATION DESIGN-BUILD PROJECTS (NATIONAL)

Project Owner	Project Name	Affordability Limit
Alameda Corridor Transportation Authority	Mid-Corridor Trench	
Arizona Department of Transportation	South Mountain Freeway (Design-Build-Maintain)	Yes (through a maximum allowable cumulative draw schedule)
California High Speed Rail Authority	Fresno-to-Bakersfield Segment (Contract Packages 1 and 2-3)	
Central Puget Sound Regional Transit Authority (Sound Transit)	South-Link Extension	
Chesapeake Bay Bridge and Tunnel District	Parallel Thimble Shoal Tunnel	
Colorado Department of Transportation and Regional Transit District (Denver RTD)	T-Rex	Yes (including additive options)
District of Columbia Department of Transportation	South Capitol Street Corridor Project	
Honolulu Authority for Rapid Transit	Honolulu High Capacity Transit Corridor	
Indiana Finance Authority	I-69 Major Moves 2020 Expansion Project	
Los Angeles County Metropolitan Transportation Authority (LACMTA)	Metro Gold Line	
Louisiana Department of Transportation and Development	I-10	
	I-12 Widening Project (Phase 1)	
	I-12 Widening Project (Phase 2)	Yes

Project Owner	Project Name	Affordability Limit
	I-49	
	John James Audubon Bridge	
	US 90/LA 85 Interchange	
	US 90/LA 318 Interchange	
Metropolitan Transit Authority of Harris County, TX (Houston Metro)	Metro Solutions Phase 2	
Metropolitan Washington Airports Authority	Dulles Corridor Metrorail Project Phase 1	
	Dulles Corridor Metrorail Project Phase 2	
Minnesota Department of Transportation	Hiawatha Light Rail Transit	Yes (including additive options)
Nevada Department of Transportation	I-80 Corridor	
	Project Neon	
	USA Parkway (SR 439)	
New York State Thruway Authority	Tappan Zee Bridge	
Orange County Transportation Authority	I-405 Improvement Project	
Port of Long Beach	Gerald Desmond Bridge	Yes
Riverside County Transportation Commission	SR 91 Express Lanes	
	I-15 HOT Lanes	
Santa Clara Valley Transportation Authority (VTA)	BART Silicon Valley Berryessa Extension	
Texas Department of Transportation	Border West Expressway (D-B-M)	
	SH 130 Segments 1 – 4 (D-B-M)	
	DFW Connector	
	Grand Parkway Segments F and G	
	Grand Parkway Segments H and I	
	Highway 161	
	I-35E Managed Lanes (D-B-M)	Yes
	SH 249 (D-B-M)	
	SH 360 (D-B-M)	
	U.S. 181 Harbor Bridge Replacement (DBOM)	
Utah Department of Transportation	I-15 CORE	Yes
	I-15 POINT	
Utah Transit Authority	Draper TRAX Line (Blue Line)	
	Medical Center Extension	
	Mid-Jordan TRAX Line (Red Line)	
	University TRAX Line	
Virginia Department of Transportation	Coalfields Expressway	
Washington State Department of Transportation	Alaskan Way Viaduct Replacement	

Appendix D. – Additional Funding Sources

City of Cambridge
Richard C. Rossi • City Manager

Executive Department
Lisa C. Peterson • Deputy City Manager

May 9, 2016

Stephanie Pollack
Secretary of Transportation and Chief Executive
Massachusetts Department of Transportation
10 Park Plaza
Boston, Massachusetts 02116

Re: Letter of Intent – Green Line Extension Financial Contribution

Secretary Pollack:

For many years, the City of Cambridge has been a strong supporter of the relocation of Lechmere Station and the Green Line Extension (GLX) from Cambridge to Somerville and Medford. The purpose of the GLX project is to improve regional air quality, encourage sustainable growth, promote economic development, and provide a convenient means of public transportation for residents, employees, and visitors along the GLX corridor. This project will benefit the three municipalities it touches as well as the entire Greater Boston region and the Commonwealth of Massachusetts. This Letter of Intent (LOI), which I am submitting to the Massachusetts Department of Transportation (MassDOT) Board of Directors and the Massachusetts Bay Transportation Authority (MBTA) Fiscal and Management Control Board, is intended to set forth the terms and conditions that I, as the City Manager of the City of Cambridge, intend to discuss with and recommend to the Cambridge City Council as the basis for the City of Cambridge to commit to contributing to the construction costs associated with the GLX, to the extent legally permissible, and subject to City Council approval and appropriation of funds.

While the Commonwealth's appeal for local funding contributions at this late stage in the project represents an extraordinary request, I believe that the value of this project to the City of Cambridge, the Boston Region, and the entire state requires us to respond in a meaningful way to help move this project towards reality. I also intend to work with the North Point developers to obtain commitments from them to contribute financially to the GLX in partnership with the City.

The Green Line Extension Project
The City of Cambridge supports the GLX and I will recommend that the City Council approve the City contributing an amount that the City Council considers to be a fair and reasonable amount to assist in offsetting the cost of the project, in partnership with the Federal Government and the Commonwealth of Massachusetts, based upon the proposed total budget for the project and the proportionality of Cambridge's monetary contributions of new revenue thereto, the City's reasonable financial capabilities, the contributions of new revenue from the other municipalities the GLX touches, and assurance that the project will commence as scheduled and continue reasonably to completion.

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GLX will comprise seven Green Line stations. The project will relocate Lechmere Station and create a new Green Line station in Union Square in Somerville. Five additional stations will also be built outside of Cambridge, between Lechmere Station and College Avenue in Medford along existing railroad rights of way.

The GLX stations will be designed in accordance with MassDOT/MBTA station requirements. MassDOT will obtain all necessary legal approvals for the GLX and its operations from any local, state, or federal agencies. The GLX will be constructed in accordance with a construction management plan approved by MassDOT, and will be operated and maintained by the MBTA. Service, at a minimum, will include stops on both inbound and outbound trains during standard MBTA service hours. MassDOT will be responsible for compliance with all state procurement requirements, public bidding laws, and any other laws applicable to MassDOT due to its governmental status. In making this financial contribution to MassDOT/MBTA's construction of Lechmere Station and the other improvements that are part of the GLX project, the City does not commit to taking on any additional responsibilities related to the planning, design, construction, operations, or maintenance of any GLX facilities.

Value of Financial Contribution

I intend to recommend to the Cambridge City Council that the City contribute fair and reasonable funding, as set forth in this letter, to support the GLX project and to help close the currently anticipated budget gap that remains after the project is value engineered, in the event that all other efforts to procure and employ federal and state funds for the project have been exhausted and a gap remains that can only be addressed with monetary contributions from Cambridge, North Point developers in Cambridge, and other municipalities. The financial contribution will be based upon the value of the infrastructure improvements in Cambridge and the economic, environmental, and mobility benefits those improvements create, and will be subject to the requirement that other municipalities contribute their reasonably proportionate share of new revenue required for the gap funding.

I am prepared to enter into discussions with the Cambridge City Council and the North Point developers to seek their approval for the City to contribute up to $25,000,000 of new revenue towards the completion of the GLX project, in the manner described below. The exact nature, timing, and form of this contribution is still to be determined, but it will represent new revenue to the project that will directly contribute to closing the funding gap together with proportionate contributions of new revenue from other municipalities that the GLX project will touch. The contribution from Cambridge-based sources will make up not more than one third (1/3) of the total amount of new revenue that is provided from the municipalities of Cambridge, Somerville, and Medford for the gap funding.

Use of Financial Contribution

This $25,000,000 commitment of new revenue from Cambridge-based sources will be used solely for the construction of the project-related improvements within the City of Cambridge, including the new and relocated Lechmere Station that will be built as part of the GLX. MassDOT and the MBTA will work with the City of Cambridge to establish a mechanism to ensure that the funds are used in this manner, and will ensure that any expenditure of those funds will be for the GLX project only and consistent with the terms and conditions outlined in this letter.

Payment Mechanism

Assuming the Cambridge City Council and the North Point developers commit to contributing to the GLX project as outlined above, the City of Cambridge will work with MassDOT, the MBTA, and other relevant state agencies to develop mechanisms for disbursing the agreed upon funds and committing those funds to the Commonwealth for the GLX project. These mechanisms could include direct cash contributions, state borrowing backed by guaranteed payments from the City of Cambridge (through the Cherry Sheet or other appropriate mechanism), or other similar mechanisms for payments from the City of Cambridge or the North Point developers. Over the course of those discussions, I expect to reach agreement with MassDOT and/or the MBTA on the amount to be paid, the period and frequency of payment, the mechanism of payment, and any regulatory or statutory changes that may be necessary to accomplish the foregoing. The City of Cambridge expects the Commonwealth to stipulate that any funding provided by the City will not be transferable to any state expenditure other than those directly related to those portions of the GLX project that are constructed within the City of Cambridge and that the City of Cambridge's share of new revenue provided for the gap funding is not more than one third (1/3) of the total amount of new revenue provided by all municipalities for the gap funding. To the extent that any regulatory changes or special legislation is required at the state level to enable a specific payment mechanism, I expect MassDOT, the MBTA, and other state agencies to pursue said regulatory changes or special legislation in an expedited manner.

Local Approval

After a preliminary agreement between the City of Cambridge and MassDOT is reached regarding the elements describe above, and after the final adoption of any necessary regulatory or statutory actions, the City will have an additional period to obtain the legally mandated and/or otherwise required local public approval, as well as completing negotiations with the North Point developers resulting in their approval of funds to be contributed to the GLX project, prior to the execution of any final agreement. Should the City of Cambridge not approve or obtain those approvals, the City will not be held responsible for any financial contributions or other commitments.

Priority in Use of Funds

I would like to be explicit that my objective in providing this letter is to indicate my commitment for Cambridge and the North Point developers to take the above steps only in the event that all other federal and state funding sources have been explored and that but for monetary contributions of new revenue from the City of Cambridge, the North Point developers and the other municipalities, there is a gap in the federal and state funding for the project that cannot be filled by any other means. In the event that the Cambridge City Council and the North Point developers approve this funding and the project costs turn out to be less than anticipated at this juncture, I also expect the City of Cambridge to be relieved of a portion of that funding commitment in a fair and proportional manner. To ensure this outcome, the funding provided from Cambridge-based sources will only be accessed once MassDOT and the MBTA have provided appropriate assurances that Cambridge's contribution of new revenue to the gap funding is partially or wholly necessary proportionately with other municipal funding sources of new revenue in order to construct the project and that the project-related improvements in Cambridge have been or will be fully completed in a manner that enables service to the relocated Lechmere station to commence operations.

Future State Policy
To my knowledge, never before has a municipality or group of municipalities in Massachusetts been asked to assume a portion of the cost of a large infrastructure project. Traditionally the state and federal governments have worked together to fund these projects, and to address cost overruns, with an understanding that municipalities in Massachusetts have a limited ability under Massachusetts law to raise new revenue or to dedicate local funding to costs outside of routine municipal services such as education, public safety, public health, and local infrastructure. Given the Commonwealth's request for municipal funding contributions for the GLX, it will be an important factor in Cambridge's decision as to whether to contribute municipal funding to this project that there be appropriate assurances that when future infrastructure projects face similar funding circumstances, the local municipalities will be treated in a similar manner with respect to expected financial contributions.

Legal Authority
I commit to work with MassDOT and the MBTA toward entering into a final agreement by September 30, 2016. In advance of a final and binding agreement to contribute funds to the GLX, I require assurances that the Commonwealth of Massachusetts and the MBTA have the legal authority to accept such funds and expend them according to the requirements and expectations set forth in this letter and any subsequent agreements between the parties referred to herein. To the extent that any special legislation or regulatory action is required at the state level to enable or ensure this legal authority, I expect MassDOT, the MBTA, and other state agencies to pursue said special legislation or regulatory action in an expedited manner.

I look forward to continuing to work together with you, the MassDOT Board of Directors, and the MBTA Fiscal and Management Control Board to advance this important project.

Very truly yours,

Richard C. Rossi
City Manager

CITY OF SOMERVILLE, MASSACHUSETTS
JOSEPH A. CURTATONE
MAYOR

May 5, 2016

Secretary Stephanie Pollack
Massachusetts Department of Transportation
10 Park Plaza
Boston, Massachusetts 02116

Dear Secretary Pollack:

Thank you for your tireless efforts to advance the MBTA Green Line Extension, which is a critical element of the regional transportation system as well as a long-standing shared commitment between the Commonwealth of Massachusetts, the City of Somerville, and the 101 cities and towns comprising the Boston Region Metropolitan Planning Organization and the Metropolitan Area Planning Council.

The purpose of the Green Line Extension (GLX) is to improve regional air quality, mitigate roadway congestion, encourage sustainable economic growth, and provide a convenient means of public transportation for Massachusetts residents, workers and visitors. The purpose of this Letter of Intent is to set forth the terms and circumstances under which the City of Somerville, MA, intends to expand its financial partnership with the Commonwealth to construct elements of the GLX program, subject to and contingent on approval by the Somerville Board of Aldermen.

As you know, the City of Somerville has already invested into the GLX program more than $8 million in "sunk costs" that have relieved the Commonwealth of several specific required project costs. Expanding this financial partnership is an extreme and unprecedented arrangement for a state infrastructure project. Despite the fact that the City bears no responsibility for the cost overruns that brought the GLX to this moment of crisis, the City intends to support the Commonwealth by expanding its cost-sharing role. The Green Line is that important to our community.

It is my understanding a new cost estimate for the GLX is being prepared, and that it will retain core program elements including seven (7) light rail transit stations with service headways required in the 2015 Full Funding Grant Agreement (every 6 minutes in the weekday peak period, every 8 to 11 minutes in the weekday off-peak period, every 13 to 14 minutes on weekday evenings and every 8 to 10 minutes on weekends), a Vehicle Maintenance Facility, a Community Path, and related utility upgrades. I understand that the MassDOT Board of Directors and the MBTA Fiscal and Management Control Board have

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formally resolved that should a funding gap still exist after these estimates are published, outside funding sources including municipal contributions would be required to move the GLX forward.

MassDOT has consistently and publicly indicated that the Boston Region Metropolitan Planning Organization must formally reassign $150 million of federal funds previously designated for the Green Line station at Route 16 / Mystic Valley Parkway in Somerville to help fill the likely funding gap on the core GLX program to Union Square and Tufts University / College Avenue. In addition, MassDOT has consistently and publicly indicated that the three municipal governments hosting the GLX must formally contribute funding to help build the core GLX program to Union Square and Tufts University / College Avenue. It is my understanding that without firm commitments from these non-state funding sources, the Green Line Extension could be cancelled and the Commonwealth would forfeit not only its $996 million federal New Starts grant award, but at least $700 million in "sunk costs" of the state's $996 million share of the project.

With that clear understanding, it is my intention as Mayor of the City of Somerville to recommend to the Somerville Board of Aldermen that the City commit to underwriting project costs for several specific, tangible elements of the GLX program that are not core transit assets, but would deliver meaningful public safety and quality-of-life benefits for Somerville residents.

The project elements I intend to recommend for municipal financing include safety and accessibility upgrades at numerous local roadway intersections that the GLX project was required to perform under state and federal environmental permits. In addition, the City has a clear and urgent interest in supporting GLX project costs associated with flood mitigation and stormwater management assets around the Washington Street station site and stretching southeast into the Innerbelt and Brickbottom districts, where historical and current flooding have threatened public safety, jeopardized environmental sustainability, discouraged private business investment and inflated local water and sewer ratepayer costs. The value of these recommended new contributions by the City of Somerville is projected at $50 million.

Although building these improvements is an obligation of the Commonwealth, I intend to recommend municipal support in financing this construction because I see the independent value of these utility and roadway upgrades for our community.

I commit to requesting that the Somerville Board of Aldermen review and vote on this recommendation by August 31, 2016 to support MassDOT's negotiations with the Federal Transit Administration on a new finance plan for the GLX, and to ensure timely procurement of a new Design / Build contract for the re-scoped GLX project. The City will work with MassDOT to embed appropriate protections and recovery provisions for any municipal monies advanced in any funding agreement, in the event that some or all municipal contributions are not in fact needed, or the project does not go forward.

Furthermore, it is my intention to work with Governor Baker's administration and the City's state and federal delegations to seek legislative action on new and refined "value capture" tools capable of

supporting new infrastructure investments around Massachusetts, including extension of borrowing terms to maximize allowable amortization periods for these costs. In addition, I request that the Commonwealth establish a baseline tracking framework for future Infrastructure Investment Incentive (I-Cubed) state tax revenue accruals generated by transit-oriented development around the GLX, so as to not preclude a formal application to use eligible I-Cubed revenues to offset Somerville's proposed municipal contribution.

It is clear that the Commonwealth requires a new paradigm for major transportation infrastructure investments. Across the nation, many states have established predictable and equitable frameworks for local value capture financing in state transportation projects. While this proposed GLX partnership arguably meets neither of these criteria, Somerville will stand with you to advance the state of the art, provided that this is truly a new precedent for statewide policy, and that our small community will not be held to higher standards than other Massachusetts municipalities seeking state and federal financing for roadway, transit or other infrastructure projects.

Sincerely,

Joseph A. Curtatone
Mayor

Marc Draisen's motion

Seconded by Jim Gillooly

The Boston Region MPO votes to send out for a 30-day period of public comment its intention to move the funding currently programmed for the Green Line Extension (GLX) from College Avenue to Route 16 to the first phase the GLX from Lechmere Station to College Avenue. This 30-day period will allow for a revised scope, procurement method, and budget to be provided to the MPO to confirm the necessity of these funds to be reprogrammed.

In doing so the MPO recognizes and incorporates into the record of this vote the commitment by the Secretary of MassDOT to file by December 31, 2016 an environmental notification form under the Massachusetts Environmental Protection Act (MEPA) for the second phase of the GLX from College Avenue to Route 16 in Medford, and after such filing to carry forward the MEPA review process to its conclusion, so long as the Lechmere to College Avenue portion of the GLX continues to go forward.

Appendix E. – Estimate Narrative

Executive Summary

The Green Line Extension (GLX) Interim Program Management Team (IPMT) has been tasked with providing a new construction cost estimate as part of a major reevaluation of the remaining construction scope. The IPMT has chosen to initiate the following estimate process to provide this deliverable as expeditiously as possible. Additionally, it is expected that this methodology will provide a reasonable approach and a defendable basis of accuracy for a revised construction cost estimate. The IPMT has decided that it is the best course of action to utilize the functional benefits of some of the work that was previously generated by the previous GLX independent cost estimator (ICE). The IPMT will not rely upon the information provided within the extensive ICE documentation. Rather, the IPMT estimators are tasked with a review and modification of that documentation to generate a new construction cost estimate that reflects what will be significant design changes. It is also important to note that the IPMT has many other important deliverables that the new construction cost estimate relates to – this narrative report addresses the construction cost estimate only.

In developing this critical process decision, the IPMT also reviewed the alternative options, and the reasoning, with members of the Federal Transit Administration (FTA) with representation from the FTA Program Management Oversight Consultant (PMOC), the MBTA's GLX Owner's Representative (HMM), as well as Senior Management staff of MassDOT and the MBTA. The IPMT concluded that all other alternatives, such as a detailed bottom-up cost estimate methodology, are either not feasible within the IPMT reporting deadline (of 5/11/16) and/or does not offer any significant increase in price certainty. Part of the reasoning for choosing the following estimating methodologies relates to the fact that most of the redesigned elements will not have detailed engineering drawings that the estimators can utilize for quantity development.

This summary table outlines the cost centers of the redesigned GLX and the corresponding estimating methodology that will be utilized by the IPMT.

Performance Measure/Objective

The IPMT's new construction cost estimate will be utilized by the MassDOT and the MBTA Fiscal & Management Control Boards to assist in their decision on the progression, or termination, of the GLX Program. Specific to the finalization of this new construction cost estimate, the success of this effort will likely be first evaluated upon the results of a Peer Roundtable Review (that MassDOT will initiate in late March 2016). More importantly, and should the Boards authorize the continuation of the GLX, the success of this effort will ultimately be measured from the comparative results of a solicitation of bids for future construction contract(s). The IPMT cost assessment will be a critical component to formulate a new GLX Program budget and scope, as such it is vital that the estimate process be documented to properly reflect the substantial changes to the previous design. It is also vital that the end result of the overall IPMT estimate generate a reasonable level of construction cost estimating accuracy that compares to within a range of 10%-15% of future bid results of what may be a re-procured GLX. This IPMT estimate will be a tool to provide progress updates and communication with the FTA as well as other stakeholders such as the Cities of Medford, Somerville, and Cambridge.

Redesigned GLX Cost Center	*Estimate Methodology Description*
Lowell Line, Union Line, New Hampsire Line, and Fitchburg Line Rail Corridors	
• Track • Retaining Walls • Earthwork • Drainage • Bridges • Systems/Power • Noise Walls • Pathway	**ICE DECONSTRUCTION** - Review and Adjust Previous iGMP4 Independent Cost Estimate. Project Forward to Similar iGMP5 Redesigned Scope.
Viaduct Cross Section	
Vehicle Maintenance Facility	Major Commodity / Assembly Unit Price
Stations	Major Commodity / Assembly Unit Price & Similar Historic Comparisons (stations)
General Conditions, Overheads & Indirects	Full Independent Assessment/Detailed Line Items -- Adjusted to New GLX
Escalation & Contingencies	Full Independent Assessment/Detailed Line Items -- Adjusted to New GLX

Basis Summary - Construction Cost Estimate Process

The GLX IPMT will utilize many benefits of an industry accepted estimating process that has been utilized for large public transportation programs. These benefits are explained further in sections below. As the design phase of large transportation programs progress normally, an Independent Construction Cost Estimate (ICE) is developed concurrently with the public agency's own engineer's construction cost estimate. The ICE is most often generated by a team of experienced construction cost estimators who are free of contractual conflict as the ICE team is precluded from bidding on the work competitively. The ICE is independent from the construction community. Unlike a contractor who prepares a bid cost estimate or a change order estimate, the ICE is not motivated for profit. The ICE is not motivated to demonstrate that the project costs more than it truly does. The ICE team's performance is measured by how well they prepare a construction cost estimate that accurately forecasts a fair and reasonable price that is reflective of the contract documents and the market conditions for the project.

Specific to the GLX, in 2013 the MBTA hired a professional estimating team, Stanton Constructability Services LLC., to assist in providing a series of independent construction cost estimates. In 2015, and prior to the termination of the pre-construction planning work of the GLX CM/GC Contractor (J.F. White, Skanska, Kiewit), the MBTA had received what is called a full 'bottom up cost estimate' from Stanton for the scope of a major portion (iGMP#4) of the remaining GLX program. The following paragraphs detail the benefits that are provided from the GLX ICE.

6. The IPMT will not rely upon the information provided within the extensive ICE documentation. Rather, the IPMT will be tasked with a review and modification of that documentation to generate a new construction cost estimate that reflects what will likely be significant scope changes. As an example of a pricing adjustment that the IPMT will generate, the cost for ballast curb may be adjusted from ballast curb costs $50/lf to $45/lf based upon the IPMT estimator's local knowledge of current market pricing. Pricing adjustments can be made utilizing industry accepted references such as Engineering News Record, RS Means, Blue Book Equipment, estimator experience, past sub-contractor quotations, past supplier quotations, and local union labor agreements.
7. The IPMT estimate will utilize previous organization aspects of the ICE estimate for iGMP#4 package. This entails extensive structured information within the full estimate detail that was provided by the ICE including:
    a. a work-breakdown-structure (WBS) that has been tailored to the work within the GLX,
    b. anticipated production rates for all major operations,
    c. crew compositions,
    d. permanent material prices,
    e. equipment prices,
    f. base labor rates,
    g. small tools and supplies,
    h. temporary materials,
    i. allowances,
    j. burdened labor rates (i.e. including employee benefits, payroll taxes and other payroll burdens),
    k. copies of quotations from subcontractors and suppliers,
    l. cost estimates for facilities and services necessary for the proper execution of the work,
    m. project overheads (or otherwise called general condition costs and other indirect construction costs),
    n. other allocated general and administrative expenses not accounted for in project overheads, such as bonds, non-exempt taxes, home office support costs, and corporate insurances.

All the above are components of what is often called a bottom-up estimate or a production based cost estimate. It is the IPMT's intent to utilize the WBS that had been generated within the ICE's bottom-up estimate.

8. Related to above, it has been determined that performing a completely new full bottom-up estimate, for the remainder of what will be a significantly modified GLX program, is not practical due to the level of design completion for the new reevaluated GLX. As a common alternative to a bottom-up estimate, estimating teams also use what are called **unit price estimates** which often rely upon past bid prices from projects that may be comparable. The unit price estimate offers some advantages as not nearly as much effort/detail is required) as compared to the bottom-up estimate methodology. The IPMT will utilize a unit price estimating methodology for certain aspects of the GLX evaluation when it is necessary and appropriate.

9. The previous iGMP#4 ICE will be reviewed and adjusted considerably. EXHIBIT I (below) further details the process within each of these five ICE adjustment categories:

    a. Unit/Quantity

    b. Pricing

    c. Production Rate

    d. Limitations-of-Operations Adjustments (beyond the basis of c.)

    e. Indirects and Overheads

Additionally, the following other three aspects will be critical components to the IPMT's new construction cost estimate projection. These will be generated separately from what is described below (#5) as the ICE estimate de-construction and will be important elements to the overall new/recommended program budget and overall GLX program affordability limits.

    a. Estimate for the Reduced Vehicle Maintenance Facility

    b. Estimate for the Reduced Green Line Stations

    c. Review of Escalation and Contingency

    d. Review of 'Sunk Costs'

10. The IPMT will utilize the functional benefits of the largest construction package. The scope within Interim GMP#4 was significant in that it ultimately was estimated to be the largest of 8 construction packages. Using this same information as a starting point, this will help the IPMT greatly as thousands of consultant labor hours will not need to be expended as part of an estimate de-construction. This estimate deconstruction is essentially a major effort to modify an existing estimate to reflect a more efficient/less costly project. Critical initial steps will be taken to rather simply reduce major commodities to reflect the results of the overall IPMT's efforts to reevaluate the GLX as it provides redesign adjustments. As a good example of how an estimate deconstruction will be applied, it is currently anticipated that many retaining walls can be considerably scaled down in size or possibly eliminated. Associated cost center line-items such as grade preparation, installing forms, installing rebar, placing concrete, removing forms, curing concrete, finishing concrete and backfilling can be reduced rather quickly with the utilization of the ICE's previous estimate. It is also important to note that original quantities of iGMP#4 were all reconciled and agreed to by the previous PM/CM, the previous contractor and the ICE team.

11. It is very important to re-emphasize that the ICE estimate that was provided at that time (for iGMP#4) will have a significantly different basis of scope at the completion of the IPMT work. The IPMT is tasked with a major reevaluation and will be modifying the previous design of the GLX dramatically.

12. In utilizing some aspects of the ICE and as part of an estimate deconstruction, the IPMT estimating team has also received important instruction to not be driven to generate an artificial estimate to fit within what was previously approved as part of the Full Funding Grant Agreement between the MBTA and the Federal Transit Authority Department of Transportation. Rather, it is understood that the IPMT team members, as well has key staff from the MBTA and MassDOT, are tasked with generating a significant overall evaluation and redesign considerations that optimize efficiencies to help to generate a new scope for the GLX that is affordable to the Commonwealth and the FTA.

13. The previous iGMP#5 scope included many of the same cost centers as iGMP#4. The IPMT will further benefit from the utilization of the iGMP#4 as it will be translated to what will be the new refined scope for the remainder of the GLX.

EXHIBIT I

Independent construction estimate (ice) de-construction

Aspects and Stages

Unit/Quantity - The estimating team will generate new quantities for the major commodities of the revised design of the GLX. These will be based on the preliminary sketches and narrative provided by the designers. This will greatly help the IPMT Estimating staff to save valuable time as part of the overall GLX evaluation. See example in Basis Summary above.

Pricing - A typical/detailed ICE construction cost estimate contains prices for labor, materials and equipment. When prices are applied to anticipated production rates and crew compositions, this formulates the basis of what is called a *production based cost estimate* or a *bottom-up estimate*. The GLX ICE had provided a great deal of information with regard to prices that were part of the iGMP estimate. The IPMT will be providing a general review of the prices for the major commodities that are contained within the iGMP4 Independent Cost Estimate. The IPMT will review, adjust, and document the significant adjustments that should be taken to best reflect the current market prices and the benefits of the GLX redesign concepts. This will be performed utilizing various pricing references such as Engineering News Record, RS Means, Blue Book Equipment data base, estimator experience, past sub-contractor quotations, past supplier quotations, and local union labor agreements. These will include those aspects that the IPMT determines to be below Boston area pricing averages, or above those averages, to help estimate the current market conditions (2016). See escalation below.

Production Rate - Production rates are factors that are established by utilizing past experiences, engineering judgment, historical records, time-motion studies and evaluations of anticipated construction crews that will be working in a particular area. The most significant crew compositions and the associated production rates in the ICE estimate will be reviewed and adjustments will be made to reflect the changes in the scope of the work and/or what the IPMT determines to be a reasonable and necessary adjustment (increase and/or decreases).

Limitations-of-Operations Adjustments (beyond the basis of c.) - Limitations of Operations is the term that is used to describe the conditions and restrictions that the contractor is required to account for in executing the work. These are contractual restrictions that are most often specified by the known restrictions of the work. Examples of this include noise restrictions, railroad operational restrictions, environmental requirements, traffic restrictions, etc. The IPMT is tasked with evaluating some of the most restrictive aspects of the past GLX planning effort and making recommendations to modify aspects that will be most beneficial to a future contractors production rates. This is ultimately intended to be offered up as significant cost avoidance in the new construction cost estimates for the GLX. It is anticipated that IPMT revised estimate will be updated to reflect some enhancements to allowable working hours, constraints related to shut down periods and the overall work within the GLX corridor.

Indirect/Overheads/Profit - The typical contactor detailed bid estimate contains hundreds of line items to forecast and budget for the supporting operations for the execution of the direct cost aspects of the estimate. Direct costs are detailed in a-d above. These are clear allocations of labor, materials and equipment to specific construction operations. Indirect costs (also often called general conditions or overheads) support those direct cost elements are a grouping of a much broader aspect of the project execution. Examples of indirect costs are non-manual supervision, insurances, temporary facilities, construction vehicles, home and office support. As is done in a contractor generated detailed bottom-up estimate and an ICE, the indirect costs are most often estimated based upon the direct costs of the particular project, along with the overall time constraints and completion deadlines. Because indirect costs often represent a very large percentage of the overall construction cost estimate, it is very important to estimate them properly.

The IPMT intends to provide a detailed review if the iGMP ICE aspects of the indirect costs. Additionally, it is expected that the IPMT will build a new estimate build-up to support the redesigned GLX. The pricing will be updated to reflect the IPMT's current understanding of the project timeline and adjustments will be made to the assumptions around construction schedule, production rates, a competitive bidding environment, contractor profit, and risks.

Profit will be applied based on the anticipated bidding climate at the time of the re-designed GLX project commencement and the level of risk the bidding contractors are expected to carry.

Estimate for the Reduced Vehicle Maintenance Facility (VMF) - The IPMT will generate and estimate for the reduced VMF using a unit price approach. Due to the level of detail for the modified design, major assemblies of construction elements will need to be priced as groups that compare to aspects of similar building types. Examples of this are the price per square foot of a wall façade that is comprised of wall framing, insulation, masonry units, waterproofing and paint. This estimating methodology will allow the IPMT to provide a reasonable budgetary projection of what will likely be a significantly scaled-down version of the VMF.

Estimate for the Reduced Stations - Similar to the VMF, each of the seven Green Line stations will need to be priced utilizing the same unit priced approach for the major assemblies of the construction elements. An example of this will be to provide a price per cubic yard of concrete that will be placed for the platforms. This will represent an in-place comparative price that has been utilized on past/similar transit projects. Additionally, to gain further confidence in the new estimates, the IPMT will be gathering past MBTA historical bid results. These results will be utilized to compare the past stations to the new redesigned stations. When appropriate and necessary, escalation factors will be utilized to account for a current day comparison of those past MBTA projects.

Review of Escalation and Contingency - One of the final and most important aspects of any program level estimate, is to finalize the escalation and contingency values. Escalation is a time dependent variable that is often a very significant cost of the project. Economic projections are often relied upon to apply % factors, onto current pricing, to project the cost of purchasing items in the future. The IPMT will provide an escalation assessment that that is consistent with program budgeting on large federally funded projects. A MassDOT escalation evaluation will be made available for the review of escalation factors that will be utilized.

And finally, the IMPT will also be recommending a range of reserve that the MassDOT Board should expect to include in budget of the redesigned GLX. This will be completed utilizing a general assessment of the most significant known-risk with a % projection for unallocated risk. Although the IPMT will not be performing a program level risk assessment of the revised scope and costs, it is anticipated that a considerable portion of any future GLX budget will need to be established to adequately accommodate a redesign that has regressed to less than 25% design maturity. There will be three groupings of contingency to consider: design phase contingency, construction phase contingency, and unallocated program contingency.

Review of Sunk-Cost - As part of a significant GLX program cost assessment, the IPMT will generate an adjustment to the overall/revised program budget to properly account for expenditures that have occurred as of February of 2016. The costs that have been expended (sunk) prior to the Boards decision to suspend certain aspects of the GLX Program have been accounted for and monitored. Additionally, the IPMT, the Owner's Representative, and the MBTA will monitor the progress of any construction elements that had been discontinued within the previous iGMP1-3 construction packages. This, along with the effort described above, will further assist the MBTA Board with their decision to either continue or terminate a redesigned GLX program.

Appendix F.

Figure 3.1 – STATIONS

Function	Previous Design							Redesign						
	Lechmere	Union Sq.	Washington	Gilman Sq.	Lowell St.	Ball Sq.	College Ave	Lechmere	Union Sq.	Washington	Gilman Sq.	Lowell St.	Ball Sq.	College Ave
Elevators	3	2	2	2	2	2	2	2	N	N	1	1	N	2
Escalators	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N
Stairs	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	Y
Ramp	N	N	N	Y	Y	N	Y	N	N	N	Y	N	N	N
Fare vending	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fare arrays	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N
Canopies	Y	Y	Y	Y	Y	Y	Y	Weather Shelter	Weather Shelter	Weather Shelter	Weather Shelter	Weather Shelter	Weather Shelter	Weather Shelter
Platforms	4-Car	3-Car	3-Car	3-Car	3-Car	3-Car	3-Car	4-Car	3-Car	3-Car	3-Car	3-Car	3-Car	3-Car

Figure 3.4 – BRIDGES

Bridge	Previous Design	Redesign
Medford Street	Full Replacement	Keep existing bridge. Westbound GLX tunnel behind abutment
School Street	Full Replacement	Keep existing bridge. Westbound GLX tunnel behind abutment
Lowell Street	Full Replacement	Revise GL alignment, remove south abutment earthwork, and avoid bridge reconstruction
Broadway	Full replacement of 2-lane bridge plus 1 parking lane, sidewalk, and 2 bike lanes. Partial closure during construction	Replace with 2 lane bridge and 2 bike lanes. Parking lane removed. Full closure during construction
College Ave	Widen bridge structure to accommodate right-hand turning lane	Maintain right-hand-turning lane on existing bridge, remove sidewalk, and add new pedestrian bridge

Figure 3.6 – COMMUNITY PATH

Function	Previous Design	Redesign
Length of Path	10,000 feet	7,000 Feet
Start/Finish	Lowell Street to Water Street, Cambridge	Lowell Street to Washington Street, Somerville
Width	11-foot average, 8-foot minimum	11-foot average, 8-foot minimum
Street Access Points	Central Street Sycamore Street School Street Medford Street Walnut Street Chester Street Washington Street West Boulevard	Central Street Sycamore Street School Street Chester Street (Possible) Washington Street

Figure 4.0 – GLX NEW PROGRAM COST ESTIMATE SUMMARY

Line Item #	PROGRAM BUDGET COST CENTER DESCRIPTION	New Program Estimate IPMT	Sunk-Cost Included in Estimate	
1	**CONSTRUCTION *(D-B Value)***	**$ 1,192,400,000**	$0	
2	**REAL ESTATE**	**$ 112,500,000**	$93,000,000	
3	**VEHICLES**	**$ 182,700,000**	$182,700,000	
4	**PROFESSIONAL SERVICES**	**$ 414,900,000**	$221,000,000	Inc. Force Account
5	**UNALLOCATED CONTINGENCY**	**$ 182,200,000**	$0	
6	***CURRENT CM/GC CONSTRUCTION CONTRACTS***	*$ 203,900,000*	$203,900,000	
7	**TOTAL** (with no Additional Funding Considerations)	**$ 2,288,600,000**	**$700,600,000**	

FIGURE 4.1 – CONSTRUCTION COST REDUCTION COMPARISON

In Figure 4.1, the 'New 90 Percentile IPMT estimate" provides the initial predicted bid price (prior to Alternative Technical Concepts) of a Design-Build procurement outcome that includes construction costs, cost of final design (designer fee), design-builder profit, home-office expenses, escalation and an appropriate amount of contingency.

Line Item #	Construction Cost Centers	Previous GLX Estimates	New Program Estimate *('90 percentile')* IPMT	Variance COST AVOIDANCE (previous - new)
A	**Stations**	$409,500,000	$121,200,000	**$288,300,000**
B	**Bridges**	$86,200,000	$51,300,000	**$34,900,000**
F - G	**Retaining Walls and Community Path**	$187,500,000	$64,600,000	**$122,900,000**
	(* New Community Path = $20M +-)		*	
I	**Maintenance Facility (VMF)**	$195,500,000	$80,130,000	**$115,370,000**
J	**All Other**	$935,600,000	$875,000,000	**$60,600,000**
TOTAL		**$1,814,300,000**	**$1,192,230,000**	**$622,070,000**

These partial cost estimates are for relative cost comparisons between the previous project and the redesigned GLX only. Previous GLX Estimates = generated from the Independent Cost Estimate for iGMP#4 and proportioned to iGMP#5 and other past estimates for the VMF and other components)

"All Other" = track, power, signal, and all other required program infrastructure.

FIGURE 4.2 – GLX BUDGET COMPARISON SUMMARY

Line Item #	PROGRAM BUDGET COST CENTER DESCRIPTION	Available Funding *FFGA*	Breakdown of **Previous** Project	New Program Estimate IPMT 50 Percentile	New Program Estimate IPMT **90 Percentile**	COST AVOIDANCE (rescheduled, redesigned, re-procured) B - C*	COST AVOIDANCE (rescheduled, redesigned, re-procured) B - C**
1	**CONSTRUCTION (D-B Value)**	$ 1,068	**$ 1,814**	$ 1,135	**$ 1,192**	**$ 679**	**$ 622**
2	**REAL ESTATE**	$ 113	**$ 113**	$ 113	**$ 113**	**$ -**	**$ -**
3	**VEHICLES**	$ 166	**$ 166**	$ 183	**$ 183**	**$ (17)**	**$ (17)**
4	**PROFESSIONAL SERVICES**	$ 393	**$ 393**	$ 415	**$ 415**	**$ (22)**	**$ (22)**
5	**UNALLOCATED CONTINGENCY**	$ 252	**$ 252**	$ 182	**$ 182**	**$ 70**	**$ 70**
6	*CURRENT CM/GC CONSTRUCTION CONTRACTS*			*$ 203*	*$ 203*		
7	**TOTAL** (with no Additional Funding Considerations)	$ 1,992	**$ 2,738**	$ 2,231	**$ 2,288**		

GREEN LINE EXTENSION PROJECT
PROJECT DELIVERY CHARETTE
APRIL 13, 2016

PROPOSED AGENDA

1)	Welcome and Introduction	Jamey Tesler	8:30 to 8:35 a.m.
2)	Scope of Work Update on the status of the project re-definition process When will there be adequate definition to prepare the Draft Request for Proposals? What could some early work packages be? When do we need to issue Notice(s) to Proceed?	IPMT	8:35 to 9:00 a.m.
3)	Funding and Finance Discuss cost estimate development Identification of funding sources Identification of gaps that may require private financing, if any	IPMT	9:00 to 9:15 a.m.
4)	Decision-Making Process	Nossaman	9:15 to 9:30 a.m.
5)	Project Goals	Nossaman	9:30 to 9:35 a.m.
6)	Contract Packaging Review of MBTA re-examination of contract packaging Suggestions to maximize economies of scale Review potential early work packages Recommendation	 Nossaman IPMT	 9:35 to 10:00 a.m. 10:00 to 10:20 a.m.
7)	Project Delivery Options Review of 2012 analysis Review of MBTA re-examination of project delivery options Recommendation	Nossaman	10:20 to 10:50 a.m.
	BREAK		
8)	Implementation Plan Review of Potential Procurement Schedule Mitigating challenges	Nossaman	11:15 a.m. to 12:30 p.m.
9)	Immediate Action Items 30-day 60-day 90-day	Nossaman	12:30 to 1:00 p.m.

Contract Packaging

Criteria	Separate IGMP 4, 5, 6, 7	Single Contract	IGMP 4&5 / IGMP 6&7	Package By Discipline
1. Maximize Cost Efficiencies	- Least economies of scale	- Most economies of scale	- Some economies of scale	- Least economies of scale
2. Maximize Cost Certainty	- Most owner retained interface risks that could lead to claims and change orders	- Least owner retained interface risks that could lead to claims and change orders	- Some owner retained interface risks that could lead to claims and change orders	- Most owner retained interface risks that could lead to claims and change orders
	- Low initial cost certainty because many contracts still need to be priced	- Most initial cost certainty because all remaining work priced simultaneously	- Some initial cost certainty by reducing the number of contracts that need to be priced	- Low initial cost certainty because many contracts still need to be priced
	- Most opportunity to package early or advanced owner-provided work to avoid claims and change orders for owner delay	- Least opportunity to package early or advanced owner-provided work to avoid claims and change orders for owner delay	- Some opportunity to package early or advanced owner-provided work to avoid claims and change orders for owner delay	- Some opportunity to package early or advanced owner-provided work to avoid claims and change orders for owner delay
3. Minimize Interface Risk	- Most contracts result in highest interface risk	- Fewest contracts result in lowest interface risk	- Fewer contracts reduce the interface risk	- More contracts result in higher interface risk
4. Reduce Administrative Cost	- Most required staff (in-house/consultants)	- Least required staff (in-house/consultants)	- Less required staff (in-house/consultants)	- More required staff (in-house/consultants)

Project Delivery Options

- December 2015 MBTA re-examined project delivery options
  - Goals were revisited:
    - Maximize cost efficiencies
    - Maximize cost certainty
    - Minimize interface risk
    - Reduce administrative costs
    - Preserve modal choice
    - Comply with FEIR/EA and FFGA
    -

Criteria	Design-Bid-Build	Design Build	Construction Management at Risk
1. Maximize Cost Efficiencies	- Competitive selection: lowest responsible bidder	- Competitive selection: best value	- Competitive selection: mainly on qualifications
	- Owner retains significant risks; maintains commensurate contingency	- Owner shifts selected risks; requires smaller owner contingency	- Proper risk identification; open book negotiation can minimize contingencies
	- Prescriptive specifications ; minimal contractor innovation	- Opportunities for innovation; ATCs can lead to significant cost savings; less prescriptive specifications permit design-builder innovation	- Early contractor involvement can lead to cost savings through design and constructability reviews
2. Maximize Cost Certainty	- Initial construction costs fixed at 100% design	- Design and construction costs fixed well before 100% design	- Initial construction costs fixed at 100% design and after GMP negotiation complete
	- Conventional risk allocations can lead to greater risk of claims and change orders; less cost certainty after award	- Risk shifting to design-builder maximizes cost certainty by reducing risk of claims and change orders	- Risk reduction through contractor participation in collaborative design and constructability review process increases cost certainty
	- Owner controls design to ensure plans produce construction within budget	- Single source of responsibility for design and construction	- Contractor manages subcontractors to complete work within or under GMP
3. Minimize MBTA-Retained Risks	- Standard risk allocations result in greater risk of claims and change orders	- Design-builder as single point of responsibility reduces owner risk	- Risk reduction through contractor participation in collaborative design and constructability review process
	- MBTA and MassDOT routinely deliver projects using design-bid-build	- Large design build projects will require specific experience and training to properly manage	- Large CMAR projects will require specific experience and training to properly manage
4. Reduce Administrative Cost	- Most required staff (in-house/consultants)	- Least required staff (in-house/consultants)	- More required staff (in-house/consultants)

EXAMPLES OF TRANSPORTATION DESIGN-BUILD PROJECTS (NATIONAL)

Project Owner	Project Name	Affordability Limit
Alameda Corridor Transportation Authority	Mid-Corridor Trench	
Arizona Department of Transportation	South Mountain Freeway (Design-Build-Maintain)	Yes (through a maximum allowable cumulative draw schedule)
California High Speed Rail Authority	Fresno-to-Bakersfield Segment (Contract Packages 1 and 2-3)	
Central Puget Sound Regional Transit Authority (Sound Transit)	South-Link Extension	
Chesapeake Bay Bridge and Tunnel District	Parallel Thimble Shoal Tunnel	
Colorado Department of Transportation and Regional Transit District (Denver RTD)	T-Rex	Yes (including additive options)
District of Columbia Department of Transportation	South Capitol Street Corridor Project	
Honolulu Authority for Rapid Transit	Honolulu High Capacity Transit Corridor	
Indiana Finance Authority	I-69 Major Moves 2020 Expansion Project	
Los Angeles County Metropolitan Transportation Authority (LACMTA)	Metro Gold Line	
Louisiana Department of Transportation and Development	I-10	
	I-12 Widening Project (Phase 1)	
	I-12 Widening Project (Phase 2)	Yes
	I-49	
	John James Audubon Bridge	
	US 90/LA 85 Interchange	
	US 90/LA 318 Interchange	
Metropolitan Transit Authority of Harris County, TX (Houston Metro)	Metro Solutions Phase 2	
Metropolitan Washington Airports Authority	Dulles Corridor Metrorail Project Phase 1	
	Dulles Corridor Metrorail Project Phase 2	
Minnesota Department of Transportation	Hiawatha Light Rail Transit	Yes (including additive options)
Nevada Department of Transportation	I-80 Corridor	
	Project Neon	
	USA Parkway (SR 439)	
New York State Thruway Authority	Tappan Zee Bridge	
Orange County Transportation Authority	I-405 Improvement Project	
Port of Long Beach	Gerald Desmond Bridge	Yes
Riverside County Transportation Commission	SR 91 Express Lanes	
	I-15 HOT Lanes	
Santa Clara Valley Transportation Authority (VTA)	BART Silicon Valley Berryessa Extension	
Texas Department of Transportation	Border West Expressway (D-B-M)	
	SH 130 Segments 1 – 4 (D-B-M)	
	DFW Connector	
	Grand Parkway Segments F and G	

Project Owner	Project Name	Affordability Limit
	Grand Parkway Segments H and I	
	Highway 161	
	I-35E Managed Lanes (D-B-M)	Yes
	SH 249 (D-B-M)	
	SH 360 (D-B-M)	
	U.S. 181 Harbor Bridge Replacement (DBOM)	
Utah Department of Transportation	I-15 CORE	Yes
	I-15 POINT	
Utah Transit Authority	Draper TRAX Line (Blue Line)	
	Medical Center Extension	
	Mid-Jordan TRAX Line (Red Line)	
	University TRAX Line	
Virginia Department of Transportation	Coalfields Expressway	
Washington State Department of Transportation	Alaskan Way Viaduct Replacement	

April 28, 2016

Mary Beth Mello, Regional Administrator
Federal Transit Administration
Region 1
55 Broadway, Suite 920
Cambridge, MA 02142-2055

Dear Ms. Mello,

As you are aware, the Massachusetts Department of Transportation (MassDOT) and the Massachusetts Bay Transportation Authority (MBTA) are undertaking a reevaluation of the Green Line Extension (GLX) project in order to substantially reduce the cost of the project while still maintaining its core benefits and functionality. Since December 2015, a multidisciplinary Interim Project Management Team (IPMT) has worked closely with the Federal Transit Administration (FTA) and your Project Management Oversight Contractor (PMOC), as well as with the three GLX corridor municipalities, key corridor landowners, and a wide range of project stakeholders both within and outside of the MBTA. The FTA has been a steady and supportive partner throughout these efforts, for which I am grateful.

While the IPMT is proposing significant modifications to some aspects of the original project design – including the stations, corridor retaining walls, a vehicle maintenance facility, and a multiuse path – the IPMT has been guided throughout its efforts by a commitment to preserving the essential project scope, benefits, and mitigation commitments made during the planning and environmental review processes. In particular, the IPMT has used the framework of the Full Funding Grant Agreement to define the limits of what can be modified in the interests of cost-reduction.

This letter describes the results of the IPMT effort and provides an overview explanation of how the revised design of the Green Line Extension project will meet the expectations of FTA for a fully functioning project that will deliver the ridership and other benefits originally promised. We understand that formal FTA review would come later, but wanted to share with you now our findings to date and provide our assurance that the revised GLX project will continue to meet the original purpose and need of the project.

Redesign and Re-Costing Efforts

The IPMT has identified significant cost reductions to be found through modification of project scope elements, including:

- Redesign of the stations in order to transform them from over-sized enclosed structures to open-air platforms akin to what has been in use for decades on the existing surface Green Line.

- A substantially reduced vehicle maintenance facility, which will provide light maintenance and storage for the additional vehicles required to operate the Extension.
- Preservation of a number of bridges along the GLX corridor that were originally slated to be replaced, as well as the reduced reconstruction of others.
- An alternative version of the multiuse Community Path.
- An alternative and simplified version of the Lechmere viaduct.
- Modifications to retaining walls to reduce height and simplify construction.
- Modifications to the power distribution system, including traction power substations at Red Bridge, Gilman Square, and Ball Square.
- An alternative construction plan and schedule that would allow a construction contractor greater and more flexible access to the work area.
- A reduced construction scope, which could reduce the overall project schedule and risk profile.

In all cases, the IPMT is collaborating with the relevant MBTA operating divisions to ensure that any design changes would not fundamentally compromise the ultimate functionality and promised public benefits of the Extension.

A comparison of the original and revised design of the project scope items is attached.

Maintenance of Core Functionality and Project Benefits

The proposed redesign maintains the functionality and essential purpose of the Project, consistent with the Full Funding Grant Agreement and the New Starts project ratings that supported its award. As with the original project design, the revised design consists of a 4.3-mile extension of the existing MBTA Green Line light rail service to College Avenue in Medford and Union Square in Somerville, relocating Lechmere Station, and providing six new light rail stations in the same locations as originally envisioned. The stations will have the same size platforms as originally proposed and will therefore be able to serve the same number of passengers as originally anticipated. The redesigned project also includes the construction of a smaller vehicle storage and maintenance facility with the capacity to provide light maintenance and storage for 44 vehicles. Heavy maintenance activities will be accomplished at the existing Riverside and Reservoir maintenance facilities. The 24 light rail vehicles required for the extension of Green Line service have already been procured.

We understand that the FTA New Starts project justification criteria for the evaluation and rating process – including mobility improvements, environmental benefits, congestion relief, and cost-effectiveness – are largely dependent on the number of transit trips produced by the project. Factors which influence potential trip generation include (1) the number and location of stations, (2) platform size, (3) span of service, and (4) service frequency are the same in the redesign concept as was originally proposed. The Green Line Extension service as redesigned will still provide six-minute headways in the weekday peak period, with service every 8 to 11 minutes in the weekday off-peak

period. Service will be provided every 13 to 14 minutes on weekday evenings, and every 8 to 10 minutes on weekends. The station locations, platform size, and functionality remain unchanged.

Given that the basic functionality and service plan are the same, we are confident that the Green Line Extension redesign concept project will achieve the same forecasted ridership of 37,900 daily linked transit trips[2], and therefore the same project benefits. In addition, the New Starts economic development and land use benefits associated with the stations remain unchanged.

It should be noted that the IPMT has found a way to continue to include a multiuse path as part of the revised project concept, even though we recognize that the Community Path was not considered as a factor in New Starts' process in determining the core project benefits nor in estimating the number of future transit trips anticipated for the GLX project.

Consistency with Environmental Mitigation Commitments

As required by the Full Funding Grant Agreement, MassDOT and the MBTA are fulfilling the environmental mitigation requirements developed with stakeholder input through the Environmental Assessment (EA) process and documented in the Finding of No Significant Impact. As part of the redesign process, the IPMT is re-evaluating the cost-effectiveness of noise barriers as a mitigation measure, and is proposing sound insulation as an alternative measure in certain locations to achieve the same mitigation result at lower cost. We understand that FTA would need to concur with the use of alternative mitigation measures, and we look forward to working with you on this.

In addition, we are partnering with the City of Somerville to assist in the implementation of mitigation measures, whereby the City would take responsibility for constructing traffic and pedestrian improvements on city streets adjacent to the stations. This is similar to the exiting mitigation commitment for traffic and pedestrian improvements in Cambridge, where the developers of the NorthPoint project are taking on the responsibility of improvements on city streets around Lechmere Station.

The EA contains a commitment to, "complete the final design for the proposed Somerville Community Path between Lowell Street and the Inner Belt area." This design has been completed, meaning that MassDOT/MBTA have met the EA commitment. Nevertheless, the Community Path was intended to be constructed along with the GLX project, with the Path interwoven with the larger GLX rail corridor design. Given the nature of the original design, the Path become extremely costly to construct due to the incremental height of retaining walls and viaduct structure designed solely to support the Path. Because of this, the order of magnitude cost of the Path as originally designed was in the range of $100 million, based on a cost comparison prepared by the IPMT. An alternative, simplified Community Path concept has been developed by the IPMT that reduces the structures

[2] MBTA, *Green Line Extension Project, FY 2016 New Starts Update and Full Funding Grant Agreement Support Material*, New Starts Travel Forecasts Template, Fall 2014.

required to support the Path and the time required to build it. We believe that the cost of the alternative Path concept is approximately $20 million.

In closing, I would like to reiterate my gratitude to you and your colleagues at FTA for your patience, support, and time as MassDOT and the MBTA have undertaken the Green Line Extension Review. I look forward continuing our close collaboration with FTA as we work towards a resolution on the project. I hope that you will not hesitate to let me know if you have any questions or concerns.

Sincerely,

Stephanie Pollack
Secretary and CEO

May 9, 2016

Stephanie Pollack

Secretary of Transportation and Chief Executive

Massachusetts Department of Transportation

10 Park Plaza

Boston, Massachusetts 02116

Re: Letter of Intent – Green Line Extension Financial Contribution

Secretary Pollack:

For many years, the City of Cambridge has been a strong supporter of the relocation of Lechmere Station
and the Green Line Extension (GLX) from Cambridge to Somerville and Medford. The purpose of the GLX project is to improve regional air quality, encourage sustainable growth, promote economic development, and provide a convenient means of public transportation for residents, employees, and visitors along the GLX corridor. This project will benefit the three municipalities it touches as well as the
entire Greater Boston region and the Commonwealth of Massachusetts. This Letter of Intent (LOI), which
I am submitting to the Massachusetts Department of Transportation (MassDOT) Board of Directors and the Massachusetts Bay Transportation Authority (MBTA) Fiscal and Management Control Board, is intended to set forth the terms and conditions that I, as the City Manager of the City of Cambridge, intend
to discuss with and recommend to the Cambridge City Council as the basis for the City of Cambridge to commit to contributing to the construction costs associated with the GLX, to the extent legally permissible, and subject to City Council approval and appropriation of funds.

While the Commonwealth's appeal for local funding contributions at this late stage in the project represents an extraordinary request, I believe that the value of this project to the City of Cambridge, the
Boston Region, and the entire state requires us to respond in a meaningful way to help move this project
towards reality. I also intend to work with the North Point developers to obtain commitments from them
to contribute financially to the GLX in partnership with the City.

The Green Line Extension Project

The City of Cambridge supports the GLX and I will recommend that the City Council approve the City contributing an amount that the City Council considers to be a fair and reasonable amount to assist in offsetting the cost of the project, in partnership with the Federal Government and the Commonwealth of
Massachusetts, based upon the proposed total budget for the project and the proportionality of Cambridge's monetary contributions of new revenue thereto, the City's reasonable financial capabilities,

the contributions of new revenue from the other municipalities the GLX touches, and assurance that the
project will commence as scheduled and continue reasonably to completion.

GLX will comprise seven Green Line stations. The project will relocate Lechmere Station and create a new Green Line station in Union Square in Somerville. Five additional stations will also be built outside of Cambridge, between Lechmere Station and College Avenue in Medford along existing railroad rights of way.

The GLX stations will be designed in accordance with MassDOT/MBTA station requirements. MassDOT will obtain all necessary legal approvals for the GLX and its operations from any local, state, or federal agencies. The GLX will be constructed in accordance with a construction management plan approved by
MassDOT, and will be operated and maintained by the MBTA. Service, at a minimum, will include stops on both inbound and outbound trains during standard MBTA service hours. MassDOT will be responsible
for compliance with all state procurement requirements, public bidding laws, and any other laws applicable to MassDOT due to its governmental status. In making this financial contribution to MassDOT/MBTA's construction of Lechmere Station and the other improvements that are part of the GLX project, the City does not commit to taking on any additional responsibilities related to the planning,
design, construction, operations, or maintenance of any GLX facilities.

Value of Financial Contribution

I intend to recommend to the Cambridge City Council that the City contribute fair and reasonable funding, as set forth in this letter, to support the GLX project and to help close the currently anticipated
budget gap that remains after the project is value engineered, in the event that all other efforts to procure
and employ federal and state funds for the project have been exhausted and a gap remains that can only be
addressed with monetary contributions from Cambridge, North Point developers in Cambridge, and other
municipalities. The financial contribution will be based upon the value of the infrastructure improvements
in Cambridge and the economic, environmental, and mobility benefits those improvements create, and will be subject to the requirement that other municipalities contribute their reasonably proportionate share
of new revenue required for the gap funding.

I am prepared to enter into discussions with the Cambridge City Council and the North Point developers
to seek their approval for the City to contribute up to $25,000,000 of new revenue towards the completion
of the GLX project, in the manner described below. The exact nature, timing, and form of this contribution is still to be determined, but it will represent new revenue to the project that will directly contribute to closing the funding gap together with proportionate contributions of new revenue from other
municipalities that the GLX project will touch. The contribution from Cambridge-based sources will make up not more than one third (1/3) of the total amount of new revenue that is provided from the municipalities of Cambridge, Somerville, and Medford for the gap funding.

Use of Financial Contribution

This $25,000,000 commitment of new revenue from Cambridge-based sources will be used solely for the
construction of the project-related improvements within the City of Cambridge, including the new and relocated Lechmere Station that will be built as part of the GLX. MassDOT and the MBTA will work with the City of Cambridge to establish a mechanism to ensure that the funds are used in this manner, and
will ensure that any expenditure of those funds will be for the GLX project only and consistent with the terms and conditions outlined in this letter.

Payment Mechanism

Assuming the Cambridge City Council and the North Point developers commit to contributing to the GLX project as outlined above, the City of Cambridge will work with MassDOT, the MBTA, and other relevant state agencies to develop mechanisms for disbursing the agreed upon funds and committing those
funds to the Commonwealth for the GLX project. These mechanisms could include direct cash contributions, state borrowing backed by guaranteed payments from the City of Cambridge (through the
Cherry Sheet or other appropriate mechanism), or other similar mechanisms for payments from the City
of Cambridge or the North Point developers. Over the course of those discussions, I expect to reach agreement with MassDOT and/or the MBTA on the amount to be paid, the period and frequency of payment, the mechanism of payment, and any regulatory or statutory changes that may be necessary to
accomplish the foregoing. The City of Cambridge expects the Commonwealth to stipulate that any funding provided by the City will not be transferable to any state expenditure other than those directly related to those portions of the GLX project that are constructed within the City of Cambridge and that the
City of Cambridge's share of new revenue provided for the gap funding is not more than one third (1/3) of the total amount of new revenue provided by all municipalities for the gap funding. To the extent that
any regulatory changes or special legislation is required at the state level to enable a specific payment mechanism, I expect MassDOT, the MBTA, and other state agencies to pursue said regulatory changes or
special legislation in an expedited manner.

Local Approval

After a preliminary agreement between the City of Cambridge and MassDOT is reached regarding the elements describe above, and after the final adoption of any necessary regulatory or statutory actions, the
City will have an additional period to obtain the legally mandated and/or otherwise required local public
approval, as well as completing negotiations with the North Point developers resulting in their approval of
funds to be contributed to the GLX project, prior to the execution of any final agreement. Should the City

of Cambridge not approve or obtain those approvals, the City will not be held responsible for any financial contributions or other commitments.

Priority in Use of Funds

I would like to be explicit that my objective in providing this letter is to indicate my commitment for Cambridge and the North Point developers to take the above steps only in the event that all other federal
and state funding sources have been explored and that but for monetary contributions of new revenue from the City of Cambridge, the North Point developers and the other municipalities, there is a gap in the
federal and state funding for the project that cannot be filled by any other means. In the event that the Cambridge City Council and the North Point developers approve this funding and the project costs turn out to be less than anticipated at this juncture, I also expect the City of Cambridge to be relieved of a portion of that funding commitment in a fair and proportional manner. To ensure this outcome, the funding provided from Cambridge-based sources will only be accessed once MassDOT and the MBTA have provided appropriate assurances that Cambridge's contribution of new revenue to the gap funding is
partially or wholly necessary proportionately with other municipal funding sources of new revenue in order to construct the project and that the project-related improvements in Cambridge have been or will
be fully completed in a manner that enables service to the relocated Lechmere station to commence operations.

Future State Policy

To my knowledge, never before has a municipality or group of municipalities in Massachusetts been asked to assume a portion of the cost of a large infrastructure project. Traditionally the state and federal governments have worked together to fund these projects, and to address cost overruns, with an understanding that municipalities in Massachusetts have a limited ability under Massachusetts law to raise new revenue or to dedicate local funding to costs outside of routine municipal services such as education, public safety, public health, and local infrastructure. Given the Commonwealth's request for municipal funding contributions for the GLX, it will be an important factor in Cambridge's decision as to whether to contribute municipal funding to this project that there be appropriate assurances that when future infrastructure projects face similar funding circumstances, the local municipalities will be treated in a similar manner with respect to expected financial contributions.

Legal Authority

I commit to work with MassDOT and the MBTA toward entering into a final agreement by September 30, 2016. In advance of a final and binding agreement to contribute funds to the GLX, I require assurances that the Commonwealth of Massachusetts and the MBTA have the legal authority to accept such funds and expend them according to the requirements and expectations set forth in this letter and any subsequent agreements between the parties referred to herein. To the extent that any special legislation or regulatory action is required at the state level to enable or ensure this legal authority, I expect MassDOT, the MBTA, and other state agencies to pursue said special legislation or regulatory action in an expedited manner.

I look forward to continuing to work together with you, the MassDOT Board of Directors, and the MBTA Fiscal and Management Control Board to advance this important project.

Very truly yours,

C:\Users\mcarvello\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Outlook\PZSDLCBL\Rich signature (002).jpg
Richard C. Rossi

City Manager

Performance Measure/Objective

Redesigned GLX Cost Center	Estimate Methodology Description
Lowell Line, Union Line, New Hampshire Line, and Fitchburg Line Rail Corridors	
Track Retaining Walls Earthwork Drainage Bridges Systems/Power Noise Walls Pathway	ICE DECONSTRUCTION – Review and adjust previous iGMP4 Independent Cost Estimate. Project Forward to similar iGMP5 redesigned scope.
Viaduct Crossing Section	
Vehicle Maintenance Facility	Major Commodity / Assembly Unit Price
Stations	Major Commodity / Assembly Unit Price & Similar Historic Comparisons (Stations)
General Conditions, Overheads & Indirects	Full Independent Assessment/Detailed Line Items—Adjusted to New GLX.
Escalation & Contingencies	Full Independent Assessment/Detailed Line Items—Adjusted to New GLX.

Marc Draisen's motion

Seconded by Jim Gillooly,

The Boston Region MPO votes to send out for a 30-day period of public comment its intention to move the funding currently programmed for the Green Line Extension GLX from College Avenue to Route 16 to the first phase the GLX from Lechmere Station to College Avenue. This 30-day period will allow for a revised scope, procurement method, and budget to be provided to the MPO to confirm the necessity of these funds to be reprogrammed.

In doing so the MPO recognizes and incorporates into the record of this vote the commitment by the Secretary of MassDOT to file by December 31, 2016 an environmental notification form under the Massachusetts Environmental Protection Act (MEPA) for the second phase of the GLX from College Avenue to Route 16 in Medford, and after such filing to carry forward the MEPA review process to its conclusion, so long as the Lechmere to College Avenue portion of the GLX continues to go forward.

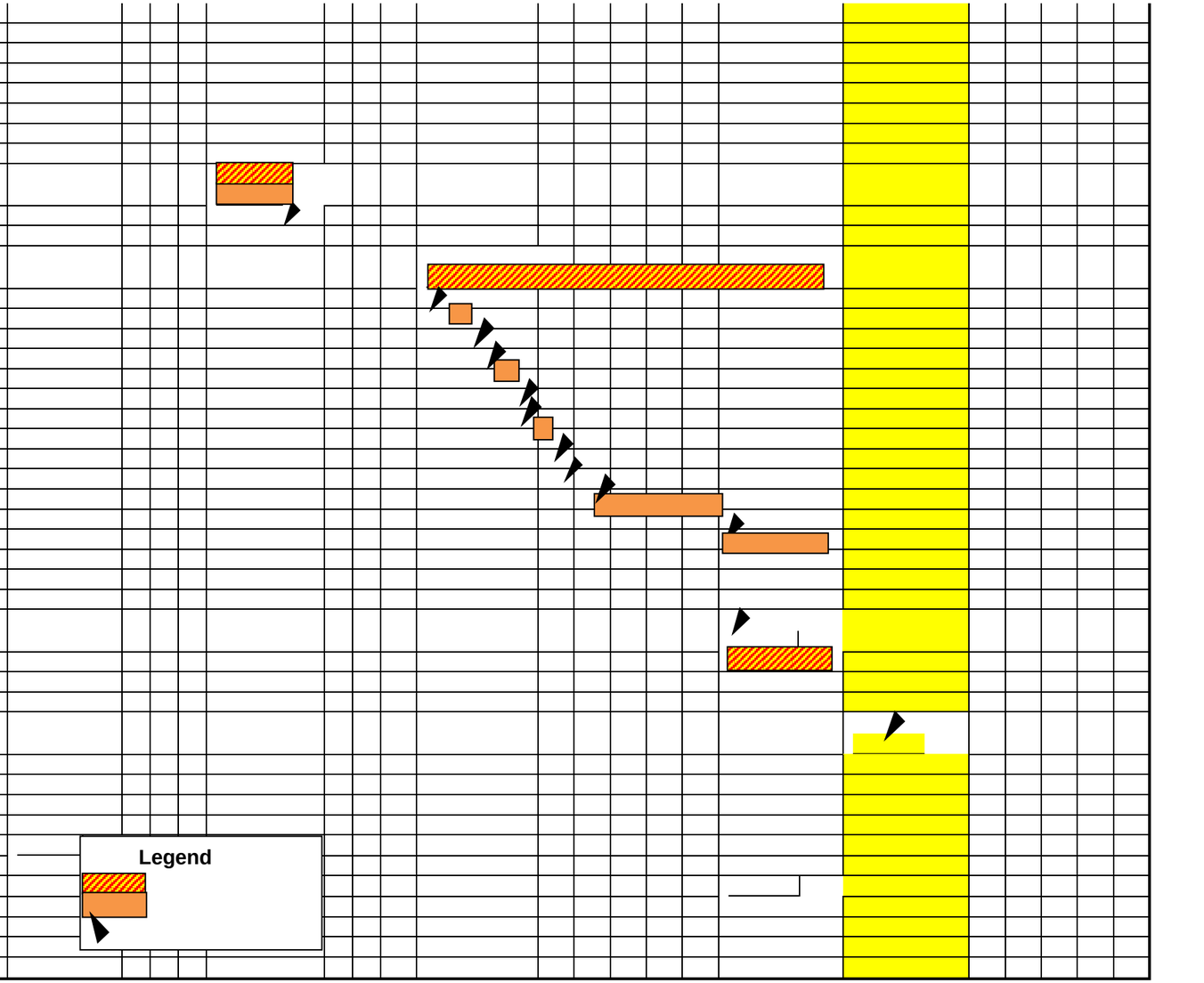
Construction Schedule Considerations

Schedule Scenario	2016				2017				2018				2019				2020				2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Previous Project																																
Trend Baseline (Sept 2015 adjusted to new start)									64 months																							
Base Redesign: Procurement additions, Design, Scope, Logic Fixes									Design				51 months																			
Recommended: Weekends, Procurement additions, Design, Scope, Logic Fixes									Design				42.7 months																			
Night Time Work: Additional Schedule Optimization: Recommended Plus selected night working									Design				42.7 months																			
Summer Shutdowns: Additional Schedule Optimization: Recommended Plus selected night working and Summer Shutdowns									Design				42.7 months																			

Green Line Extension Design Build Procurement Schedule - DRAFT
(post Financial Plan approval)

Step	Activity	Months																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	FTA FINANCIAL PLAN APPROVAL																							
2	ORGANIZATIONAL CONFLICT OF INTEREST GUIDANCE																							
3	ORGANIZATION AND CAPACITY																							
3a	Develop the Project Management Plan																							
3b	Core team retained																							
3c	Execution of the PMP																							
4	RISK WORKSHOP																							
4a	Prepare Risk Workshop Materials																							
4b	Hold Risk Workshop																							
5	PRE-PROCUREMENT FORUM																							
5a	Book Location for the Forum																							
5b	Prepare RFLOI & Notice of Forum																							
5c	Prepare Questions for Inclusion in the Notice																							
5d	Prepare DBE Policy																							
5e	Prepare Agenda for the Forum																							
5f	Identify Speakers for the Forum																							
5g	Prepare Presentation for Forum																							
5h	Create and Populate E-Data Room																							
5i	Issue RFLOI & Notice of Forum																							
5j	LOI Due Date																							
5k	Hold Pre-Procurement Forum																							
5l	Hold DBE Networking Event																							
5m	Hold One-on-One Meetings																							
6	REQUEST FOR QUALIFICATIONS																							
6a	Prepare Draft RFQ																							
6b	Identify Selection Committee Members																							
6c	Issue RFQ																							
6d	Prepare SOQ Evaluation Manual																							
6e	Book Secure Space for Evaluations/Documents																							
6f	Selection Commmittee Training																							
6g	Statements of Qualifications Due																							
6h	SOQ Evaluations																							
7	DRAFT REQUEST FOR PROPOSALS																							
7a	Develop Draft Instructions to Proposers																							
7b	Develop Draft Contract Documents																							
7c	Develop Draft Technical Provisions																							
7d	Draft One-on-One Meeting Protocols																							
7e	Draft Alternative Technical Concept Procedures																							
7f	ATC Review Training																							

7g	Issue Draft RFP and Begin ATC Process
7h	Short-List Review of Draft RFP & ATC Development
7i	Prepare Proposal Evaluation Manual
7j	1st Round One-on-One Meetings & ATC Review
7k	2nd Round One-on-One Meetings & ATC Review
7l	Proposer Comments on Draft RFP Due
7m	Revise RFP
8	SHORT-LISTING
8a	Draft Work Product Letter Agreement
8b	Announce Short-List
9	FINAL RFP
9a	Issue RFP
9b	1st Round One-on-One Meetings & ATC Review
9c	Issue Addendum
9d	Final ATC Submission Date
9e	2nd Round One-on-One Meetings & ATC Review
9f	Issue Addendum
9g	Issue Final ATC Responses
9h	3rd Round One-on-One Meetings
9i	Issue Final Addendum
9j	Selection Committee Training
9k	Proposals Due
9l	Proposal Evaluations
9m	Price Proposal Opening
9n	Negotiations
10	AWARD RECOMMENDATION
11	CONTRACT EXECUTION
12	NOTICE TO PROCEED



Project Delivery Options

- In December 2015 MBTA re-examined project delivery options
  - Goals were revisited:
    - Maximize cost efficiencies
    - Maximize cost certainty
    - Minimize interface risk
    - Reduce administrative costs
    - Preserve modal choice
    - Comply with FEIR/EA and FFGA

Criteria	Design-Bid-Build	Design Build	Construction Management at Risk
1. Maximize Cost Efficiencies	- Competitive selection: lowest responsible bidder	- Competitive selection: best value	- Competitive selection: mainly on qualifications
	- Owner retains significant risks; maintains commensurate contingency	- Owner shifts selected risks; requires smaller owner contingency	- Proper risk identification; open book negotiation can minimize contingencies
	- Prescriptive specifications ; minimal contractor innovation	- Opportunities for innovation; ATCs can lead to significant cost savings; less prescriptive specifications permit design-builder innovation	- Early contractor involvement can lead to cost savings through design and constructability reviews
2. Maximize Cost Certainty	- Initial construction costs fixed at 100% design	- Design and construction costs fixed well before 100% design	- Initial construction costs fixed at 100% design and after GMP negotiation complete
	- Conventional risk allocations can lead to greater risk of claims and change orders; less cost certainty after award	- Risk shifting to design-builder maximizes cost certainty by reducing risk of claims and change orders	- Risk reduction through contractor participation in collaborative design and constructability review process increases cost certainty

	- Owner controls design to ensure plans produce construction within budget	- Single source of responsibility for design and construction	- Contractor manages subcontractors to complete work within or under GMP
Criteria	**Design-Bid-Build**	**Design Build**	**Construction Management at Risk**
3. Minimize MBTA-Retained Risks	- Standard risk allocations result in greater risk of claims and change orders	- Design-builder as single point of responsibility reduces owner risk	- Risk reduction through contractor participation in collaborative design and constructability review process
	- MBTA and MassDOT routinely deliver projects using design-bid-build	- Large design build projects will require specific experience and training to properly manage	- Large CMAR projects will require specific experience and training to properly manage
4. Reduce Administrative Cost	- Most required staff (in-house/consultants)	- Least required staff (in-house/consultants)	- More required staff (in-house/consultants)