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Item No. 8.1
Transportation Standing Committee
October 24, 2019

TO: Chair and Members of Transportation Standing Committee

SUBMITTED BY: Original Signed

Dave Reage, Director, Halifax Transit

Original Signed

Chief Stuebing, Acting Chief Administrative Officer

DATE: June 21, 2019

SUBJECT: **Halifax Transit Moving Forward Together Plan (MFTP) Corridor Routes Review**

INFORMATION REPORT

ORIGIN

At the June 20, 2017 meeting of Halifax Regional Council, the following motion was put and passed:

> That Halifax Regional Council request that staff engage a consultant to prepare a report including travel time mapping in 18/19 that outlines any recommended modifications to Corridor Routes, as shown in the Moving Forward Together Plan. The report is to consider new or updated data, specifically including ridership data, as well as the findings of the following studies/projects:
>
> - The Integrated Mobility Plan;
> - The Bus Rapid Transit Feasibility Study;
> - The Mumford Terminal Replacement Opportunities Assessment; and
> - The Transit Priorities Corridor Study.

LEGISLATIVE AUTHORITY

Section 69(1) of the Halifax Regional Municipality Charter provides the legislative authority for the municipality to provide a public transportation service. Section 79(1)(o) provides the authority for Council to expend money required by the municipality for public transportation services.

In addition to the Halifax Regional Municipality Charter, authority is also provided by Section T-5 of the 2014 Regional Municipal Planning Strategy which reads “Transit Service Plans shall be prepared at regular

intervals for consideration by HRM. These plans will be developed in consultation with the public and other stakeholders and, upon adoption by HRM, shall provide guidance for investment in transit services."

BACKGROUND

Halifax Regional Council approved the *Moving Forward Together Plan* (MFTP) in April 2016. This plan featured a redesigned transit network with an increased proportion of resources allocated towards high ridership services. As such the network was designed around a hierarchy of routes with route numbers 1-19 reserved for 'Corridor Routes' at the top of the hierarchy. Other principles included: building a simplified transfer-based system, investing in service quality and reliability, and giving transit increased priority in the transportation network. The approved network featured 10 Corridor Routes with several Local Routes identified as long-term candidate Corridor Routes.

The MFTP is being implemented in phases with recent changes made in August and November 2017, and August 2018. Significant changes are also planned for November 2019. All proposed service changes for a given fiscal year are approved by Regional Council through the budget process and by approving the Halifax Transit Annual Service Plan, including those associated with the MFTP.

The MFTP recognised that the planned routes may not remain static throughout implementation. Modifications based on operational needs, demand, integration with land uses, or significant changes to the transportation network would be considered and highlighted in future Annual Service Plans. The implementation of the MFTP will continue throughout the duration of this review, and any significant proposed changes will be reviewed by Regional Council and if approved, reflected in modifications to later phases of implementation and/or retrospective changes to routes already implemented.

The general goal of the Corridor Routes Review was to engage a consultant to recommend modifications to, or retention of, the number and routing of Corridor Routes as set out in the MFTP based on:

- Insight provided by reports and plans completed since the approval of the MFTP in 2016.
- Insight provided by plans under development or consideration.
- Insight from travel time mapping, ridership and on time performance data collected since plan approval.

It is also the intent of this project to provide direction on additional potential network changes which may result from implementation of potential Bus Rapid Transit (BRT) routes identified in the BRT feasibility study and commuter rail proposals.

Scope of Work

The following tasks were undertaken by the consultant over the course of this project:

a) Review implications of recent and current studies on the Corridor Routes identified in the MFTP network, including but not limited to:
    - The recently approved Integrated Mobility Plan, and other HRM plans.
    - Approved and foreseeable transit priority measures.
    - Mumford Terminal Replacement Opportunities Assessment.
    - The Transit Priorities Corridor Study.
    - The draft Centre Plan.

b) Conduct a review of planned and implemented Corridor Routes, including:

- Analysis in relation to new data, including ridership data.
- Complete travel time (isochrone) mapping and associated impact analysis.

c) Review any routing implications of the Bus Rapid Transit (BRT) feasibility study and/or Commuter Rail proposals on Corridor Routes planned in the MFTP and/or any modifications proposed by the proponent as a result of the preceding points.

MFTP Implementation to Date

At the end of March 2019, 20 MFTP Routes or 26% of the total MFTP Routes have been implemented. An additional 19 MFTP Routes or 25% of the total MFTP Routes will be implemented by the end of the 2019/20 fiscal year.

Table 1: MFTP Implementation Summary

Route Phasing	Number of MFTP Routes	Percent of Total MFTP Routes
MFTP Routes Implemented to Date	20	26%
MFTP Routes Planned for Implementation in 2019/20	19	25%
MFTP Routes Yet to be Implemented (after 2019/20)	38	49%
Total MFTP Routes	**77**	**100%**

At time of writing, even with only 26% of MFTP routes implemented, the increase to ridership has been notable across the transit network, with an 8% increase in revenue ridership above pre MFTP implementation figures to date.

Project Award

The MFTP Corridor Routes Review was issued for tender on July 10, 2018. This contract was awarded to Stantec Consulting on August 3, 2018 for an award amount of $66,674.00. Work on this project was initiated in fall 2018 and continued into early 2019. A scope extension was awarded in March 2019 to increase Stantec's scope of work to include further travel time mapping.

DISCUSSION

Soon after project award and kick off, Stantec initiated the review of Corridor Routes, evaluating each route and the network through the lens of each of the new council approved policy documents described above. The following sections will summarize the recommendations made on a route by route basis, and detail the recommendations made by Stantec on the metrics such as service span and frequency.

Corridor Route Network Coverage

Stantec's recommended Corridor Route network includes nine Corridor Routes (as opposed to the 10 Corridor Routes described by the MFTP), including the H-Line, described in greater detail below. but the consultant recommended network offers relatively similar level of coverage, with less redundancy. Figure 1 on the following page demonstrates that corridor route service is provided on the nearly all the same streets in both the MFTP and Stantec's report. There are however minor differences between the two networks. These network wide differences are described below and are captured in Figure 3.

H-Line

In addition to eight Corridor Routes, Stantec proposes that the existing Route 1 and Corridor Route 2 be combined into the H-Line, an enhanced bus service which maximizes the value of existing and planned Transit Priority Measures (TPMs). The H-Line retains a similar structure to that of Route 1 from the MFTP with a few notable differences:

- The route would be extended to Lacewood Terminal and serving Bayers Road Centre. This alignment would not serve Mumford Terminal.
- The H Line is proposed to operate on Robie Street instead of Oxford Street\
- By replacing existing Routes 1 and 2, the consultant recommends that the H Line route operate at frequencies of 5 minutes or less during weekday peak hours.

Further detail in routing differences between the H-Line and MFTP Corridor Routes can be seen in Figures 1 and 2 below.

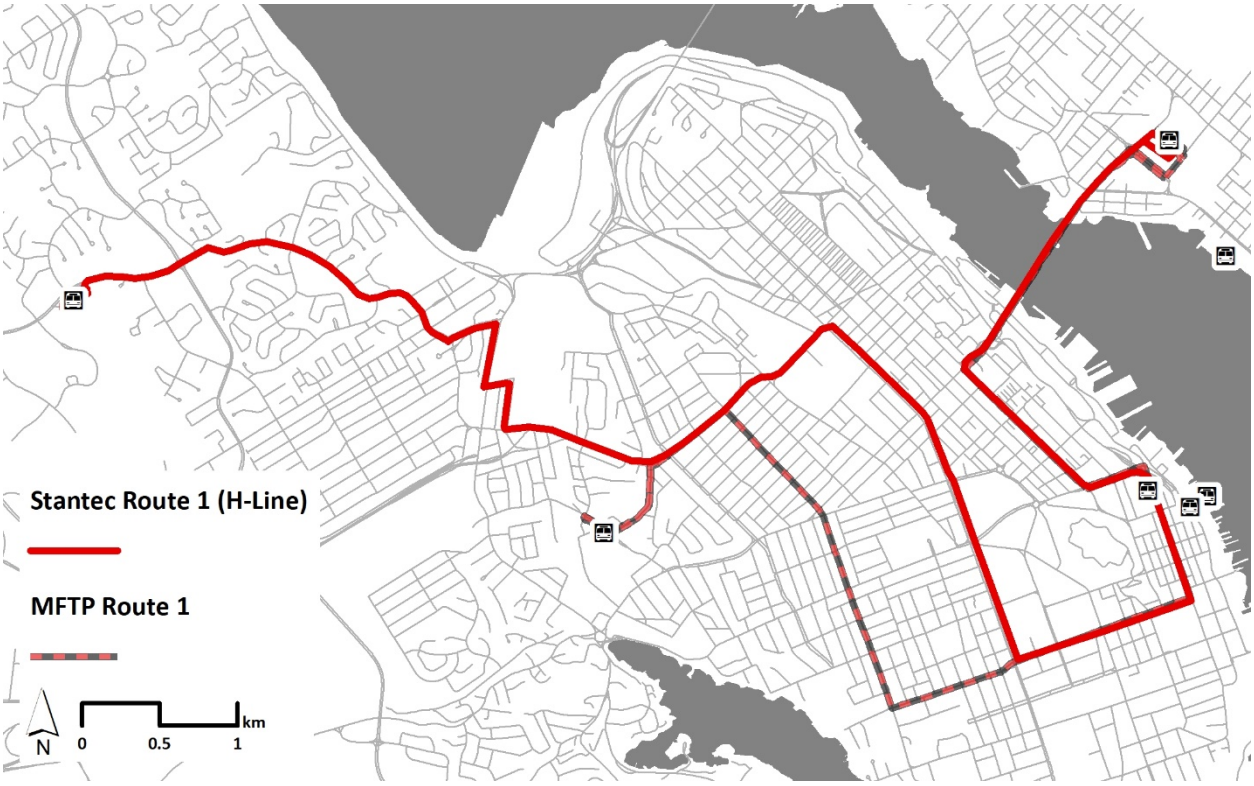


Figure 1: H-Line overlaying MFTP Corridor Route 1

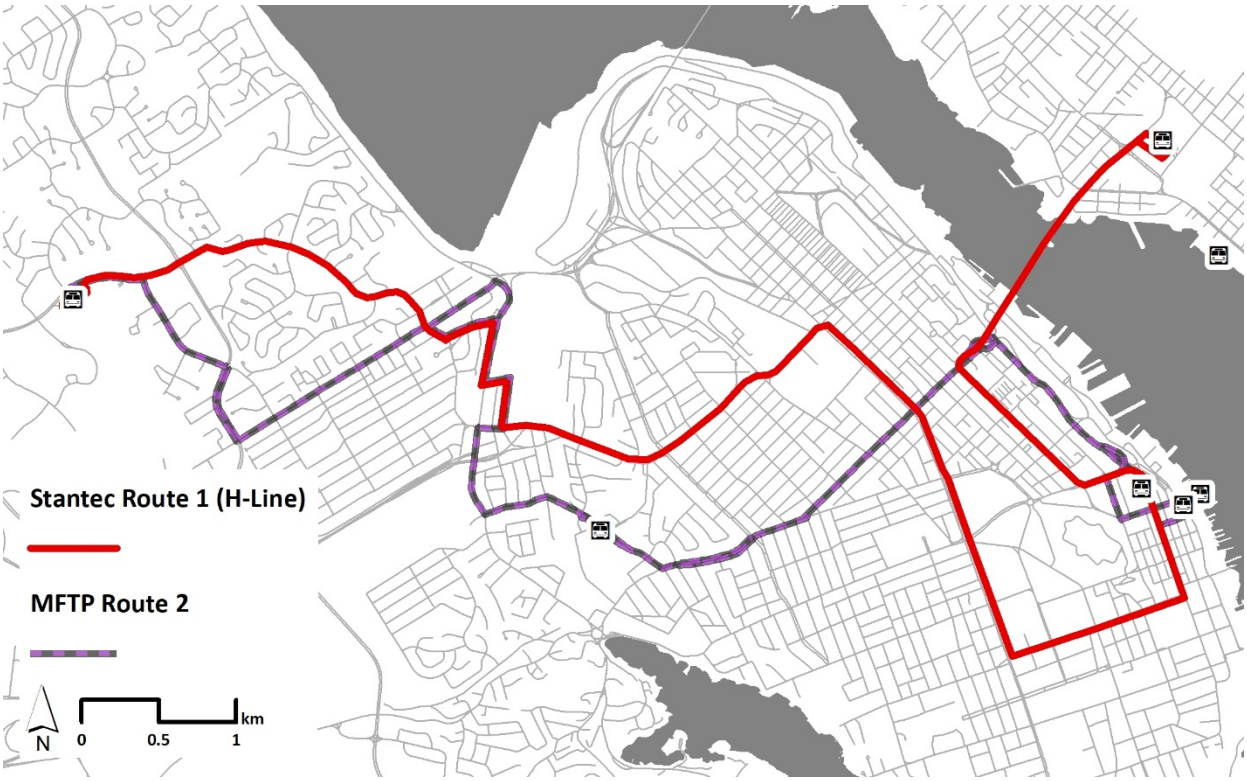


Figure 2: H-Line overlaying MFTP Corridor Route 2

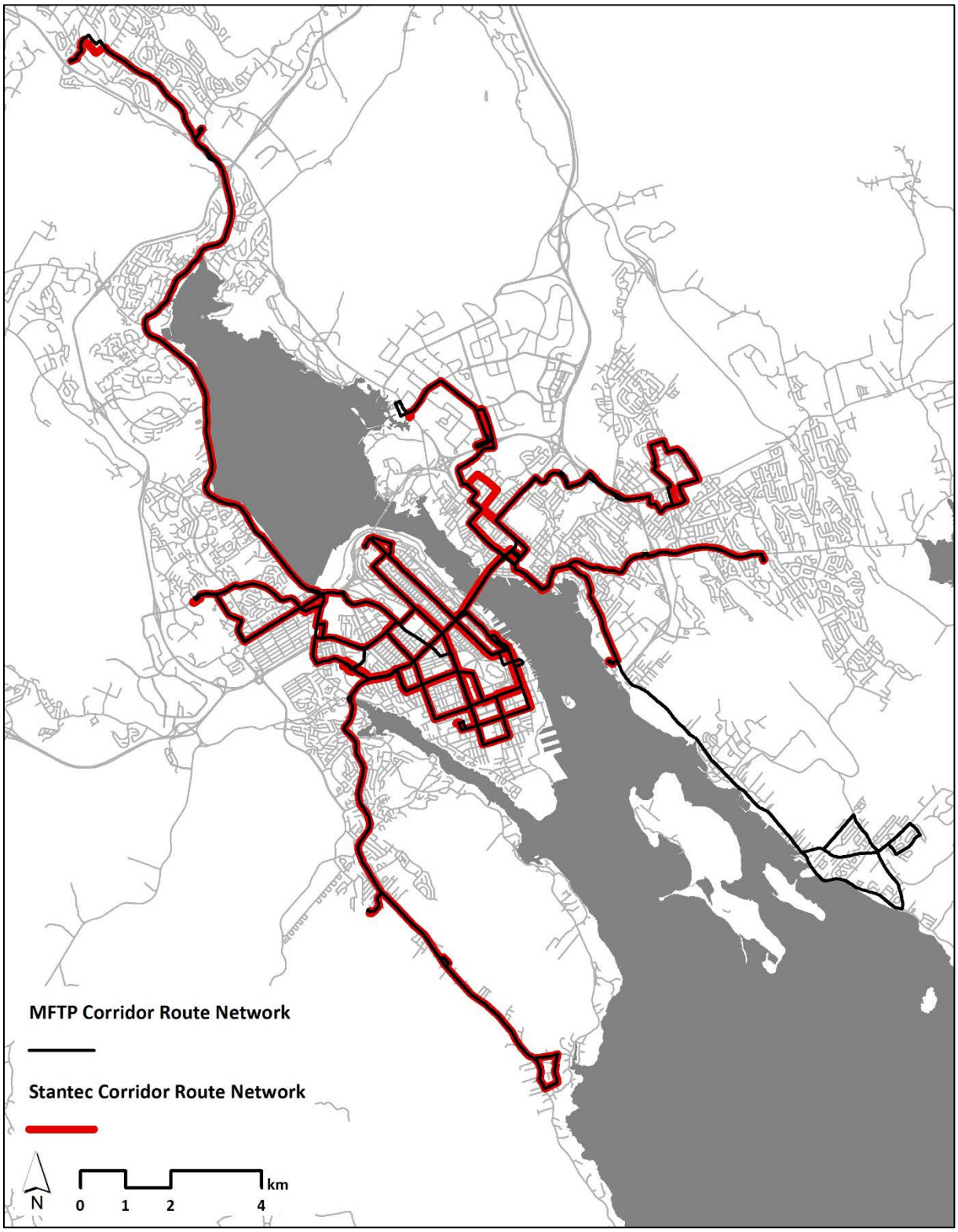


Figure 3: Corridor Route Network Comparison

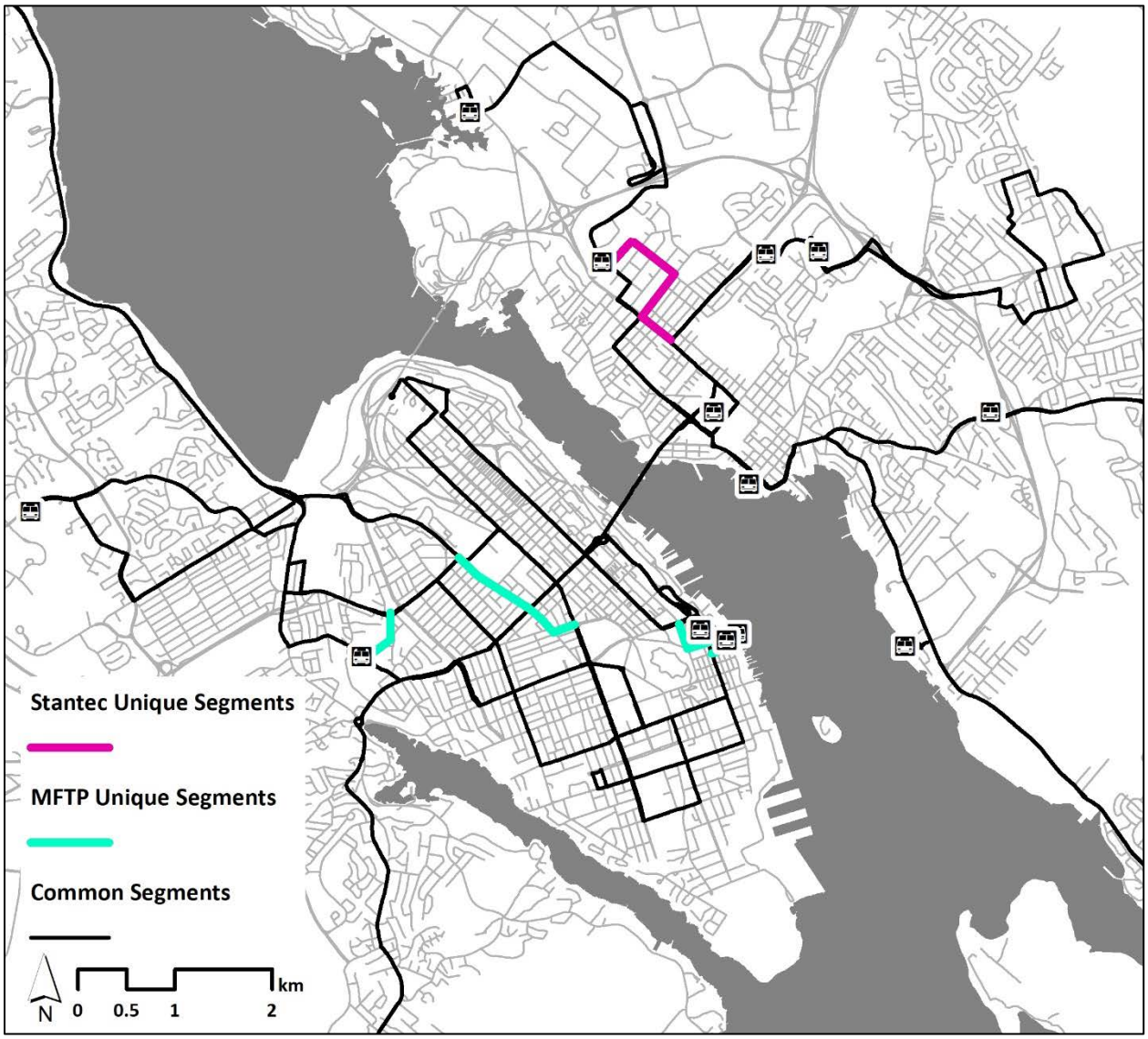


Figure 4: Corridor Route Network Comparison - Unique Segments

Notably, the Stantec Corridor Route network would see the following roadway segments excluded from the MFTP approved network (shown in green on Figure 4 above):

- Windsor Street (Bayers Road to Cunard Street)
- Cunard Street (Windsor Street to Robie Street)
- East Perimeter Road
- Brunswick Street (Duke Street to Cogswell Street)

The following route segments shown in pink in Figure 4, would be added under the Stantec-recommended scenario, but were not included in the approved MFTP:

- Victoria Road (Albro Lake Road to Woodland Avenue)
- Albro Lake Road (Victoria Road to Pinecrest Drive)
- Pinecrest Drive (Albro Lake Road to Highfield Terminal).

Corridor Route Network: Service Duplication

Overall, the Corridor Route network recommended by Stantec includes less redundancy than the Corridor Route network described by the MFTP. While difficult to show graphically, the following table summarizes along each Corridor where there are overlapping routes:

Table 2: Change in Corridor Route Network Redundancy

Road Segment	MFTP Corridor Routes Serving Segment	Stantec Corridor Routes Serving Segment	Change in Corridor Route Service Segment (Stantec vs. MFTP)
Alderney Drive	2	2	-
Victoria Road (Thistle Street to Woodland Avenue)	1	1	-
Victoria Road (Woodland Avenue to Albro Lake Drive)	0	2	+2
Wyse Road and Albro Lake Road	1	2	+1
Macdonald Bridge	4	3	-1
Barrington Street North of Cogswell Street	3	1	-2
Barrington Street South of Cogswell Street	6	5	-1
Gottingen Street	4	3	-1
Spring Garden Road	5	4	-1
Robie Street (Cunard Street to Spring Garden Road)	3	2	-1
Robie Street (Young Street to Cunard Street)	2	2	-
North Street	2	1	-1
Chebucto Road	3	3	-
Young Street	1	1	-
Bayers Road (Oxford Street to Windsor Street)	1	2	+1
Bayers Road (Connaught Avenue to Oxford Street)	2	1	-1
Bayers Road West of Connaught Avenue	1	1	-
Bayers Road Centre to Lacewood Drive	3	2	-1
Lacewood Drive	2	1	-1

As described above, Stantec's recommendations reduce Corridor Route service duplication on many key segments particularly on the Halifax Peninsula. The recommendations do however, introduce new service duplication on one segment along Bayers Road and two segments in Dartmouth.

Change in Anticipated Rate of Transfers

One potential limitation in reducing redundancy in the Corridor Route network is that it has the potential of increasing the rate of transfers between two points. Stantec provided an analysis of the anticipated change in transfers required between Corridor Routes to better understand the impact of reducing redundancy. Table 16 in Attachment B shows the number of anticipated transfers required to make a trip between two points on the Corridor Route network alone.

While this shows a limited picture by excluding Local and Express routes on which a passenger could make a single seat trip between two points (for example, a single seat trip between Bridge Terminal and Sackville Terminal could be completed on Local Route 87), the table does show that for the most part, similar to the approved MFTP, a passenger can travel between many major terminals across the network with one transfers or less on high frequency Corridor Routes.

One notable change in the proposed network is the introduction of a transfer between Mumford Terminal and Lacewood Terminal and Mumford Terminal and Highfield Terminal, both of which can currently be completed on the Corridor Route 3. This would result in an increase in forced transfers between these popular origin/destinations.

Individual Route Evaluation

Attachment A to this report provides a detailed comparison of the MFTP Corridor Routes against the consultant-recommended routings. While in some cases, it's not an easy to compare one route to another, as some of the new routes are in effect a combination of two or more MFTP Corridor Routes, the recommendations can generally be grouped into the following categories:

- No Routing Changes: In these recommended changes, the actual routing does not change, but the scheduling and/or level of service may be recommended for change. One example of this is Corridor Route 9 (page 9 of Attachment A).
- Minor Routing Changes and/or changes to Level of Service – In these recommended changes, while alignment may change, the general intent of the route remains the same. One example of this is Route 4 (page 4 of Attachment A).
- Substantial Routing Change: These recommended changes represent a significant departure from the original intent of the Corridor Routes imagined in the approved MFTP. One example of this is Route 3 (page 3 of Attachment A), or Route 10 (page 10 of Attachment A).

In some cases, changes to particular Corridor Routes recommended by Stantec could be implemented with relatively little impact to the rest of the network, for example the change to Route 7, as described below.

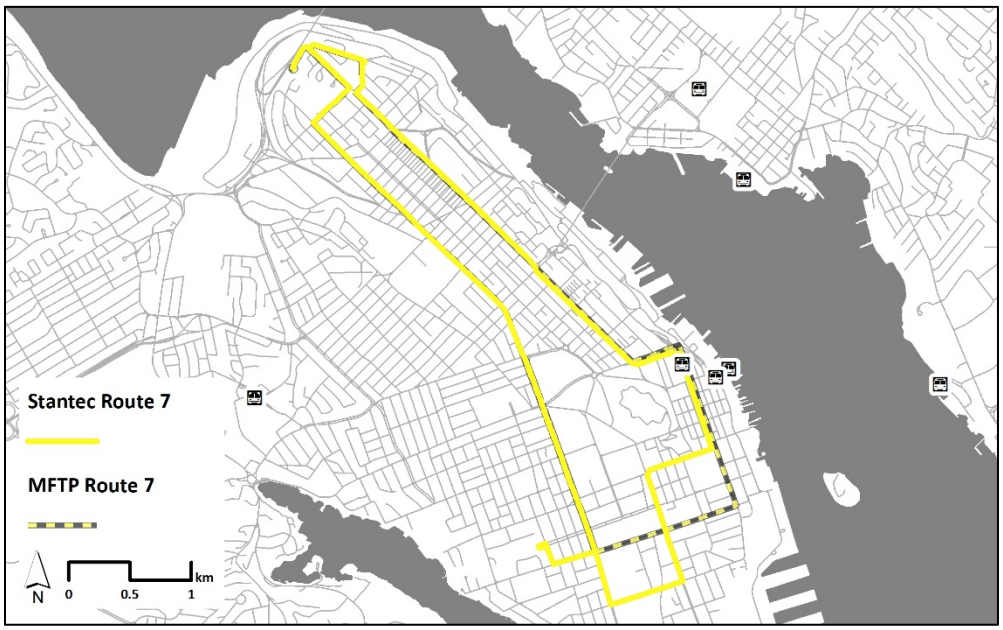


Figure 5: Route Comparison - MFTP Corridor Route 7 vs. Stantec Route 7

Notable benefits of Stantec's routing include improved service to Saint Mary's University, and providing coverage to streets removed in the recommended changes to Corridor Route 4. However, staff note that this alignment would introduce an additional 8 buses an hour to Spring Garden Road[1] and introduces a diversion which may be contrary to the Moving Forward Principles of reducing redundancy.

[1] Although the proposed routing shows one less Corridor Route serving Spring Garden Road, there is still an increase in service as a result of higher frequency.

While it is important to evaluate the recommended network on a route by route basis, it's equally important to look at it at the network scale. Each change would need to be evaluated in the context of other Corridor and Local Routes, as well as through the lens of how passenger travel patterns would be impacted.

Consultant Recommended Level of Service by Route

Table 3 below compares the frequency of Corridor Route service as established in the MFTP with Stantec's recommendations.

Stantec's recommendations are guided by the desire to standardize service across the corridor routes as much as possible. While this is also true of the MFTP Corridor Routes, the level of service planned for MFTP Corridor Routes was also informed substantially by resource availability and observed demand.

Stantec's recommendations represent increases in peak service on four corridor routes, off peak service on two routes and weekend service on one route. Stantec also recommends reducing service on Route 9 and Saturday service on three other routes, as per Table 3 below. However, even with the elimination of MFTP Corridor Route 2 and the reductions in frequency on the other routes, this level of service might not be achieved without an increase in service hours above what is established in the approved MFTP.

While staff support the proposed increases in frequency in principle, current resources are unlikely to allow for the implementation of these recommendations. Higher frequencies on corridor route service may be considered but will be dependent on available resources and ridership demand.

Table 3: Stantec Recommended Change in Corridor Route Frequency

	MFTP				Stantec			
Route	**Peak**	**Off Peak**	**Saturday**	**Sunday**	**Peak**	**Off Peak**	**Saturday**	**Sunday**
1 / H-Line	5 to 10	10	15	15	3 to 5	5 to 10	10	10
2	15 to 20	15 to 20	15	20	N/A	N/A	N/A	N/A
3	15	20 to 30	30	30	10	15	30	30
4	10 to 20	15 to 20	30	30	10	15	30	30
5	15	15	20	30	10	15	30	30
6	10 to 15	15 to 20	30	30	10	15	30	30
7	15	15 to 20	20	30	10	15	30	30
8	20 to 30	20 to 30	30	30	20	30	30	30
9	10 to 15	15 to 20	30	30	20	30	30	30
10	5 to 10	10 to 15	20	30	10	15	30	30

Service frequency displayed in minutes
Increase in frequency from MFTP
Decrease in frequency from MFTP

Stantec's recommendations for MFTP Corridor Route 9 (e.g. lower frequency) and MFTP Corridor Route 8 (e.g. routing changes) are designed for the two routes to operate with a combined frequency of 10-minutes between Mumford Terminal and Scotia Square Terminal. This recommendation does introduce some unique challenges that should be considered.

Halifax Transit has had limited success with combined headway service in the past. Currently, routes 59, 61, and 68 provide a combined 10-minute service between Portland Hills Terminal and Bridge Terminal but this type of service has proven to be difficult for users to navigate. Additionally, due to the different lengths of MFTP Corridor Route 8 and 9, compounded by peak period congestion experienced on the roadways that these two routes use, it is unlikely that operationally, evenly spaced headways could be provided in a way that is efficient. Lastly, since being implemented in November 2017, the MFTP Corridor Route 9 has become one of the highest performing routes in the network. For these reasons staff would not support Stantec's recommendation to reduce the frequency of MFTP Corridor Route 9 and implement a new combined frequency service.

Network Implementation

As per the direction of Regional Council, the scope of work for the consultant was to evaluate and then recommend a revised network of Corridor Routes. Therefore, the network recommended by the consultant must be evaluated as a whole and compared against the entirety of the MFTP Corridor Routes network. While evaluating route by route is helpful in some ways, in particular in the case of a transfer-based network such as this, the importance of the network as a whole is greater, and to examine it piecemeal may underrepresent benefits or disadvantages.

Overall, staff have determined that the complete implementation of the Corridor Route network described in the consultant's report would not provide an overall benefit to passengers over the Corridor Route network approved by Regional Council in the MFTP. If implemented as a full network, the following network deficiencies are noted:

- Corridor Routes 8 and 9 – The consultants recommend the implementation of route realignment and combined headways for Corridor Routes 8 and 9, which would see a decrease in service on Corridor Route 9 and a realignment of Corridor Route 8 away from Bayers Road, Young Street, and Robie Street. As one of the highest ridership and highest performing routes in the network, a service reduction on the Corridor Route 9 is not recommended. Further, the realignment of Corridor Route 8 service away from the Bayers Road and Robie Street Transit Priority Corridors is not recommended, in part due to the public and stakeholder feedback received during the preparation of the MFTP.
- Lack of Direct Connection on the Corridor Route Network between Mumford and Lacewood Terminals: The Corridor Route network described in the consultant report does not offer a single seat trip between two of the busiest transfer points in the network, Lacewood Terminal and Mumford Terminal. While it would still be possible to make this connection on a lower frequency local route, or by transferring on street, it does make navigating the network more difficult and less accessible, particularly in between two high demand origin/transfer points in the network.

Beyond the concerns noted above, there are several elements of the network which would need to be confirmed by additional trip data. For example, the recommendation for the Route 10 is to realign service away from Downtown Halifax, instead connecting areas of Main Street Dartmouth to North Street and Mumford Terminal. By contrast, the new Corridor Route 3 connects the communities of Burnside and Highfield Park Drive to Downtown Halifax rather than continuing to Mumford and Lacewood Terminals. At this time, it is not clear that these new alignments would provide stronger connections than what already exists in the network, and in some cases would remove important and popular direct connections. Based on analysis undertaken by staff, it is not clear that the potential ridership increase and/or benefit to passengers which would be achieved by these changes outweigh the potential negative impact to ridership.

Consultant Performance Metric Recommendation

Table 4 below summarizes the recommendations made by Stantec related to measuring the performance of Corridor Routes, and how or if staff recommend actioning them:

Table 4: Performance Metric Recommendations

Performance Metric	Reference in Stantec Report (Attachment B)	Discussion
Service Span	Page 63	Stantec recommends that Halifax Transit clearly define span with specific start and end periods. For example, defining service start as the "first departure of the day or first arrival time at a certain terminal" and service end being defined as the "last arrival time of the day or last departure time from a certain terminal." The service spans established in the MFTP are simply used to guide more detailed scheduling efforts. Specific spans are provided in Halifax Transit's Riders' Guide which is produced each time new service changes (e.g. MFTP routes are implemented). Thus, staff do not feel this recommendation needs to be actioned.

Boardings per Revenue Hour	Page 65, Table 17	Halifax Transit staff currently report on Boardings per Revenue Hour to Regional Council on a regular basis. This metric is incorporated into the Halifax Transit quarterly and annual performance measures reports.
Net Cost per Boarding	Page 65, Table 17	Net Cost per Boarding is used by Halifax Transit staff on an as needed basis and is reported to Council in some cases to help better understand the cost per passenger by route or service type. For example, this metric was used to inform decision-making in the development of the MFTP and is often used in more detailed individual route evaluations to inform service change recommendations. This metric could be incorporated into quarterly and annual performance measures reports going forward as a measure of service efficiency.
Reliability	Page 63, and Table 17	Stantec recommends that Halifax Transit adopt metrics to inform the reliability of actual headways to scheduled headways for corridor routes. A gapping measure can be used to evaluate how often buses fall behind the scheduled headway (e.g. 12-minute actual headway vs. 10-minute scheduled headway). A bunching measure can be used to evaluate how often buses get "bunched together" and effectively exceed the scheduled headway (e.g. 7-minute actual headway vs. 10-minute scheduled headway). The gapping and bunching measures described by Stantec have already been successfully piloted by Halifax Transit staff and can be incorporated into corridor route evaluation processes going forward. Stantec recommends a metric to evaluate reliability by measuring trip time variation, which would compare the average maximum trip time to the average minimum trip time. Staff have already developed an alternative reliability measure that evaluates scheduled arrival time at each stop along a route to the actual arrival time. This alternative measure allows for more detailed identification of operational issues along routes. This alternative measure will be incorporated into corridor route evaluation processes going forward.
Comfort	Page 463, and Table 17	Stantec recommends adopting measures to evaluate crowding on the corridor routes to inform passenger comfort. The Section 6.6.2 of the MFTP does include a metric for passenger comfort based on crowding. It is summarized below: Vehicle Load Guidelines by Service Type • Corridor Routes - 150% • Local Routes - 150% • Express Routes - 125% • Regional Express Routes - 115% These load guidelines are intended to be calculated based on the average ridership over a 30-minute period, where 100% indicates a seated full load.
Two-way Demand	Page 65, Table 17	Stantec recommends adopting a measure to evaluate the travel demand for inbound and outbound service during peak and off-peak periods on corridor routes. At present, there are some limitations around the quality of the alighting data, however Halifax Transit staff would be able arrange certain vehicles with the more reliable on-board passenger counters to sample corridor routes and acquire the data to support this measure. As such, this measure could be adopted going forward.

Travel Time Mapping

Isochrone mapping is a tool used in transportation planning to show areas of equal travel time (*iso*, meaning equal, and *chrone*, meaning time). It effectively shows how far a person could travel in a given network from a single point of origin at a given point in time.

As part of the network analysis, Stantec has undertaken isochrone mapping to compare the existing/approved MFTP network with their recommended Corridor Route network. These maps are shown in Attachment B to this report to help illustrate travel distances from particular origins at particular times of the day.

In this case, there are several notable limitations to using isochrone maps as a proxy for representing travel time and network accessibility. Some of these limitations include:

- Both networks evaluated are, to one degree or another unscheduled (i.e. only routes which have already been implemented are using real schedules). Therefore, in undertaking the modelling, the consultant had to generate "dummy" schedules based on frequencies established by Halifax Transit staff and approved by Regional Council through the MFTP. It is possible that on the attached isochrone maps, travel times will look better or worse as the model will assume that a transfer is or is not possible based on the generated schedule(s).
- The Stantec recommended Corridor Routes were overlaid on top of the MFTP network, rather than removing routes which would likely be impacted. This has the impact of artificially lowering wait time for initial boarding of a Corridor Route, and the mapped service area would likely be larger. However, this bias is shared between both the MFTP model and the Stantec Recommended models, therefore making them a reasonable comparison to one another.
- Travel time assumptions are based on historical AVL data and does not reflect all existing or planned transit priority measures. It is likely that travel times will be impacted in the case, for example, that transit only lanes are introduced on Bayers Road or Robie Street.
- Changes to Local Routes are not modeled, as changes to non-Corridor Routes was outside the scope of work for the consultant and would require substantial work and public engagement.

Included in Attachment C to this report is a statement from the consultant about the preparation of the isochrone maps, and some direction as to how they should best be utilized. Generally speaking, while they are useful to paint a general picture of the networks and the differences between them, on a route by route level, their usefulness is limited without using an actual schedule.

Generally speaking, based on a high-level examination of travel time maps, there are not many substantial differences in travel times between the MFTP Corridor Route network and the Stantec recommended Corridor Route network. One notable difference includes the travel time differences between Mic Mac Mall and North Street (consultant proposed network shows lower travel time in minutes) in all periods, likely due to the proposed realignment of Corridor Route 10.

Change Recommended for Implementation and Changes Recommended for Further Consideration and Consultation

Based on the analysis undertaken by the consultant, staff intend to undertake the following service change:

- Route 5: Truncate Corridor Route 5 at the Bridge Terminal, requiring a transfer for those wishing to travel over the Macdonald Bridge to downtown Halifax. This change will reduce redundancy in the network and is consistent with the Moving Forward principles.

Staff plan to roll out this change in the coming years through the final stages of MFTP implementation. They reflect a change which staff believe is both consistent with the direction provided by the Moving Forward principles, and is also consistent with direction provided by the substantial public engagement. Further, this routing change does not reflect an increase in operating costs beyond what has already been anticipated will be budgeted for as part of the planned implementation of the MFTP.

In addition to these changes, staff have also implemented and/or are developing options to implement several of the performance measures recommended by the consultant in Table 4 above. These include:

- Trip time variation (reliability/ gapping and bunching);
- Net Cost per Boarding; and
- Passenger Comfort.

The implementation of these new measures will not result in any changes to operating costs. A number of the routing changes recommended by the consultants, while potentially of benefit to the network, are significant, and represent a large divergence from the draft MFTP network which was consulted on by the public/stakeholders. In some cases, the fundamental purpose of a route is different, or a recommendation represents a significant change to a Corridor Route which has recently been implemented and seen significant ridership increases.

In many cases these represent significant changes to the network and there are serious trade offs which new and existing transit users will need to carefully consider. To be consistent with past practice and transparent to the public, substantial changes of this nature should not be implemented without thorough public and stakeholder engagement, most appropriately as part of the MFTP Five Year Review process, anticipated to start in the coming year.

Recommendations which staff would like to consider further and explore through a robust engagement include:

- The complete elimination of Corridor Route 2 and the full roll out of the H Line;
- The realignment of the Corridor Route 3 to connect Burnside and Downtown Halifax rather than continuing to Lacewood Terminal;
- Amend routing of Corridor Route 4 in the south end of the Halifax Peninsula to make routing more direct.
- The realignment of Corridor Route 10 to serve Mumford Terminal rather than downtown Halifax;
- The realignment of Corridor Route 4 to serve Scotia Square directly via Oxford Street;
- Extension of Corridor Route 6 (or a branch) to serve Wrights Cove Terminal via Windmill Road.
- Impact of Bus Rapid Transit implementation on Corridor Route network.

This engagement will take place as part of the mandated MFTP review process, planned for the 2021/22 fiscal year. This consultation will also consider route and schedule changes based on feedback received subsequent to recent service changes and as a result of new plans and information which have arisen since the MFTP was approved in 2016. Through the review and consultation process, staff will identify any additional costs of the amended routing, and these will be reflected in future Annual Service Plans and the Capital Budget for Regional Council's consideration.

Impact of Bus Rapid Transit (BRT) on Corridor Route Changes

Staff note that as per the Consultant's report, it's very likely that if BRT was implemented in Halifax, many of the Corridor Routes – both those described in the MFTP and those recommended by the consultant – would likely change substantially and might in some cases be entirely replaced.

For example, if proposed BRT Route 4 between Mount Saint Vincent University and the Via Rail Station were to be implemented, it's likely that the Corridor Route 4 would be substantially realigned or removed completely, or else there would be substantial redundancy along the Robie Street Corridor. For this reason, staff do not recommend substantially altering existing or planned Corridor Routes on street until direction and timeline on the implementation of BRT is established in the Higher Order Transit Framework currently in development.

FINANCIAL IMPLICATIONS

There are no financial implications associated with this report. Any service changes or changes in resource requirements will be considered in a forthcoming annual service plan and will be reviewed through the budget approval process. Funding to support analysis and engagement on amended routing as described in this report is currently available in CMU01095 Transit Strategy.

COMMUNITY ENGAGEMENT

Public consultation on the draft MFTP included a large number of ways for citizens and stakeholder groups to provide insight and direction into plan refinement. The draft MFTP, including the proposed future transit network, was released for public consultation in February 2015. The subsequent ten-week engagement process was the most diverse and comprehensive consultation strategy ever undertaken by the municipality. The following describes the variety of opportunities for consultation provided to members of the public and stakeholder groups:

- Project consultation page - MakeTransitBetter.ca: This website allowed residents to access information on proposed routing and frequencies in order to understand the impact the proposed changes would have on their transit trips. The website resulted in over 50,000 unique website visitor and 15,370 survey responses;
- Pop–Up Engagement Events: Halifax Transit had hosted 20 pop up engagement events and interacted with 2,480 individuals;
- Stakeholder Consultation Sessions: Three stakeholder sessions were held in the first week of consultation, and a fourth one was held near the end of consultation in order to ensure that all groups who were interested had the opportunity to participate. A total of 37 groups or agencies took part;
- ShapeYourCityHalifax.ca: The Municipality's online engagement portal served as a source of comprehensive information and provided the opportunity for deeper engagement through discussion forums. At the end of the consultation period, the site had hosted 2,190 unique visitors, of which 605 provided their feedback;
- Public Opinion Research: A sample of 800 Halifax residents indicated that there was a 65% awareness of proposed network changes (an increase of 14% over the 10-week engagement period), and a 73% level of public support for proposed changes;
- Twitter Town Halls: As part of the consultation strategy, two Twitter Town halls were held in April 2015. These events facilitated direct engagement with residents and allowed significant distribution of information to, and through, Halifax Transit's more than 23,000 Twitter followers.
- These events together hosted 173 participants, and resulted in 486 tweets;
- Written submissions: Nearly 1,000 email submissions were received by Halifax Transit over the 10-week consultation period, consisting of both questions and comments.

No additional community engagement was undertaken in the preparation of the consultant's report.

ATTACHMENTS

Attachment A – MFTP Corridor Routes Review – Individual Route Comparisons

Attachment B – MFTP Corridor Routes Review – Consultant's Report

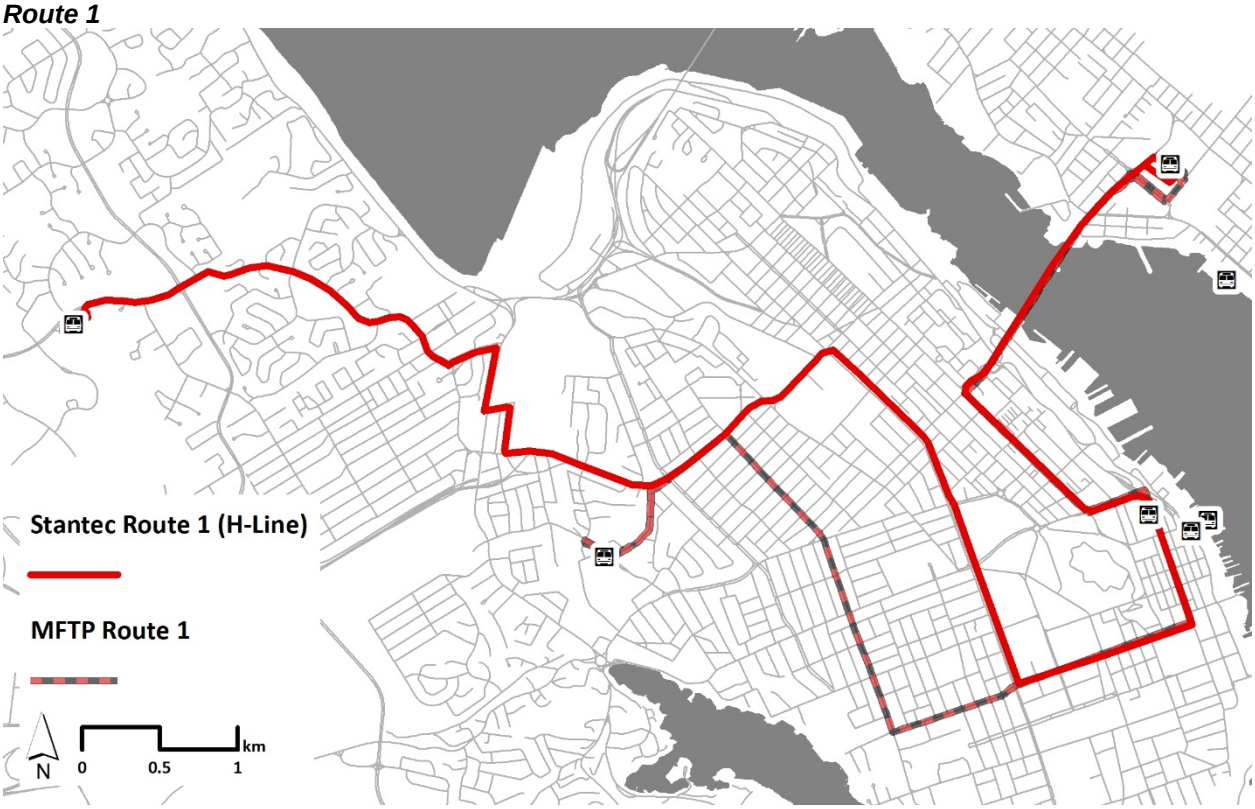
Attachment C – Detailed Evaluation of Isochronal Mapping Methodology – Memo from Consultant

Attachment D – Isochrone Maps

A copy of this report can be obtained online at halifax.ca or by contacting the Office of the Municipal Clerk at 902.490.4210.

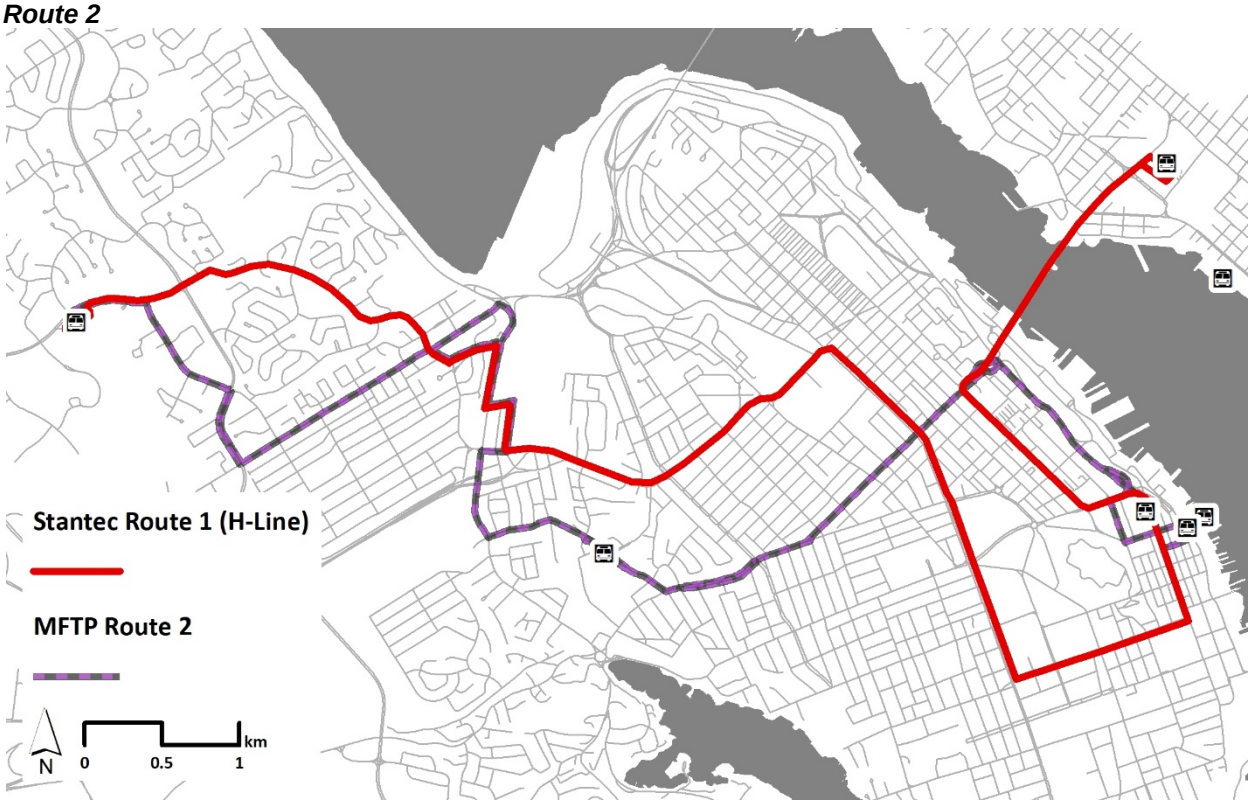
Report Prepared by: Erin Blay, MCIP, LPP, Supervisor, Service Design & Projects at Halifax Transit 902.490.4942

Route 1



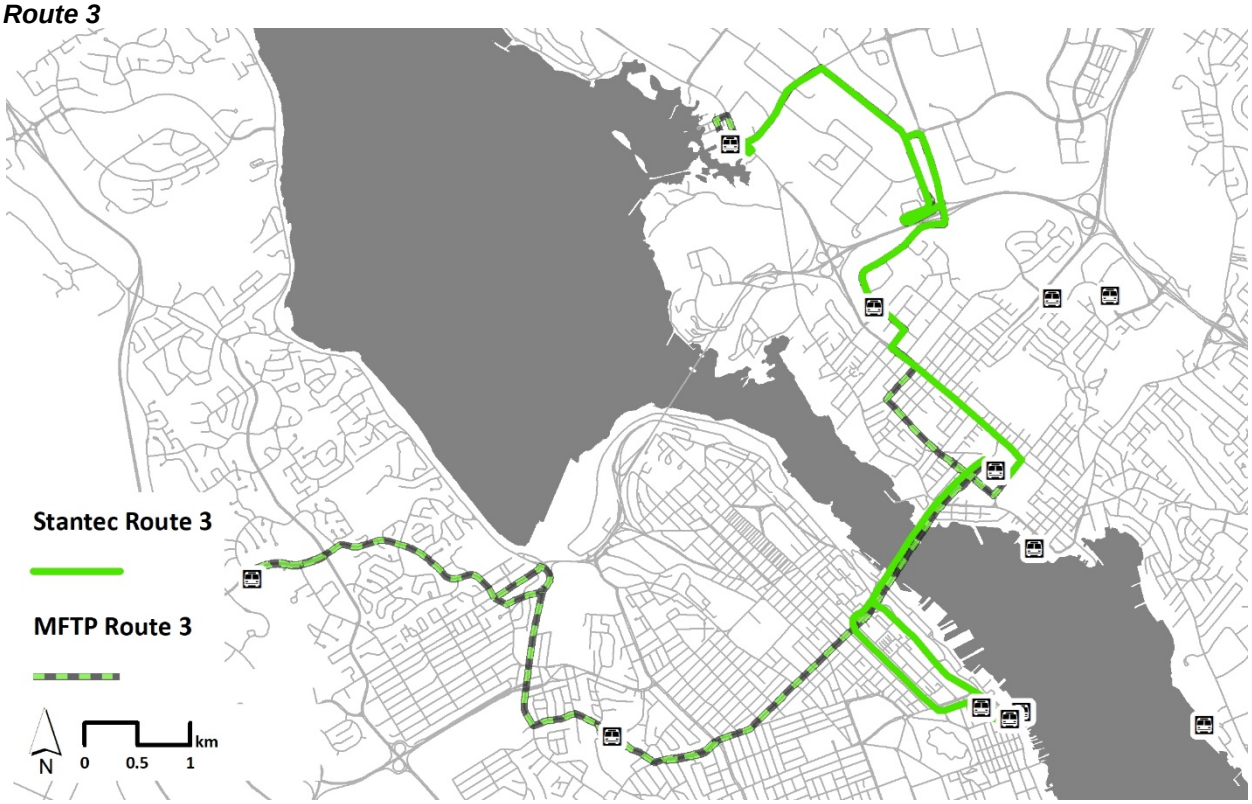
MFTP	Stantec	How Stantec Routing Differs from MFTP Routing
Purpose: • To connect Halifax West End, South End and Central Dartmouth to major retail, employment, and educational destinations and services on the Peninsula including downtown Halifax • Enable transfers at the following terminals: Mumford, Scotia Square and Bridge	**Purpose:** • Primary intent is the same as MFTP Corridor Route 1 • To maximize the value of planned transit priority measures along Bayers Road, Young Street and Robie Street • To provide a connection between Clayton Park and downtown Halifax to allow for the removal of MFTP Corridor Route 2 • Enable transfers at the following terminals: Lacewood, Scotia Square and Bridge	• Provides service between Bridge and Lacewood Terminals • Eliminates connection to Mumford Terminal which has twice the average daily boardings as Lacewood Terminal • Reduces connections to Dalhousie • Increases use of potential transit priority corridors (travel along Robie Street and Young Street instead of Coburg Road and Oxford Street) • Provides for connections at Lacewood Terminal
Staff Comments: • Branded, high-frequent service would establish a foundation for BRT • Longer route which may lead to schedule adherence issues • Rider capacity over the Macdonald bridge and into downtown Halifax may be a concern. Route alignment on Gottingen Street and Robie Street almost creates a loop which make trips less direct and less desirable for travel between Lacewood and Bridge Terminals		

Route 2



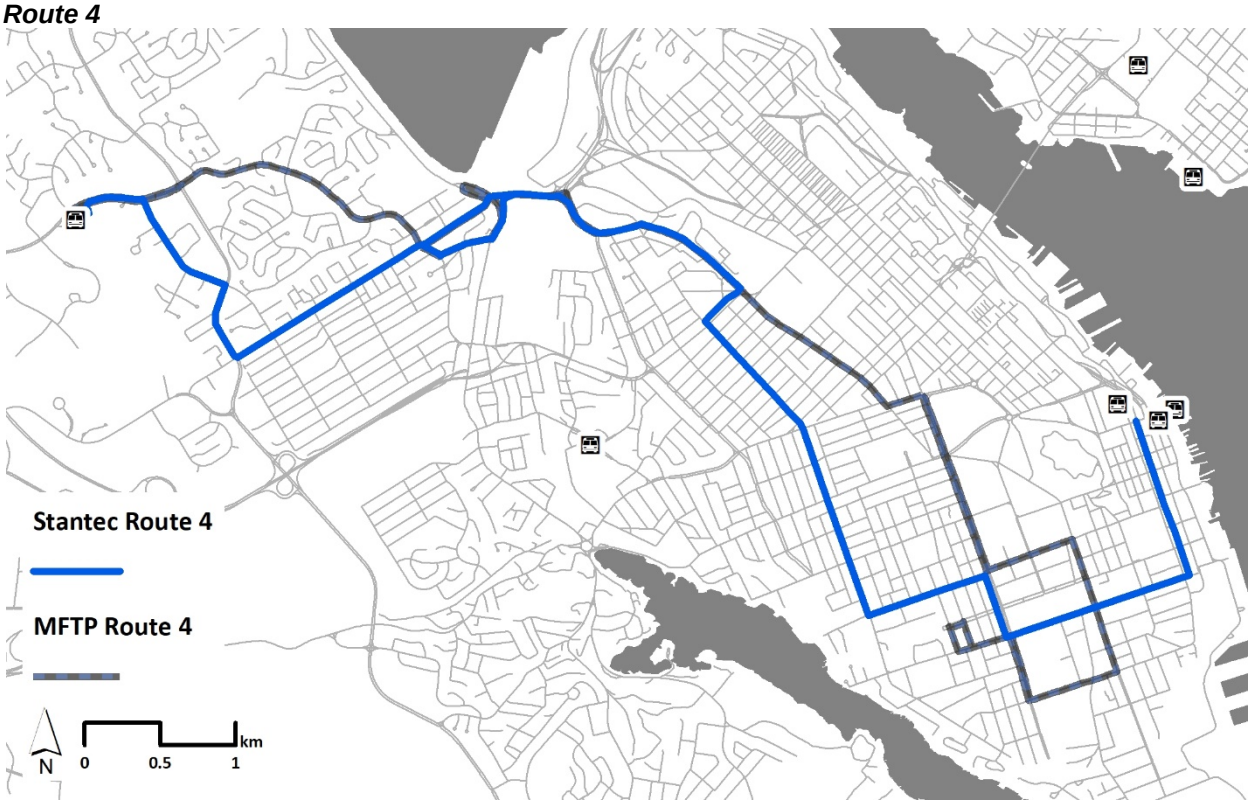
MFTP	Stantec	How Stantec Routing Differs from MFTP Routing
Purpose: • To provide a direct connection between Clayton Park and major employment and retail destinations and services on the Peninsula including downtown Halifax • Enable transfers at the following terminals: Lacewood, Mumford, Scotia Square and the Halifax Ferry	**Purpose:** • Recommend eliminating this route as the proposed modifications to the MFTP Route 1 (the H-Line) would extend into Clayton Park to provide the connection to downtown Halifax	• Eliminates the direct connection to the Halifax Ferry Terminal • Lack of direct connection in Corridor Network between Mumford Road and Lacewood Terminal
Staff Comments: • Eliminating MFTP Corridor Route 2 would reduce redundancy in the network and free up resources for reallocation elsewhere • The H-Line is a less direct route to downtown than the MFTP Corridor Route 2		

Route 3



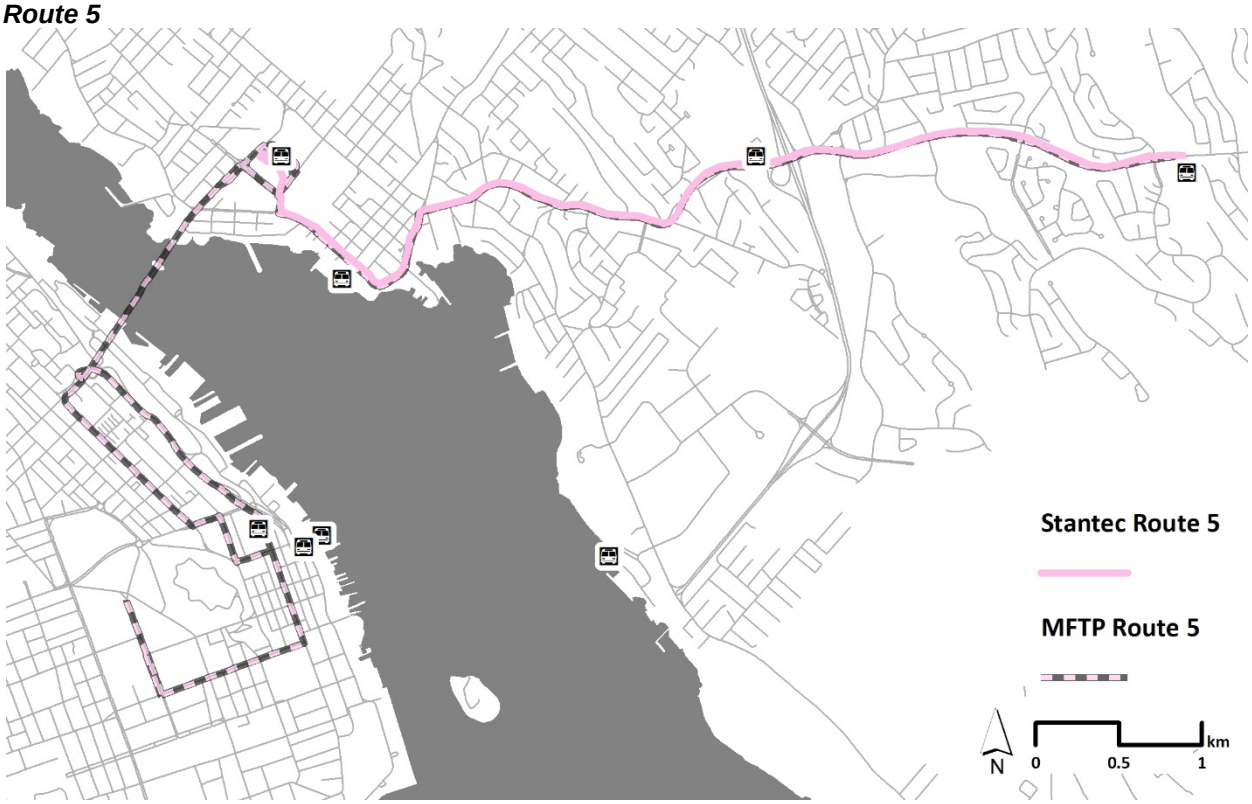
MFTP	Stantec	How Stantec Routing Differs from MFTP Routing
Purpose: • To connect Clayton Park, North Dartmouth and Burnside • To provide service across the northern portion of the Regional Centre and connect residents to major employment and retail destinations and services • Enable transfers at the following terminals: Lacewood, Mumford, Bridge, Highfield and Wrights Cove (planned)	**Purpose:** • To connect Burnside, North Dartmouth and downtown Halifax • Enable transfers at the following terminals: Scotia Square, Bridge, Highfield and Wrights Cove (planned)	• Provides service between Scotia Square and Wrights Cove (planned) • Provides service on Victoria Rd and Thistle Street (instead of Wyse Road and Albro Lake Road) • Eliminates connection to Mumford Terminal and Lacewood Terminal • Provides for connections at Scotia Square
Staff Comments: • Shorter route which may improve schedule adherence • Victoria Road may not warrant corridor route level service • Connecting two employment centres (Burnside and downtown Halifax) and only one residential area may not produce the all-day ridership demand to sustain corridor level service		

Route 4



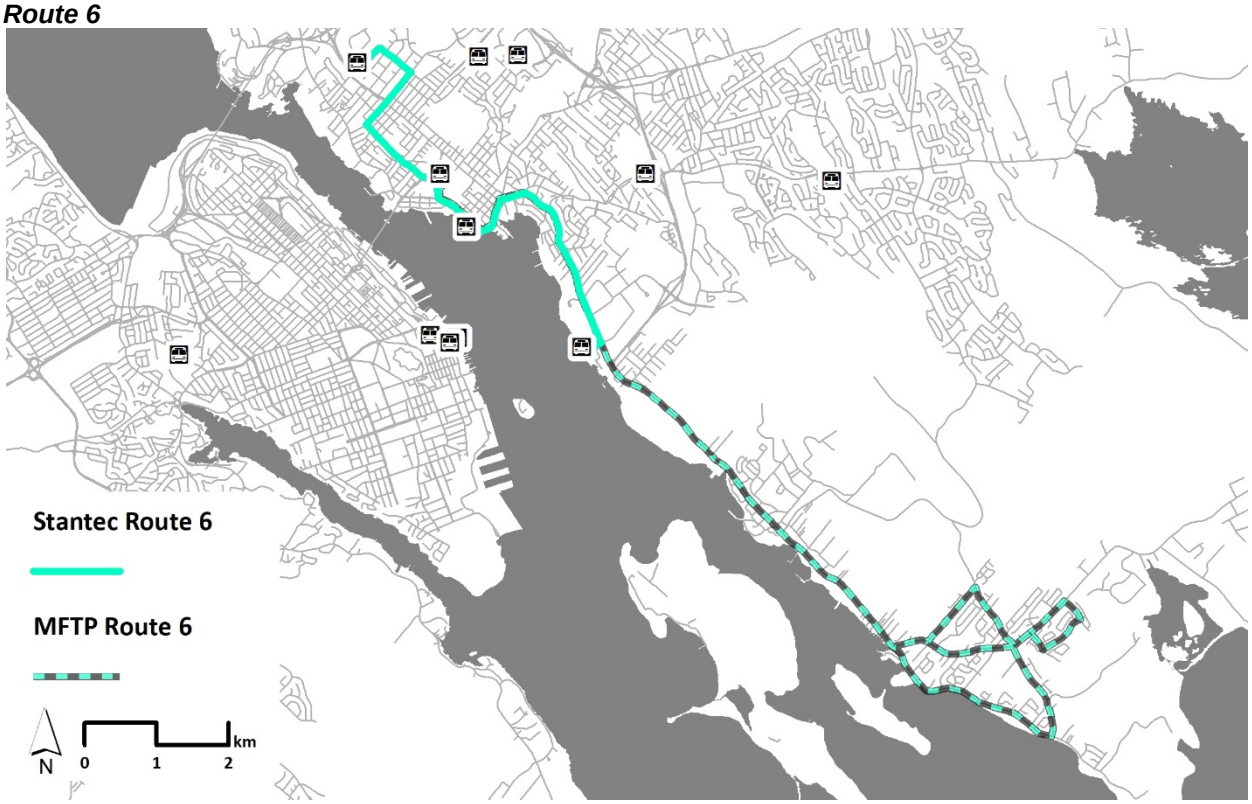
MFTP	Stantec	How Stantec Routing Differs from MFTP Routing
Purpose: • To provide a direct connection between Clayton Park and the Institutional District including Dalhousie, Saint Mary's, QEII and the IWK which connects residents to major employment and educational destinations and services • Enable transfers at Lacewood Terminal	**Purpose:** • To provide a connection between Clayton Park and the Institutional District including Dalhousie and Saint Mary's • To provide service in areas where the H-Line does not • Enable transfers at the following terminals: Lacewood and Scotia Square	• Extends the route to provide service between Lacewood and Scotia Square • Route terminates at Scotia Square instead of Dalhousie • Route travels on Dunbrack Street, Main Avenue, Windsor Street, and Oxford Street (instead of Lacewood Drive, Windsor Street, Robie Street) • Eliminates connection to QEII • More direct access to Dalhousie from Clayton Park • Reduced access to Saint Mary's and Spring Garden Road
Staff Comments: • Tail end of the proposed Statec Route 4 is more direct than MFTP Route 4 • Staff support overall route alignment for the Statec Route 4 but would like to consider further and explore through robust engagement		

Route 5



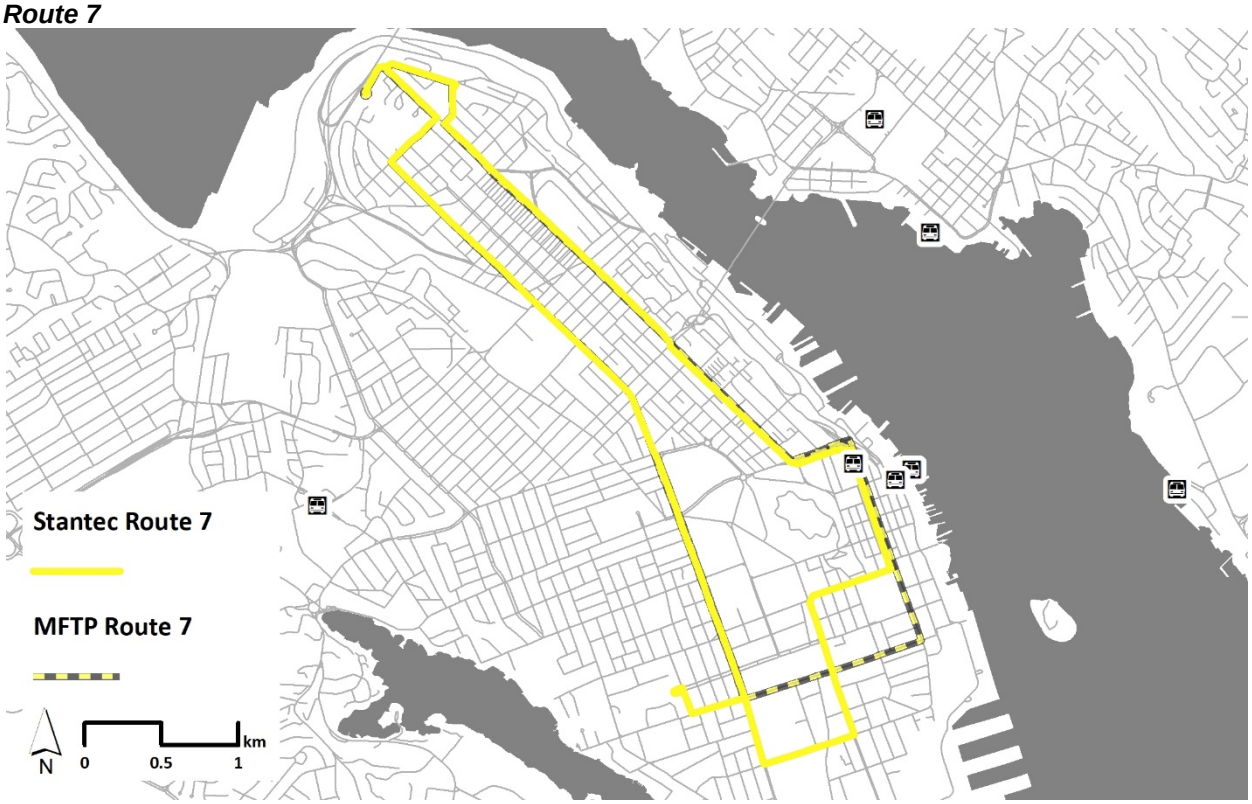
MFTP	Stantec	How Stantec Routing Differs from MFTP Routing
Purpose: • To connect the Colby Village, Portland Hills and Woodlawn area, to downtown Dartmouth, downtown Halifax and the Institutional District through a peak period extension which connects residents to major retail, employment and educational destinations and services • Enable transfers at the following terminals: Portland Hills, Penhorn, Dartmouth Ferry, Bridge and Scotia Square • Provides additional rider capacity between the Bridge Terminal and downtown Halifax	**Purpose:** • Primary intent is the same as MFTP Corridor Route 5, but the route terminates at the Bridge Terminal instead of continuing to downtown Halifax • Enable transfers at the following terminals: Portland Hills, Penhorn, Dartmouth Ferry, and Bridge	• Route terminates at the Bridge Terminal (instead of continuing across the bridge to downtown Halifax) • Eliminates connection to Scotia Square
Staff Comments: • Proposed routing reduces overlap with other corridor routes across the Macdonald Bridge and in downtown Halifax • Staff support this routing change pending a comprehensive review of rider capacity between Bridge Terminal and downtown Halifax as this change may require additional frequency on other routes		

Route 6



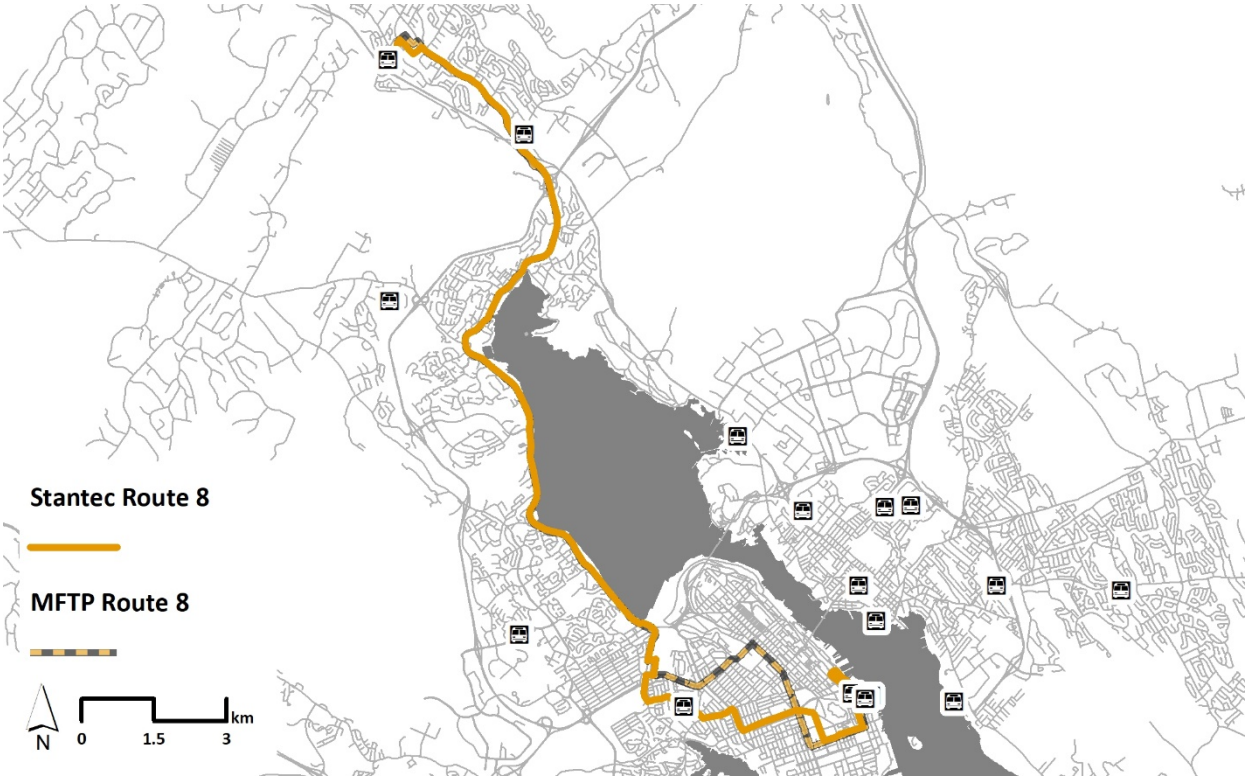
MFTP	Stantec	How Stantec Routing Differs from MFTP Routing
Purpose: • To provide a direct connection between Eastern Passage, downtown and central Dartmouth which connects residents to major employment and educational destinations and services including CFB Shearwater, Woodside Industrial Park, Dartmouth General and the NSCC Ivany Campus • Enable transfers at the following terminals: Woodside Ferry, Dartmouth Ferry and Bridge	**Purpose:** • To provide a direct connection between Woodside and North Dartmouth • Enable transfers at the following terminals: Woodside Ferry, Dartmouth Ferry, Bridge and Highfield • Note: the route would branch south of the Woodside Ferry Terminal to provide service to Eastern Passage as per MFTP Route 6	• Extends service across Dartmouth to Highfield Terminal and North Dartmouth • Provides for connections at Highfield Terminal
Staff Comments: • Increases the level of service in North Dartmouth • Staff note that the consultant's recommendation beyond Woodside is effectively the same treatment as approved in the MFTP. • Staff generally support this recommendation, but would have to evaluate implications for other MFTP routes to reduce redundancy		

Route 7



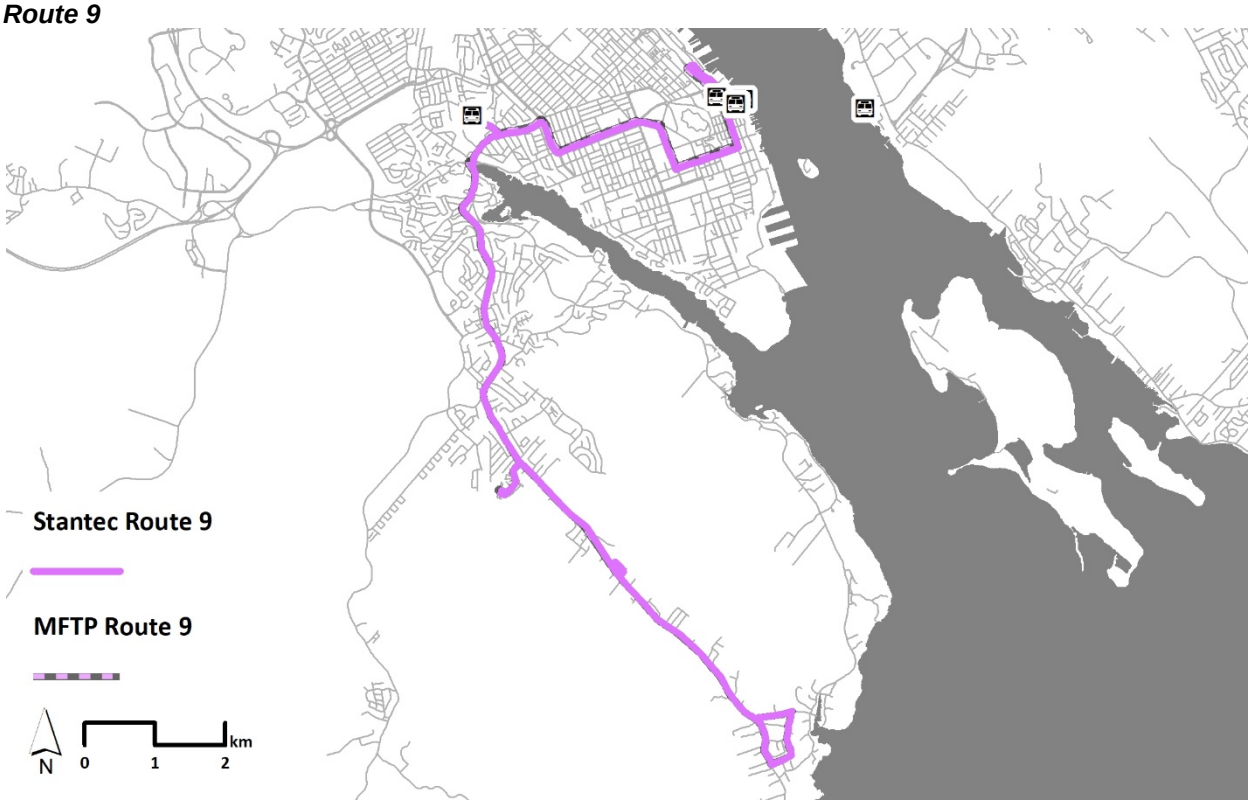
MFTP	Stantec	How Stantec Routing Differs from MFTP Routing
Purpose: • To provide a direct connection from the North End and the South End of Halifax to the Institutional District and downtown Halifax • Enable transfers at Scotia Square	**Purpose:** • Same as MFTP Route 7	• Modifications to southern portion of the route by traveling on Inglis Street, South Park Street and Spring Garden Road (instead of Robie Street and South Street) • Provides direct service to both Dalhousie and Saint Mary's • Introduces a diversion to Dalhousie • Introduces an additional route on Spring Garden Road • Southern portion of the route is less direct than MTFP Route 7
Staff Comments: • The Stantec Route 7 alignment does not represent a significant variation • Staff do not support the proposed alignment at this time as the southern portion of the route is less direct, but staff could consider the proposed alignment in the future in concert with other routing changes		

Route 8



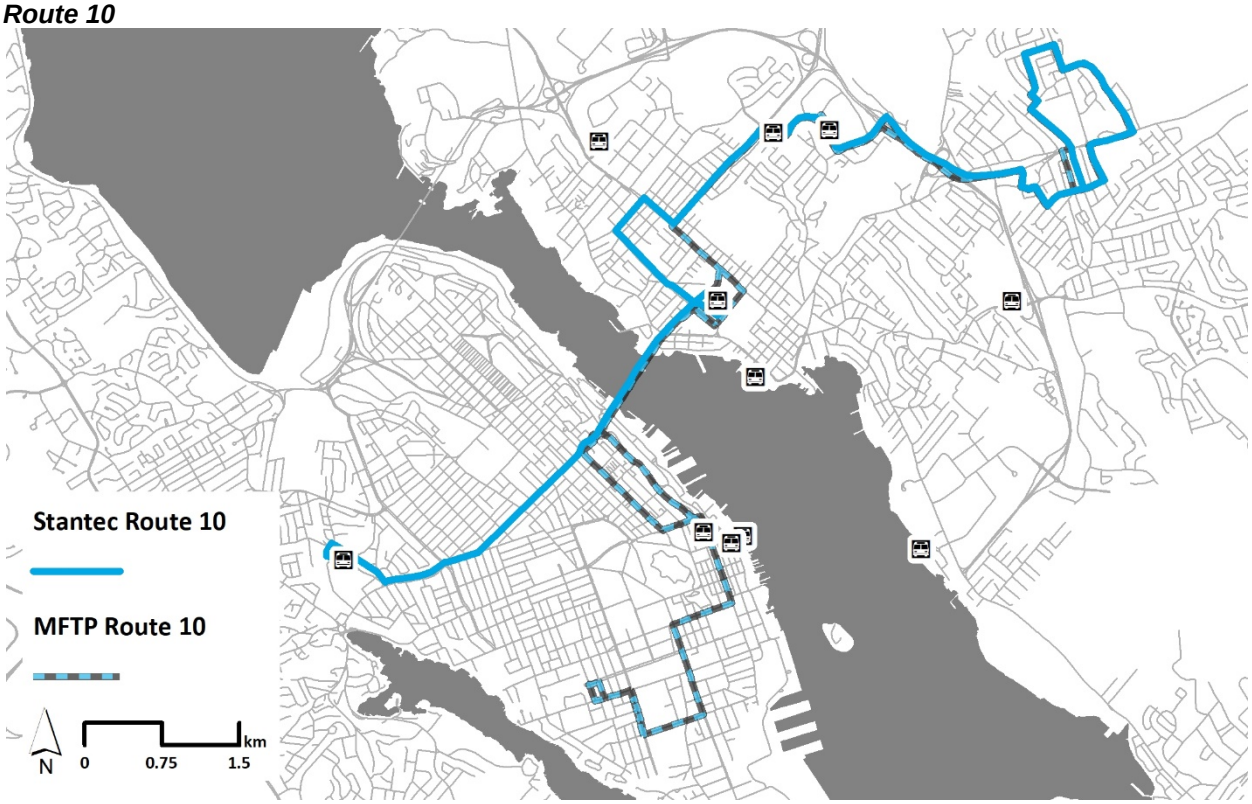
MFTP	Stantec	How Stantec Routing Differs from MFTP Routing
Purpose: • To provide a connection between Sackville, Bedford and downtown Halifax • To provide service along the Bedford Highway which connects residents to Mount Saint Vincent University, the Institutional District and downtown Halifax • Enable transfers at the following terminals: Sackville, Cobequid and Scotia Square	**Purpose:** • Same as MFTP Route 8 with routing modifications to allow for combined headway service with Route 9 • Enable transfers at the following terminals: Sackville, Cobequid Mumford and Scotia Square	• Modifications to south portion of the route by traveling on Joseph Howe Dr. and Mumford Rd. to Mumford Terminal and then following the same routing as MFTP Route 9 to downtown Halifax (instead of Bayers Road and Robie Street) • Provides for connections at Mumford Terminal including facilitating trips across Halifax Mainland without requiring a trip downtown
Staff Comments: • Proposed routing would allow for connections at Mumford Terminal, but it is unclear if this would increase connectivity at Mumford Terminal as other corridor routes are proposed to be removed from Mumford Terminal such as Route 1, 2 and 3 • MFTP local route 91 will provide for connections at Mumford Terminal and facilitating trips across Halifax Mainland without requiring a trip downtown • Staff do not support the modifications to the south portion of the route as it increases the length of the route, duplicates service on Quinpool and bypasses proposed transit priority corridors (Bayers Road, Young Street and Robie Street)		

Route 9



MFTP	Stantec	How Stantec Routing Differs from MFTP Routing
Purpose: • To provide a connection between Herring Cove, Spryfield and downtown Halifax • To provide service along Herring Cove Road to connect residents to major employment and retail destinations and services including the Institutional District and downtown Halifax • Enable transfers at Mumford and Scotia Square Terminals	**Purpose:** • Same as MFTP Route 9	• No proposed routing adjustments
Staff Comments: • Although there is no proposed routing change, Stantec did recommend reducing the frequency on this route to allow for combined headway service with the proposed Route 8 • Staff do not support the reduced level of service on MFTP Route 9 as this is one of the highest performing routes in the network		

Route 10



MFTP	Stantec	How Stantec Routing Differs from MFTP Routing
Purpose: • To provide a connection between Westphal, Central Dartmouth, downtown Halifax and the Institutional District • To provide service across the Regional Centre to connect residents to major employment and retail destinations and services • Enable transfers at the following terminals: Micmac, Bridge and Scotia Square	**Purpose:** • To provide service across the Regional Centre • Enable transfers at the following terminals: Micmac, Bridge and Mumford	• Significant modifications in the Halifax portion of the route as it is proposed to travel on North Street to Mumford terminal (instead of through downtown Halifax to Dalhousie and Saint Mary's) • Eliminates connection to Scotia Square Terminal • Route removed from Barrington Street and Spring Garden Road • Provides for connections at Mumford Terminal
Staff Comments: • Reduces duplication of service on North Street • Staff do not support this recommendation as it is not clear that the demand is stronger between North Street/West End Halifax and Dartmouth than it is between Downtown Halifax and the South End of the Halifax Peninsula		

EXECUTIVE SUMMARY

Background

In 2016, the *Moving Forward Together Plan* (MFTP) was approved by Regional Council, which proposed a redesigned transit network built on four principles:

1. Increase the proportion of resources allocated towards high ridership services.
2. Build a simplified transfer based system.
3. Invest in service quality and reliability.
4. Give transit increased priority in the transportation network.

The redesigned transit network described in the MFTP consists of new service guidelines and route classifications, with the highest-frequency routes, 'Corridor Routes', located at the top of the hierarchy. The purpose of this Corridor Route Review study is to evaluate the Corridor Routes and recommend modifications to, or retention of, the number and routing of the Corridor Routes described in the MFTP, based on changes in existing conditions since the MFTP's approval.

Service Area Review

Following the review of plans such as the *Integrated Mobility Plan*, the *Draft Centre Plan*, and the *Regional Municipal Planning Strategy*, and projects such as the Mumford Terminal Replacement and the BRT Feasibility Study, the Halifax Regional Municipality's service area was reviewed. The following observations were noted:

- **Population Density**: The densest areas include the Halifax Peninsula, especially in the South End, as well as Clayton Park, and small pockets of Dartmouth such as Highfield Park and Albro Lake. Relatively high densities also exist in parts of Lower Sackville and Bedford.

- **Income**: The areas with the lowest average income tended to be consistent with the areas of the highest population density.

- **Transit Use**: The areas with the highest density of transit commuters were also consistent with the areas of the highest population density.

- **Employment**: The highest density of job centres is located in Downtown Halifax and to a lesser extent in Downtown Dartmouth. The peninsula in general has high employment density given that it contains many institutions such as Dalhousie University, the Halifax Shopping Centre, the QEII Health Sciences Centre, and the waterfront.

- **Land Use**: The Draft Centre Plan identified important downtowns, centres, and corridors throughout Halifax and Dartmouth and provided a basis for ensuring that proposed corridor route modifications serve mixed land uses as best possible.

- **School Enrolment**: Enrolment is increasing for most schools on the peninsula. Off the peninsula, enrolment is increasing at some schools and decreasing at others.

Transit Analysis

An initial review of the MFTP corridor routes revealed one notable strength and one notable opportunity for improvement. The corridor routes juxtaposed against the automatic passenger counter (APC) data revealed that the corridor service as proposed does an excellent job of providing coverage to the stops in Halifax Transit's network with the most significant boarding and alighting activity. On the flip side, the one notable opportunity for improvement that became immediately apparent upon examining the corridor route network presented in the MFTP is the fact that there is significant overlap between some routes and that opportunities exist to improve the efficiency of service delivery if Halifax Transit were to better leverage transfer points.

The best performing routes are those that remain within the highest demand areas of the Halifax Peninsula, Clayton Park, and Central Dartmouth, as well as those that serve a large number of important destinations, most notably Scotia Square, Spring Garden Rd., and the universities in the South End. The routes running further afield, such as

Route 8 (to Sackville), Route 6 (to the Eastern Passage), and Route 9 (to Herring Cove) are lower performing by comparison, although their performance is still strong.

Evaluating the performance of existing Halifax Transit routes and existing corridors is only valuable when it is contextualized. At what point, for example, do stops or segments need to be serviced by multiple corridor routes rather than a single one? This is a difficult question to answer, particularly in the Halifax Regional Municipality where there exists a challenging geography that can necessitate overlapping routes even if the combined level of service is more frequent than may be warranted by passenger demand.

For consideration in the analysis, the headways of the MFTP corridor routes are summarized in Table 1 below. Transit planning best practice is to maintain all routes within the same "layer" (all corridor routes can be considered a layer) at the same or similar frequencies. It is noted in Table 1 though that the levels of service within the corridor layer vary considerably.

Table 1: Corridor Route Service Frequency, as described in the MFTP

Route #	Target Headways (min)			
	Weekday Peak	Weekday Off-Peak	Saturday	Sunday
1 – Spring Garden	5-10	10	15	15
2 – Clayton Park-Downtown	15-20	15-20	15	20
3 – Crosstown	15	20-30	30	30
4 – Lacewood-Universities	10-20	15-20	30	30
5 – Portland	15	15	20	30
6 – Eastern Passage	10-15	15-20	30	30
7 – Peninsula	15	15-20	20	30
8 – Sackville	20-30	20-30	30	30
9 – Herring Cove	10-15	15-20	30	30
10 – Mic Mac	5-10	10-15	20	30

The corridor route review will seek opportunities to bring more consistency to the corridor route frequencies while maintaining similar levels of frequency along HRM's transportation corridors to those which are proposed in the MFTP. In order to understand whether the proposed modifications will result in similar levels of frequency along the corridors, however, it is important to evaluate the composite frequencies, or effective average frequencies along important corridors in the MFTP corridor route network. Table 2 below summarizes the effective average frequencies along corridors in the MFTP network which are served by multiple corridor routes.

Table 2: Effective Average Frequencies along important corridors

Corridor	Routes	Target Headways (min)			
		Weekday Peak	Weekday Off-Peak	Saturday	Sunday
Alderney Dr.	5, 6	6-8	7.5-9	12	15
Barrington St.	2, 5, 10	3-5	4-6	6	9
Gottingen St.	1, 5, 7, 10	2-3	3-4	5	6
Joseph Howe Dr.	2, 3	7.5-9	9-12	10	12
Lacewood Dr.	3, 4	6-9	9-12	15	15
Macdonald Bridge	1, 3, 5, 10	2-3	4-5	5	6
Mumford Rd.	2, 3, 9	4-6	5-7.5	7.5	9
North St.	2, 3	7.5-9	9-12	10	12
Robie St.	4, 7, 8	5-7	5-7.5	9	10
South Park St.	4, 10	3-7	6-9	12	15
Spring Garden Rd.	1, 5, 8, 9, 10	2-3	2-3	4	5

Halifax Transit should also ensure that on-time performance is actively monitored across its entire network, but particularly for the Corridor Routes layer, since it forms the backbone of the network and sees the greatest amount of ridership of the network. Stantec would suggest that Halifax Transit review its schedules to ensure they are programmed with sufficient running and recovery time; too much running time is not good, neither is too little. Route directness is another consideration which can impact a route's on-time performance. The importance of on-time

performance will grow as corridor routes are implemented given the MFTP mandate of building a "simplified transfer-based system".

Proposed Corridor Route Modifications

In keeping with the principles of the MFTP and building upon them to include considerations that are reflective of best transit planning practices, summarized below are the key principles upon which the proposed corridor route modifications were based:

- **Be respectful of what is working well in the current network, and of what is strong in the corridor route network in the MFTP. Make tweaks to the MFTP corridor route network but don't reinvent it.** In particular, the excellent corridor route coverage within the Regional Municipality, the fast travel times due to minimal transferring, and the built-in redundancy are all appropriate to a certain extent.

- **Ensure compatibility with the BRT Study, with planned and implemented transit priority measures, and with regional planning priorities as best possible.** The proposed modifications leverage the transit priority measures along Bayers Rd., Gottingen St., Robie St., and Young St. A route called the "H-Line" was also developed, representing a higher level of service compared to the other corridor routes and a candidate to evolve into a BRT route in the long term.

- **Strike the balance between improving the directness of corridor routes (which can be detrimental to coverage), and improving corridor route coverage (which can be detrimental to directness).** Some circuitous routing was eliminated, most notably by St. Mary's and Dalhousie Universities, while coverage was improved, most notably along Victoria Rd., Albro Lake Rd., and Pinecrest Dr.

- **Simplify the network by reducing the amount of overlapping corridor routes, and by encouraging transfers at locations where there is capacity to accommodate increased transfer activity.** The proposed modifications involve considerable network simplification, most notably in the collapsing of ten routes into nine, and in the modest consolidation of service in Downtown Halifax. Transfers are encouraged where there is capacity for increased transfer activity, and also at key intersections such as Robie St. and North St.

- **Improve user experience by improving consistency of corridor route service frequency, and by ensuring that corridor route modifications result in shorter travel times.** In the proposed modifications, Stantec is recommending three different permutations of route frequency including the following (weekday peak frequencies for illustrative purposes):
    - 5 minutes or less for the H-Line
    - 10 minutes for the other corridor routes (excluding routes 8 and 9)
    - 20 minutes for routes 8 and 9

The modified Corridor Route network is shown in the screenshot below in Figure 2 (compared to the MFTP Corridor Route network shown in Figure 1). Following this, the changes made to each of the routes are discussed one by one. It is acknowledged that as with any transit planning exercise, it is impossible to satisfy everybody. With every modification proposed there will be users who will be better off and those who will be worse off. The goal of this exercise, therefore, is not to ensure that everyone is better off, but rather to ensure that the number of people who will be better off with the modifications exceeds the number of people who will be worse off and that we are not disenfranchising already loyal customers.

Figure 1: MFTP Corridor Route Network

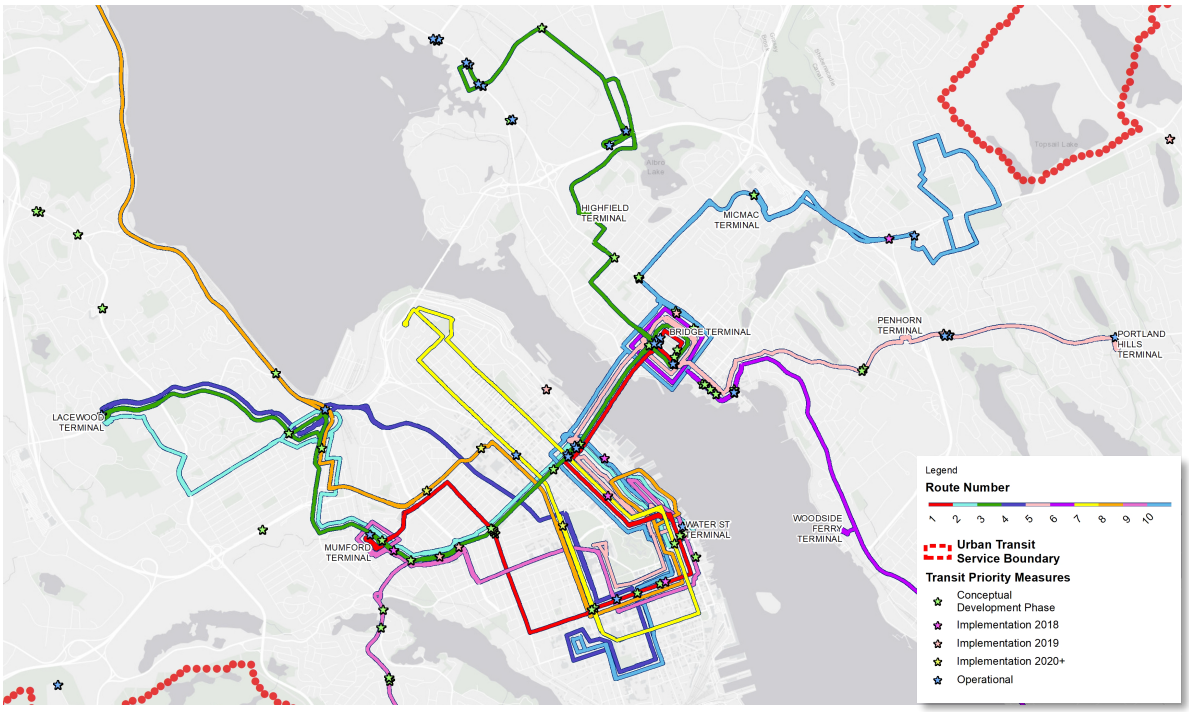
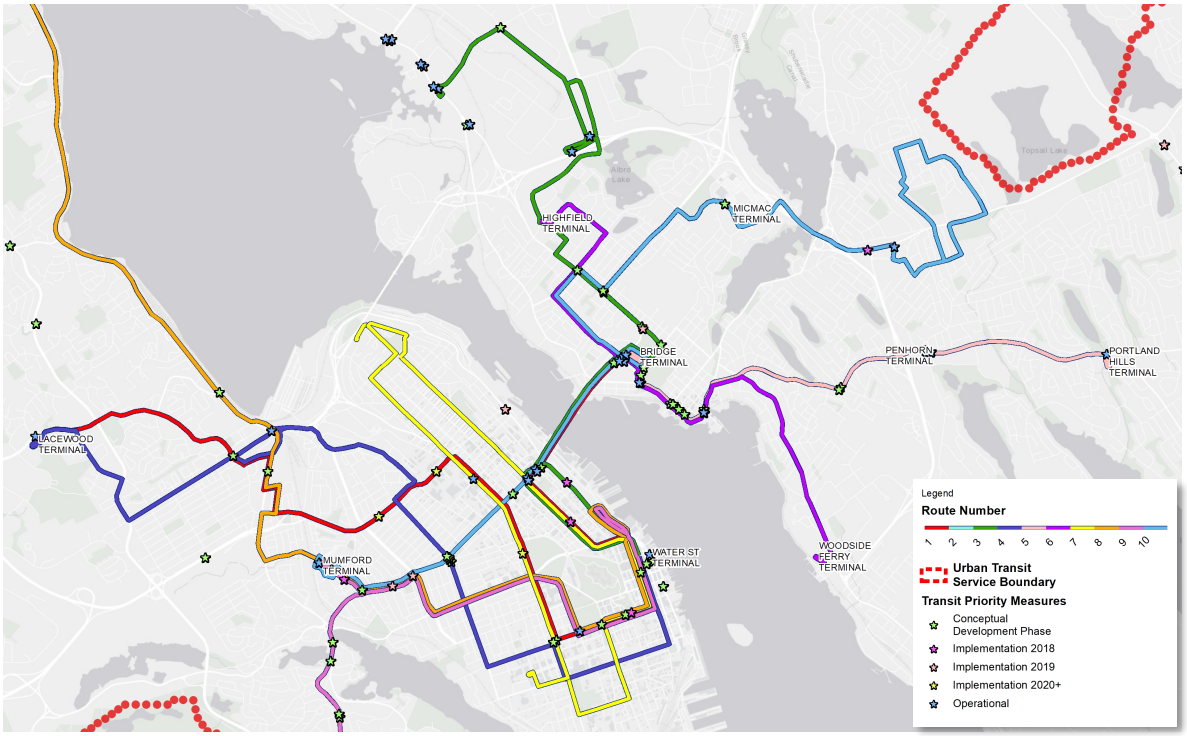


Figure 2: Proposed Modified Corridor Route Network



MFTP Route 1: Stantec proposes that Route 1 be converted into the H-Line, an enhanced bus service maximizing the value of the transit priority measures. The intent is to run the route at frequencies of 5 minutes or less during weekday peak hours. The H-Line retains a similar structure to that of Route 1 from the MFTP with a few notable

differences. First, the route's western terminus is in Clayton Park, with Lacewood Terminal and Bayers Rd. Centre receiving service instead of Mumford Terminal. Second, the alignment is proposed to run down Robie St. instead of Oxford St.

MFTP Route 2: It is proposed that MFTP Route 2 be eliminated. In the MFTP, the only unique section of the Route 2 alignment is the portion that runs along Willett St., Dunbrack St., and Main Ave. in Clayton Park. This section of the alignment, however, will be fulfilled by modified Route 4. Moreover, the connection between Clayton Park and Downtown Halifax will be fulfilled by the H-Line. Eliminating MFTP Route 2 frees up resources to reallocate elsewhere into the Corridor Route network – particularly to the H-Line which assumes greater frequencies than the other Corridor Routes.

MFTP Route 3: Several modifications are proposed to Route 3. Most notably, much of the alignment in Halifax has been removed, with the route now terminating at Scotia Square rather than continuing down North St. to Mumford Terminal, and then up Joseph Howe Dr. and across Lacewood Dr. to Lacewood Terminal. In addition, the route has been moved off of Wyse Rd., Albro Lake Rd., and Primrose St. in Dartmouth in an effort to serve Victoria Rd. from Thistle St. to Highfield Park Dr.

MFTP Route 4: Route 4 was modified to follow the same general path as the H-Line from Clayton Park to Downtown Halifax, but running on different streets to provide a coverage solution for those living (or going) off of the H-Line alignment. In Clayton Park, the route was moved off of Lacewood Dr. and onto Willett St., Dunbrack St., and Main Ave. similar to the path currently followed by MFTP Route 2. At the Windsor St./Bayers Rd. intersection, the alignment also diverts onto Bayers Rd. and then runs down Oxford St. to Coburg Rd. Finally, the modifications involve terminating the route in Downtown Halifax rather than at Dalhousie University. It was considered to reroute Route 4 through Mumford Terminal, but this was decided against in the interest of maintaining a coverage solution along Oxford St. (and to a lesser extent, Windsor St.), and to avoid the overcrowding of buses at Mumford Terminal and along Joseph Howe Dr.

MFTP Route 5: Route 5 was only modified insofar as it is now proposed to terminate at Bridge Terminal rather than travelling across the Macdonald Bridge to Downtown Halifax (and onward to Summer St./Bell Rd. during weekday peak hours). The rest of the alignment remains the same.

MFTP Route 6: An extension is proposed for Route 6, whereby rather than terminating at Bridge Terminal, Route 6 continues along Wyse Rd., turns up Albro Lake Rd., and then across Pinecrest Dr. to Highfield Terminal. This alignment is sufficiently different from Route 3 in that it provides new coverage in the Highfield Park and Albro Lake neighbourhoods and provides new transferring opportunities at Highfield Terminal. It also represents an increased supply of vehicles to service the significant demand between Bridge and Highfield Terminals and helps make transit a more compelling alternative for car users and discretionary riders. The rest of the alignment to the southeast of Bridge Terminal remains the same, with the assumption that the service south of Woodside Ferry Terminal runs on lower frequency and is more characteristic of local service, continuing to operate as a branch of Route 6.

MFTP Route 7: Route 7 involves a modification at the south end of the alignment. Rather than running down Robie St. to South St. and then up Barrington St., the route is instead proposed to run down Robie St. to Inglis St., and then up South Park St. to Spring Garden Rd., before turning onto Barrington St. The proposed modification also includes a diversion from Robie St. onto South St. and Lemarchant St. to service Dalhousie University.

MFTP Route 8: No modifications are proposed for Route 8 north of Bayers Rd. Centre. South of here, the route is proposed to continue along Joseph Howe Dr. and Mumford Rd. to Mumford Terminal. From here, Route 8 follows the same alignment as Route 9 across Quinpool Rd., down Bell Rd. and Summer St., and into Downtown Halifax. Due to high passenger activity along Bell Rd. and Summer St., and due to the high level of Corridor Route service that already exists on Robie St., it was deemed preferable to maintain coverage along Bell Rd. and Summer St., and forego the advantages of the transit priority corridor in this instance.

MFTP Route 9: No modifications are proposed to MFTP Route 9 other than to suggest that the frequency can be dropped from every 10-15 minutes at peak to every 20 minutes at peak. It is acknowledged that the section of alignment east of Mumford Terminal, which has the highest passenger activity, will have service every 10 minutes at peak as a result of the combined frequency with Route 8. It is the section of the alignment south of Mumford Terminal to Herring Cove that is proposed to run every 20 minutes. While this section of the alignment still has high passenger activity, in the context of a corridor route 20 minute frequencies should suffice. If additional service is deemed necessary, as passenger counts along Herring Cove Rd. are still fairly high, it is recommended that Halifax Transit explore a local route solution to supplement service.

MFTP Route 10: On the Dartmouth side, one minor modification to Route 10 is proposed in that the route is proposed to run along from Bridge Terminal along Wyse Rd. to Albro Lake Rd., and then back along Victoria St. to Woodland Ave. On the Halifax side, rather than running through Downtown and down South Park St. to St. Mary's and Dalhousie Universities, it is proposed to continue along North St. upon exiting the Macdonald Bridge, and then continue to Mumford Terminal terminating there.

Scheduling Considerations

Although the revenue-kilometres remain lower for the modified corridor network compared to the MFTP corridor network, we can conservatively assume that the revenue-hours are approximately equal. We can make this assumption considering that although travel times will be faster with the increased reliance on the corridors with transit priority measures, it is desirable to formally schedule appropriate running and recovery time to improve on-time performance. As such, Halifax Transit can theoretically implement the routes at the following headways at *no* additional cost to the operation.

As recommended by Stantec, it is desirable to standardize the route frequencies as best possible, with the H-Line having the most frequent service, and Routes 8 and 9 having the least frequent service, with the other corridor routes falling somewhere in the middle. We propose the following adjusted service frequencies in the implementation of the corridor routes.

Table 3: Recommended route frequencies for corridor route modifications

Route #	Frequencies (min)			
	Weekday Peak	Weekday Off-Peak	Saturday	Sunday
H-Line	3-5	5-10	10	10
Route 3	10	15	30	30
Route 4	10	15	30	30
Route 5	10	15	30	30
Route 6	10	15	30	30
Route 7	10	15	30	30
Route 8	20	30	30	30
Route 9	20	30	30	30
Route 10	10	15	30	30

The H-Line was left as a range of frequencies during the weekday with the intention that the frequency can be calibrated to the resources available, with the intention that the higher end of this range is expected to be cost-neutral or "zero sum", i.e. implementable without budget increases. Then, should more operations and maintenance funding for corridor routes become available in the future, Halifax Transit can invest these dollars into improving the frequency of the H-Line from the upper end of the range described above (i.e. every 5 minutes during weekday peak) to the lower end of that range (i.e. every 3 minutes during weekday peak). In the long-term, there may be additional considerations for route updates or for new Corridor Routes, particularly if additional funding is available.

Interlining is an important concept to explore further in the development of schedules. The following interlining possibilities are noted:

- Route 5 is recommended to operate as a branch of the H-Line, but be advertised as its own route. In the long-term, if demand proves itself, the H-Line could be extended to cover the full alignment of Route 5, and then Route 5 would no longer be needed.

- Routes 3 and 4 are recommended to be operated as if they were a single route, with one turning into the other at Scotia Square, in an effort to minimize the need for transferring.

Travel Time Mapping

Stantec performed a series of travel time mapping exercises to both support the analysis of the existing corridor routes as well as provide data-driven, transparent, and defendable arguments for our proposed recommendations. The travel time analyses were done in two capacities: (1) The estimated number of residents and jobs within a comfortable five-minute walking distance of corridor route bus stops, and (2) the estimated travel time as a transit rider on corridor routes between popular origins and destinations across the service area.

It is noted that both the existing network and the proposed network provide for a majority of the population and jobs within a comfortable walking distance to corridor route bus stops. There is a slight decline in the total estimate of people and jobs serviced in the proposed network when compared to the existing MFTP Corridor Route network. However, the number of routes and stops is also decreased which could lead to increased operational efficiencies and additional revenues for increasing service frequency and/or quality. We note additionally that the average ratio between the total number of people and jobs per bus stop actually increased in the proposed network; which suggests that our recommendations could utilize less resources and allow for a more efficient and optimized service.

As a whole across the network, travel time remains similar when comparing the MFTP and proposed network alignments. For some routes there were higher variabilities in travel time, such as those in and out of Lacewood Terminal. This indicates that special attention should be paid to service planning and scheduling when implementing the routes, and should be informed by real observed origin-destination habits by Halifax Transit riders to ensure the most amount of trips are able take the most direct or fastest routes.

Phasing

As Halifax Transit evaluates the operational impacts of the proposed corridor route modifications, it is recommended that it start by first implementing the modifications to Corridor Routes 5-9. More modest changes have been proposed to these routes compared to the others, so it should require less lead time to evaluate the scheduling and operational impacts. As routes 8 and 9 are intended to be closely related operationally, sharing the same alignment east of Mumford Terminal, it is also recommended for the proposed modifications for Route 8 to be implemented at the same time as the updated schedule for Route 9. Stantec recommends that Routes 8 and 9 depart Mumford Terminal in the inbound direction offset 10 minutes from each other, so that way the 10 minute composite frequencies along Quinpool Rd., Bell Rd., Summer St., and beyond may be achieved.

Once the changes to Routes 5-9 have been implemented, the second phase of implementation can involve implementing the H-Line, as well as Routes 3, 4, and 10, and removing Route 2. For Corridor Routes 2, 3, and 4, it is recommended that the proposed modifications be implemented alongside implementation of the H-Line. The H-Line can be marketed as a new and improved version of both Routes 1 and 2, which is supported by Routes 3 and 4 that follow the same general trajectory (Clayton Park – Downtown Halifax – Dartmouth) albeit servicing different locations.

It is recommended that Halifax Transit consolidate the implementation of all proposed modifications into these two phases (or even one phase, if possible). It is not recommended to implement these routes piecemeal, spread out over three or more phases. The value of the proposed corridor route modifications is in their synergies and ridership potential of the corridor route network as a whole – a whole which exceeds the sum of the parts.

Future Corridor Route Prospects

In addition to the proposed modifications, there are other areas that can be considered candidates for corridor route service in the future –

- **Dartmouth Crossing**, given the significant passenger activity along Countryview Dr. and along the roads south of Commodore Dr. Route 3 or Route 10 might be extended, if corridor service becomes warranted.

- **Shannon Park** is a developing neighbourhood and may warrant corridor service. A compelling option might be to upgrade local route 39 to corridor route status, thereby also improving service to/from Mount St. Vincent University. Local route 39 might then run from Shannon Park along Windmill Rd. (or Wyse Rd.) to Downtown Dartmouth, or up through Burnside and Dartmouth Crossing to Micmac Terminal.

- **SmartCentres Halifax** is likely still best served by local routes, but given the importance of the shopping centre combined with prospects for further development, it should be flagged in case it becomes appropriate to extend Route 4 westward.

- **Tower Rd. and Point Pleasant Park** may warrant corridor service in the future, with the biggest arguments in favour being the more convenient access point to St. Mary's University, as well as being a convenient spot to terminate a route (at the bottom of Tower Rd.). The other stops along this stretch have moderately high passenger activity too. Servicing this section would likely involve an update to Route 4 or 7.

- **Barrington St. north of North St.** is a proposed corridor for several express routes and two local routes, but zero corridor routes. If priority measures become installed here in the future, tweaking Route 7 to run along Barrington St. instead of Novalea Dr. may be worth considering.

- **Millview** has relatively high passenger activity at its stops, in particular those along Larry Uteck Blvd. Corridor service here might be operated as a branch of Route 8, and would fulfill the MFTP principle of ensuring that all of Halifax Transit's terminals, including West Bedford Terminal, are serviced by at least one corridor route.

Performance Monitoring and Decision-Making

Guidelines and performance measures are important to ensure that routes are performing as intended, delivering service that customers expect, while maintaining some level of financial sustainability. This includes developing service standards as well as triggers to help Halifax Transit determine appropriate classification of routes based on actual performance, as well as changes or adjustments to service. Four important categories of service standards to further develop include: frequency (or headway), loading, reliability, and service span. Halifax Transit needs to clearly define what the standards are for each attribute, how they are measured, and what they mean for the customer.

Stantec recommends that rather than focusing only one metric as a trigger for re-evaluating route service type, Halifax Transit should leverage a suite of indicators, including productivity, economic, reliability, comfort, and two-way demand indicators. Routes that consistently perform well, coupled with qualitative appraisal and public consultation, could be promoted to Corridor Route status. Meanwhile, routes that do not perform well even after corrective action could be specified as a Local Route and receive commensurate service.

Overall, the MFTP and layered approach to transit is one that allows for tiered allocation of resources, recognizing however that performance must be measured using appropriate and objective indicators, defined and transparent scoring mechanisms, and evaluated in a timely manner.

Conclusion

The proposed modifications to the MFTP corridor routes discussed in this report represents Stantec's best assessment of what will be most fruitful in terms of providing a high-quality service that will result in increased ridership, while being respectful to the current operating and fiscal constraints. As an independent third party able to review Halifax Transit operations and MFTP principles with a fresh set of eyes, our review was grounded in the data we analyzed, in our firsthand observations of the Halifax Regional Municipality, in our discussions with HRM and Halifax Transit staff, and in transit planning best practices.

The next steps resulting from this study are for HRM and Halifax Transit to carefully review the proposed modifications and evaluate them in more detail. Before implementation, it will be necessary to determine scheduling and timed transfer impacts, and also to consider whether it might be necessary to tweak other elements of the Halifax Transit network accordingly, including the local, rural, and express routes. Only when repercussions to the transit network as a whole are considered would it make sense to action the recommendations described in this report.

Moving Forward Together Plan – Corridor Route Review

Final Report

May 15, 2019

Prepared for:

Halifax Regional Municipality

Prepared by:

Stantec Consulting Ltd.

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Glossary

ADT	Average Daily Traffic
APC	Automatic Passenger Counter
AVL	Automatic Vehicle Location
BRT	Bus Rapid Transit
CUTA	Canadian Urban Transit Association
DA	Dissemination Area
GIS	Geographic Information System
GPS	Global Positioning System
HRM	Halifax Regional Municipality
IMP	Integrated Mobility Plan
MFTP	Moving Forward Together Plan
MSVU	Mount St. Vincent University
NSCC	Nova Scotia Community College
OTP	On-Time Performance
RMPS	Regional Municipal Planning Strategy
TCRP	Transit Cooperative Research Program
TOD	Transit Oriented Development
UTSB	Urban Transit Service Boundary

1.0 PROJECT BACKGROUND

1.1 PROJECT PURPOSE

Halifax Transit operates bus, ferry, and specialized transit services in the Halifax Regional Municipality (HRM), servicing a population of 316,780 as of 2016.[1] That same year, the *Moving Forward Together Plan* (MFTP) was approved by Regional Council, which proposed a redesigned transit network built on four principles:

1. Increase the proportion of resources allocated towards high ridership services.
2. Build a simplified transfer based system.
3. Invest in service quality and reliability.
4. Give transit increased priority in the transportation network.

The Urban Transit Service Boundary, as defined in the 2014 Regional Plan, illustrates the areas within HRM that support sufficient density to make transit service viable. Pursuant to Principle 1, the MFTP supports the development of Corridor Routes within the Urban Transit Service Boundary, and it supports the direction of a higher proportion of resources towards these Corridor Routes. Principle 2 translates into a greater level of service to the terminals, allowing for improved transferring between Local Routes and higher frequency Corridor Routes. Principle 3 involves investment in fleet and route improvements. To implement Principle 4, the Plan emphasizes a collection of measures including traffic signal priority, queue jumps, bus lanes, and transit corridors separated from other traffic.

The redesigned transit network described in the MFTP consists of new service guidelines and route classifications, with the highest-frequency routes, 'Corridor Routes', located at the top of the hierarchy. The Plan proposed to restructure routes in relation to the following service type categorization:

- Corridor Routes (Routes 1 – 19)
- Local Routes (Routes 20 – 99)
- Express Routes (Routes 100 – 199)
- Regional Express Routes (Routes 300 – 399)
- Rural Routes (Routes 400 – 499)
- Ferry Routes (Routes 500 – 599)
- School Routes (Routes 700 – 799)
- Access-A-Bus

The Plan also proposed continued upgrading of terminal and park-and-ride facilities to enhance user comfort.
The purpose of this Corridor Route Review study is to evaluate the Corridor Routes and recommend modifications to, or retention of, the number and routing of the Corridor Routes described in the MFTP, based on changes in existing conditions since the MFTP's approval.

Implementation of the MFTP assumed annual network updates over a five-year period, and as such the implementation of Corridor Routes is only partially complete, with routes 2, 3, 4, and 9 implemented already (as of October 2018) and the remaining routes to be implemented over the next few years. New and updated data that has become available since the creation of the MFTP will shed light on how the Corridor Route network may be modified in the interest of providing transit service more effectively and efficiently.

The evaluation of Corridor Route scheduling, Halifax Transit operations, and transit planning considerations unrelated to Corridor Routes, were all outside of the scope of this study. Determining scheduling and operational implications, as well as modifications to Local Routes and other route classifications that would result are the recommended next steps for exploration following this study.

[1] Canadian Urban Transit Association (CUTA) Fact Book 2016

1.2 PAST STUDIES

Recently completed and ongoing plans and studies including the *Integrated Mobility Plan (2017)*, the *Draft Centre Plan (2017)*, and the *Regional Municipal Planning Strategy (2014)* were reviewed to evaluate the interplay and compatibility between these plans and the MFTP. It is important to account for the insights contained within these studies and evaluate if updates are warranted to the MFTP's Corridor Route network accordingly. This is particularly important for the studies completed in 2017 which had not been completed at the time the MFTP was approved.

1.2.1 Integrated Mobility Plan and related transit priority corridor studies

The Integrated Mobility Plan (IMP) was in preparation at the same time as the MFTP. It dealt with transportation planning in HRM more broadly, offering the following vision for transportation development in the region:

> *Residents will have a choice of connected, healthy, affordable, sustainable travel options for moving both people and goods, through integrated transportation and land-use planning.*

The Plan identifies 137 specific actions to promote mobility throughout the municipality and encourage the use of non-auto modes. Among recommendations specific to transit service are:

- Higher density development in transit corridors
- Strategic application of transit priority measures
- Prioritize delivery of Transit Priority Corridors
- Improve passenger waiting environments
- Deliver Bus Rapid Transit Feasibility Study
- Implement dedicated bus lanes
- Complete a study of Commuter Rail Service
- Assess the feasibility of a ferry connection between North Dartmouth and Downtown Halifax
- Consider alternate service and cost sharing models to serve low-density areas outside of the Urban Transit Service Boundary
- Improve transit promotion and education.

The plan identifies specific routes as Transit Priority Corridors and its Action #91 specifically recommends that the Municipality should "Prioritize the delivery of Transit Priority Corridors, starting with but not limited to:

1. Bayers Road (Romans Avenue to Windsor Street).
2. Gottingen Street (North Street to Cogswell Street).
3. Robie Street (Young Street to Inglis Street).
4. Young Street (Windsor Street to Robie Street)."

HRM then commissioned studies of all four corridors in 2018. The studies addressed the corridors in pairs with Bayers Road and Gottingen Street prioritized first, followed by Robie and Young Streets. Corridor Routes should run along these priority corridors to the extent that is appropriate, to ensure the capital investments are effectively leveraged for what they are worth, and to maximize the quality of service for Halifax Transit users as it relates to travel time and on-time performance.

Bayers Road has a critical role in the HRM transportation network as it connects Highway 102 carrying traffic from Mainland North, Bedford, and Lower Sackville, as well as traffic from Highway 103, which accesses the southwestern suburbs and communities on the South Shore to routes on the Halifax Peninsula, particularly the Young Street corridor and, via East Perimeter Road, the Mumford Terminal. The Bayers Road study calls for widening of the roadway from the Halifax Shopping Centre driveway to Romans Avenue from four to six lanes to accommodate dedicated in and outbound transit lanes as well as a multi-use pathway on the south side of the road. It recommends the elimination of left turns from Bayers Road into the Halifax Shopping Centre to free two turning lanes to accommodate bus only lanes in a similar manner to the initial section of Bayers Road. Finally, it was proposed that

Bayers Road be widened between Connaught and Windsor Streets from three to four lanes to provide two dedicated bus lanes and two lanes for other vehicles.

Gottingen Street is a traditional two-lane commercial street with on-street parking that carries significant bus traffic between the Macdonald Bridge and the North End of the Peninsula, and Downtown Halifax. The study for Gottingen Street recommended a time-restricted northbound transit lane on the east side of Gottingen Street that provides dedicated space for northbound buses during weekday peak traffic periods (7AM-9AM, 3PM-6PM). As of Q4 2018, this lane is currently under construction. Right-turning traffic is also permitted to use the northbound bus lane at intersections, similar to other transit priority measures currently in use in Halifax (i.e. Windmill Road, Dartmouth). During off-peak periods, the lane accommodates time-regulated parking and loading. Parking, loading, and stopping on the west side of the street (southbound direction), which are currently accommodated intermittently, will no longer be permitted.

Young Street is a relatively wide (4 to 5-lane), straight street lined with large commercial and residential buildings and strip malls including a prominent grocery store. Robie Street is also generally wide with a variety of land uses ranging from single-detached homes and small scale commercial buildings to major apartment buildings, and office and institutional structures. Robie is particularly well-developed south of Cunard Street, from which point it has four lanes and an attractive central median. The report on Young Street provides a detailed examination of curbside and median transit lanes in both roadways and recommends continuous curbside transit lanes without time restrictions on all blocks in both corridors.

1.2.2 Draft Centre Plan

The goal of the Centre Plan (2017 Draft) is “to create complete communities that meet the needs of a diverse population while accommodating growth in a strategic manner”. This plan focuses on the Regional Centre, which consists of the Halifax Peninsula plus the portion of Dartmouth enclosed by Highway 111 and the Halifax Harbour, and aims to position the Regional Centre to accommodate growth and prosperity, and an enhanced quality of life. One of the Plan’s general policies is mobility, and there is a call to action for more convenient and accessible public transit, where strategies such as transit priority measures, improved scheduling, and integration with other municipal infrastructure are referenced as opportunities for improvement.

The Centre Plan further delineates the Regional Centre into downtowns, centres, corridors, future growth nodes, residential areas, and employment areas, providing a basis for further work in analyzing which types of transit services are better suited to which areas. Areas for transit service considerations and policy development include:

- Designated Downtowns in Halifax and Dartmouth
- Designated Centres along Gottingen and Young Streets, and Quinpool, Spring Garden, and Wyse Roads
- Designated Corridors along: Agricola St., Barrington St., Bayers Rd., Chebucto Rd., Cunard St., Gottingen St., Inglis St., Kaye St., Oxford St., Pleasant St., Portland St., Prince Albert Rd., Robie St., and Victoria Rd.
- Future Growth Nodes at Joseph Howe, Mic Mac Mall, Mumford, Penhorn, Highfield Park, Graham’s Grove, and Shannon Park

1.2.3 Regional Municipal Planning Strategy

The current Halifax Regional Municipal Planning Strategy (RMPS) was adopted in 2014 when it replaced the original RMPS adopted in 2006. The strategy covers the entire region, which includes the former Cities of Halifax and Dartmouth, and the former Town of Bedford, as well as surrounding suburban communities and extensive rural areas, particularly on the Eastern Shore. The regional document provides the framework for interpretation of more than 30 local plans applicable to subareas in the region. Most of these local plans predate the amalgamation of the two cities and the town with Halifax County in 1996, which created the current Regional Municipality.

Both editions of the RMPS have been very supportive of transit. Both versions emphasized transit as a key feature of transportation demand management and encouraged transit-oriented development. The 2016 RMPS reinforces the commitment to transit-oriented development by setting “growth targets of 25% of new housing starts (growth) in the Regional Centre, 50% in the urban communities and 25% in the rural areas of HRM.” The RMPS also sets complementary transit ridership goals to be achieved by 2031 of 23% for the Regional Centre (i.e., the Halifax

Peninsula and the core of Dartmouth within the Circumferential Highway), 20% for Inner Urban Areas, 10% for Outer Urban Areas, and 16% for the entire region, increasing each, respectively, from 18%, 15%, 9%, and 13%. Comparatively, the Integrated Mobility Plan sets out a target of 16% of regionwide trips to be made by transit by 2031. The Policy also requires new and revised secondary plans to encourage housing development "where transit is or will be available."

1.2.4 Emergent themes from past studies

In reviewing these studies alongside the MFTP, significant overlap in themes was observed. First, the premise of better integrating transit with the larger transportation network was a theme that emerged in all four documents. The 'larger transportation network' refers not only to personal vehicles, but also to active transportation modes and other elements of Halifax Transit services, i.e. route-to-route connectivity. This theme is evident in the MFTP through the principle of building a simplified transfer system, which refers not only to improving transit-to-transit transfers by tweaking routes and schedules, but also to transfers to other modes through improving passenger amenities and introducing new transit terminals and, if appropriate, park-and-rides. In the *Integrated Mobility Plan* (IMP), *Draft Centre Plan* (Centre Plan), and the *Regional Municipal Planning Strategy* (Regional Plan), themes of increasing transit mode share, improving terminal connections, integrating travel modes, and ensuring a connected mobility grid are all prevalent.

A second theme prevalent in these studies is that of targeted growth along specific corridors or nodes in the Regional Municipality. This is not evident in the MFTP, but is prevalent in the IMP, Centre Plan, and Regional Plan where priority corridors and growth areas have been identified, for which transit has been identified as an important avenue for fostering growth due to the anticipated Transit Oriented Development (TOD). Additionally, both the Centre Plan and the Regional Plan identify the Regional Centre (i.e. the Halifax Peninsula and the Dartmouth Centre) as particularly important growth areas into the future. Third, the theme of (and desire for) transit priority is discussed in both the IMP and Regional Plan in addition to the MFTP.

These themes are important to recognize in the context of the Corridor Route network. Any proposed modifications to the network presented in the MFTP, therefore, should ideally:

1. Promote integration with non-transit modes.
2. Encourage improved transferability at terminals in growth areas, and better facilitate connections between Corridor Routes and to other levels in the Halifax Transit hierarchy (Local Routes, Express Routes, etc.)
3. Run along corridors that are already (or are becoming) destinations in their own right.
4. Provide better levels of service, particularly in the Regional Centre.
5. Be in alignment with approved and proposed transit priority measures.
6. Result in improved systemwide ridership, and setting HRM up for success in achieving its desired target of at least 16% mode share on transit regionwide by 2031 (and 23% and 20% mode share on transit for 'regional centres' and 'inner suburban' areas respectively).[2]

In addition to reviewing the completed and ongoing planning studies, the Mumford Terminal Replacement Opportunities Assessment and the Bus Rapid Transit (BRT) Feasibility Study were also reviewed. Mumford Terminal and BRT considerations are highlighted below in Sections 1.2.5 and 1.2.6 respectively.

1.2.5 Special Project: Mumford Terminal Replacement

The recent study of the Mumford Terminal addresses one of the two Regional District Growth Centres identified in the RMPS. The Terminal at the western edge of the Halifax Peninsula has long been a critical node in the Halifax Transit network. Although the current terminal is a fairly recent, modern building, the Mumford Terminal Replacement Opportunities Assessment study explains that the terminal site is limited by space constraints. Its long narrow property offers limited space for laybys and a variety of amenities expected by transit users.

Alternative sites were examined within 1.5 km of the existing terminal to the north and east of the Armdale Roundabout applying the following selection criteria:

[2] Integrated Mobility Plan; Regional Municipal Planning Strategy

- Sufficient land area to accommodate the required terminal footprint;
- The potential to re-purpose a portion of the public right-of-way for the terminal;
- Proximity to major transportation corridors;
- Proximity to potential future BRT and commuter rail services;
- Proximity to a mix of land uses (e.g. residential, commercial, retail, services);
- Proximity to existing or planned higher-density development; and
- Ease of servicing by the existing municipal service and utility networks (e.g. water, sewer, electrical, etc.)

It was recommended that the terminal be moved onto lands adjacent to the current terminal now used for parking for the Annex Mall and a strip mall associated with West End Mall. The current terminal site will be freed for new retail development (including an estimate of 22,600 square feet and vehicle parking for the new and existing retail that will be to the east of the new terminal).

Before these recommendations can be implemented, however, there is likely additional work to be done in consulting with property management and with retailers before redevelopment moves forward. To enhance the impact of the new Mumford Terminal, for example, it would be prudent to build new retail space to ensure the terminal remains a destination in its own right, and also to consider the impact of the businesses in the Annex Mall which will have limited accessibility during construction and limited parking following construction. These uncertainties suggest that the redevelopment of Mumford Terminal may be a longer-term process. Particularly since the Mumford Terminal is currently at capacity and cannot accommodate an increase in transfer activity, in evaluating proposed modifications to the MFTP's Corridor Routes, consideration will be given to what may be possible both before and after the terminal is redeveloped.

1.2.6 Special Project: BRT Feasibility

Finally, the Bus Rapid Transit (BRT) Feasibility Study summarizes the concept of a BRT and presents the methodology that was followed for evaluating its appropriateness in Halifax. Following analysis of boarding and alighting activity at stops, and after undergoing a round of stakeholder and public engagement, the conceptual design of a BRT network was drawn. This resulting BRT network was accompanied by information about route alignments, stop/station locations, and possible station configurations, as well as commentary on operations planning, technology, and branding. Finally, cost estimates and an implementation strategy were provided.

The BRT Feasibility Study proposed four BRT routes as follows:

- From Cowie Hill Rd. to Bridge Terminal, via Chebucto Rd., Mumford Terminal, Bayers Rd., Young St., Gottingen St., and the Macdonald Bridge
- From Lacewood Terminal to Water St. Terminal, via Lacewood Dr., Joseph Howe Dr., Mumford Terminal, Chebucto Rd., Oxford St., Coburg Rd., Spring Garden Rd., and Downtown Halifax
- From Portland Hills Terminal to VIA Rail Station, via Portland St., Alderney Dr., Bridge Terminal, Macdonald Bridge, Gottingen St., and Downtown Halifax
- From Mount St. Vincent to VIA Rail Station, via Bedford Hwy., Kempt Rd./Massachusetts Ave., Robie St., Dalhousie/St. Mary's Universities, and Inglis St.

These four routes have considerable overlap with the alignments of the MFTP Corridor Routes. However, while the Corridor Routes are intended to provide coverage throughout the Halifax Regional Municipality, the BRT network only extends as far as Lacewood Terminal in the west, Portland Hills Terminal in the east, Mount St. Vincent University in the north, and Cowie Hill Rd. in the south. This is to ensure that BRT infrastructure investments are made in high-traffic areas where investments will provide the greatest impacts. Although Corridor Routes are not explicitly mentioned in the BRT Feasibility Study, presumably they are envisioned to complement the BRT routes by providing some additional redundancy (allowing for more flexible travel options) while extending the geographical reach into areas such as Bedford, Sackville, Herring Cove, Burnside, Micmac Village, and the North End.

While the BRT Feasibility Study involved significant planning and analysis, and resulted in meaningful conclusions, in the context of Stantec's review of the MFTP Corridor Route network its usability was limited. First, it is important to note that the BRT Feasibility Study was completed independently of the MFTP, and therefore the BRT Study does not describe any considerations for the corridor routes. It also does not describe a bigger-picture implementation strategy nor does it describe how the BRT proposal creates synergies with existing or proposed corridor, local, and rural routes. Impacts on local bus service were not considered among the BRT evaluation criteria. As such, it is difficult to comment on the extent to which the BRT augments corridor routes versus replaces them. Additionally, the BRT Study does not appear to have been completed in coordination with ongoing transit priority measure efforts. These items were not a part of the scope of work of the BRT Feasibility Study and this creates challenges in the form of attempting to integrate the BRT Study's findings into the corridor route modifications. Rather than attempt to marry together the BRT Study with the MFTP, Stantec opted for considering BRT planning principles more broadly in its proposed corridor route modifications discussed further in Section 4.

2.0 SERVICE AREA REVIEW

Before making a deep dive into recent performance of Halifax Transit, it is important to continue to set the stage by profiling the service area and the market for transit and for Corridor Routes. Specifically, the review will focus on the elements which affect transit uptake and route performance, including population density, income, transit use, employment, land use, and school enrollment.

2.1 POPULATION DENSITY

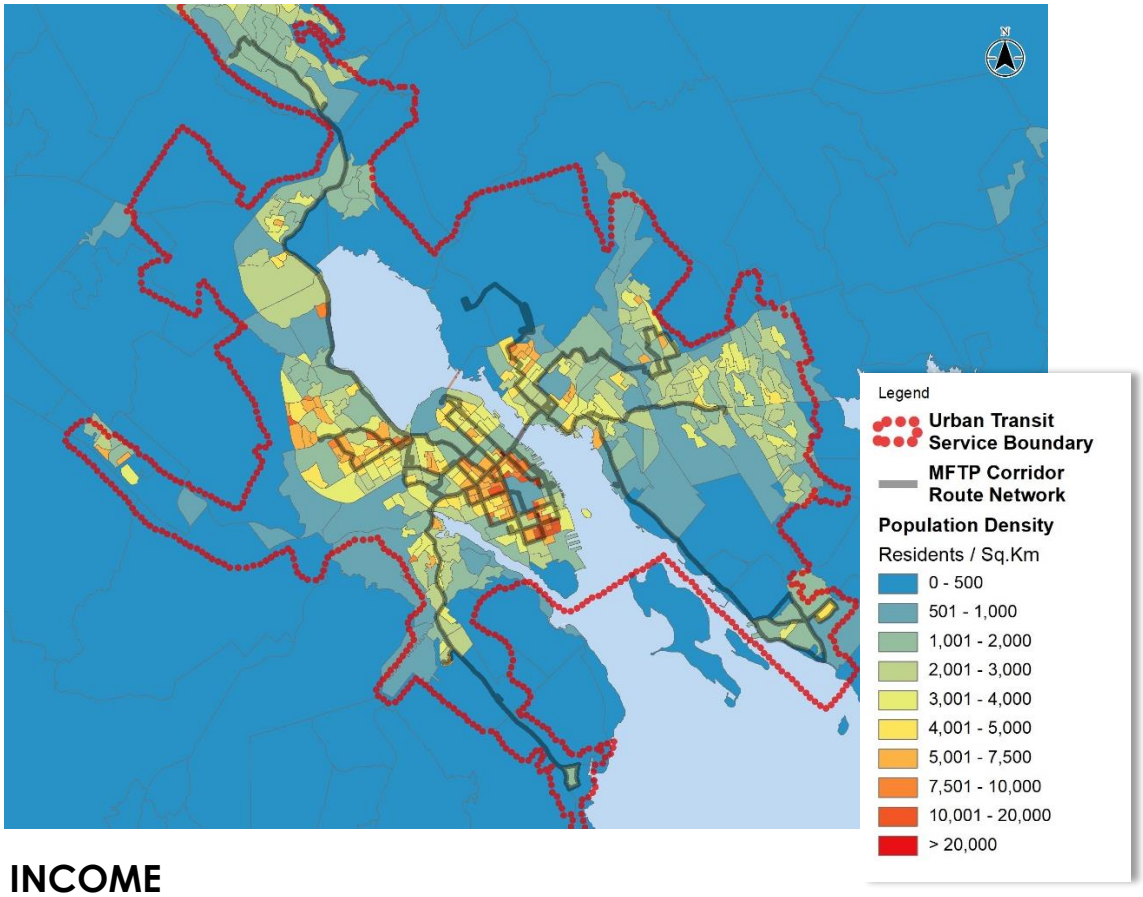
Residential or population density is a key indicator of transit use and of route performance—put simply, more people means more potential riders. And while not all transit trips begin or end at home, a substantial number of trips begin or end at home on most days. In addition, residential land uses also generate trips from visitors, for home-based services, etc.

In Halifax, the densest neighbourhoods are found on the peninsula, mainly in the South End neighbourhood. Interestingly, beyond the peninsula, neighbourhoods such as Clayton Park and Clayton Park West, have densities nearly comparable to some central neighbourhoods, and have greater residential densities than neighbourhoods to the south of the peninsula such as Armdale and Spryfield. Nevertheless, upon closer inspection of the street network and housing types, it's clear that downtown neighbourhoods are dense and have gridded streets that facilitate transit service, while neighbourhoods that are in the suburbs may have relatively high density, but are characterized by curvilinear cul-de-sacs that are difficult to serve efficiently with transit vehicles, suggesting that residents in these neighbourhoods require longer walks to transit service along main arterial roads—this may discourage some transit use.

Generally speaking, residential density is lower in Dartmouth than it is in Halifax. Nevertheless, there are some dense neighbourhoods, generally northwest of downtown Dartmouth, including Highfield Park and Albro Lake. Again, similar to inner-ring suburban neighbourhoods in Halifax, neighbourhoods like Highfield Park and Albro Lake are designed with apartment blocks on curvilinear streets that reduce street connectivity, and thus may result in longer walks to bus stops, as well as meandering route alignments.

Corridor Routes should aim to provide high-quality transit service to neighbourhoods with high residential density, while balancing the need to design direct routing along walkable, gridded streets when possible.

Figure 1: Population Density



2.2 INCOME

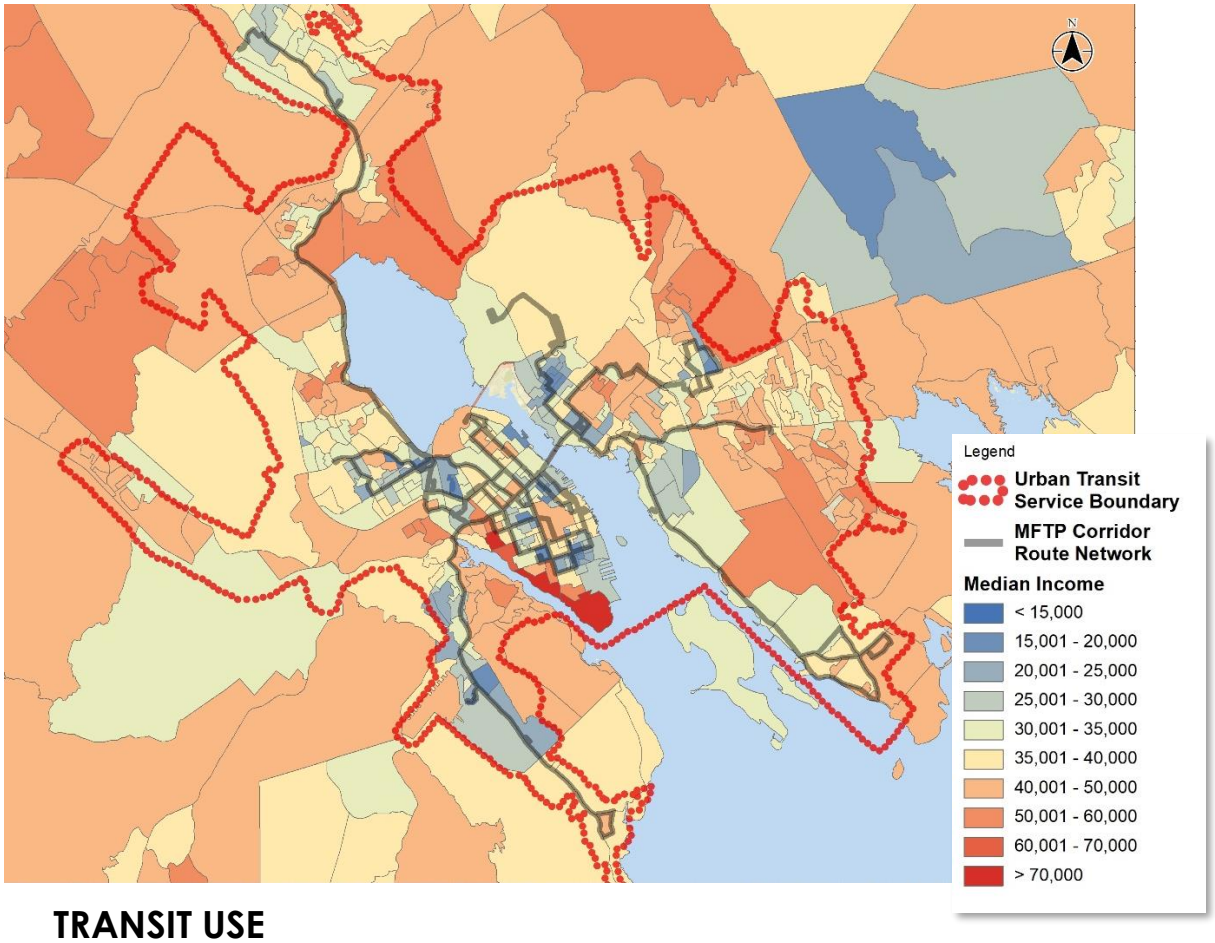
A major determinant of public transit usage is car ownership. Without car ownership data, a good proxy is household median income, with the rationale that households with lower incomes are less likely to own a vehicle (and if they do, they devote a large portion of income to it) and thus are more likely to use public transit.

Income and Housing/Population Density

A population with a greater need for transit (due to lack of a vehicle or other options for travelling) located in neighbourhoods that provide useful spatial components for transit (higher density, granular street layout), significantly increases the propensity of transit use. By proxy, these two characteristics – income and housing density – also increase the propensity of Corridor Route use.

This is indeed the case in the HRM, in both Halifax and Dartmouth. For example, in the South End adjacent to Halifax's downtown, median household income is relatively low and contains high residential densities. Similarly, in Dartmouth, Albro Lake and adjacent neighbourhoods also have low median household incomes coupled with higher residential densities. Together, these areas are likely excellent candidates for transit, housing many people who likely depend on transit as a predominant mode choice. Moreover, providing transit access to low-income neighbourhoods helps ensure that households with few travel options have viable travel opportunities through transit, addressing social equity concerns, while also providing transit in areas where it is more likely to be used by residents. At the same time, it is important to note that social equity concerns cannot be addressed in isolation. Coupling income with population density and other variables is necessary to ensure transit service is viable, particularly for higher frequency routes such as Corridor Routes.

Figure 2: Median Income

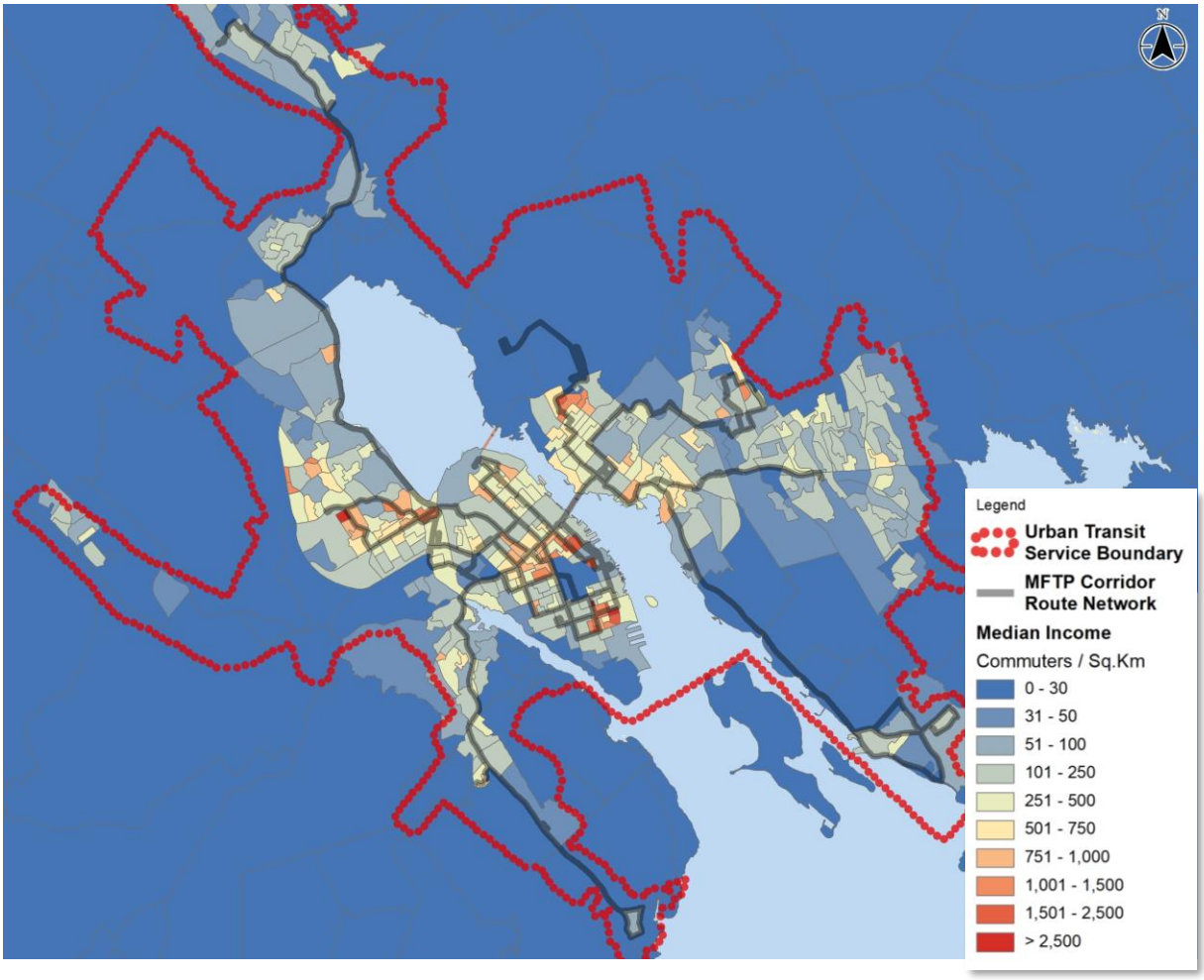


2.3 TRANSIT USE

This map of transit commuter density (number of transit commuters per square kilometre) confirms the ideas presented above—dense residential neighbourhoods typically with lower incomes are the same neighbourhoods where more residents commute to work by public transit. Furthermore, this map is different from typical mode share maps where commuters using public transit are displayed as a percentage of all commuters. This map of commuter *density* helps us distinguish areas that may have large transit mode shares, but relatively low population density compared to other areas that may have lower transit mode shares, but at higher population densities. Again, serving higher commuter density areas is key for having productive transit routes like the Corridor Routes.

However, this map has some limitations and also points to some opportunities. This map shows public transit use for work trips only, and tells us nothing about other trips, like shopping, recreation, errands, etc. These trip purposes are also very important and productive transit routes (and also Corridor Routes) are those that are used for multiple purposes, by many people throughout the day. To understand where these land uses are located, we can look at employment density which reveals where people are travelling to work, but also where people are travelling to for activities at these locations, such as to shop, to eat, to worship, to study, to exercise, and so on. Finally, the transit commuting map may also provide insight into areas within the Halifax Regional Municipality that have a high level of transit service but a relatively low number of commuters. This may suggest that there are areas of the bus network that can be reconsidered to better serve residents, in an effort to improve ridership and transit mode share. These are opportunity areas for Corridor Routes.

Figure 3: Public Transit Commuting



2.4 EMPLOYMENT

As alluded to above, Corridor Routes are likely to be successful and productive if they connect people to activity generators—these destinations typically serve as employment locations *and* places of interest and as such, employment density is one of the strongest predictors for transit use.[3] Moreover, clusters of institutional employment tend to also be activity generators, as is the case for academic institutions, health centres, and hospitals.

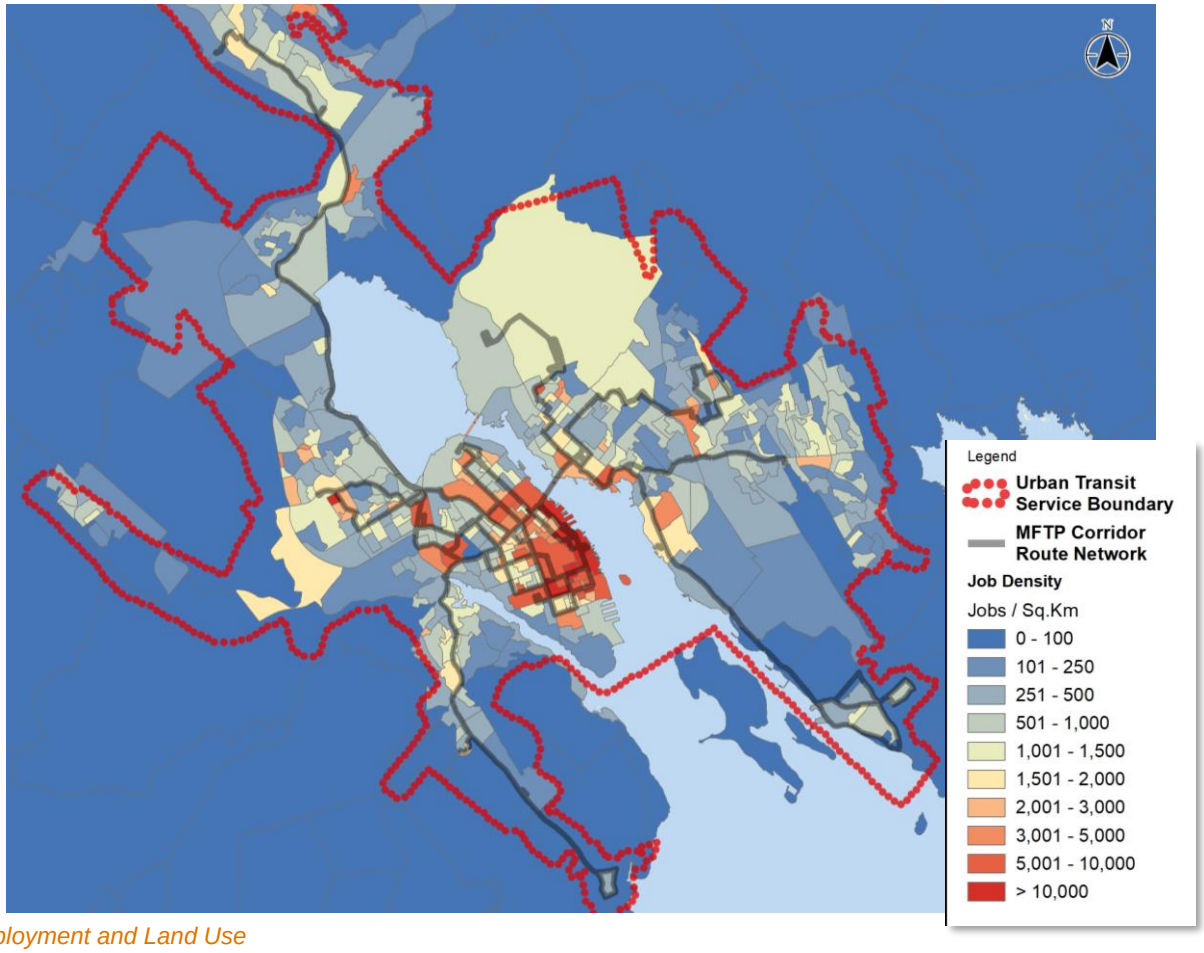
The highest density job centres are located in downtown Halifax and to a lesser degree in downtown Dartmouth. Furthermore, medium density job centres are located on the Peninsula, including at institutional land uses like Dalhousie University, along the waterfront, and at clustered locations such as shopping centres (Halifax Shopping Centre) and the QEII Health Sciences Centre.

Ensuring that transit provides connections between work and home (employment and residential density, respectively) is important for designing useful routes, but may also draw from a limited market, since not all employment density generates the same level of transit demand—for instance, a shopping centre may have limited transit demand due to abundant and free parking, compared to employment density in older central neighbourhoods,

[3] Of course, not all types of employment generate the same level of transit ridership or demand, with some employment, like service industry, health care, and retail typically better suited for transit than construction or heavy industry, for example.

where a mix of land uses and limited parking, together with a walkable streetscape can create significant transit demand.

Figure 4: Employment Density along Corridor Routes



Employment and Land Use

Indeed, to build ridership and design successful Corridor Routes, transit needs to connect many different land uses, such as retail, educational, and residential in order to be useful for many different people across the day. These types of land uses are usually disbursed along corridors at distances too far to walk but long enough to generate overlapping transit markets, that is, two-way all-day ridership from riders accessing different destinations at different locations along a corridor.

The map below from the Draft Centre Plan shows the different types of land uses in the centre of the HRM. Routes traversing the downtowns, centres, and corridors will likely generate high two-way ridership, while established residential neighbourhoods will most likely generate high one-way ridership, such as toward employment and retail centres in the morning, and away from these centres in the afternoon. These are typically peaked demand trips. Corridor Routes should aim to generate all-day demand by linking multiuse areas. For example, the South End of Halifax has all the necessary ingredients for productive transit routes—density, diversity of land uses, and a connected street network—resulting is high transit commute mode share.

Future Developments

These observations indicate that for future developments to successfully support transit services (and eventually Corridor Routes, as explored further in section 5.2), these developments should aim to have connected, walkable streets, with dense and mixed land uses. In this way, since the “Future Growth Nodes” are at the periphery of the

Centre, Corridor Routes may be anchored at these new developments or connect to these new nodes along their Corridor Route alignments, providing convenient transit options for future residents and fostering transit use over vehicle use.

In summary, Corridor Routes aim to provide frequent and attractive service, and as such, rely on patronage to be productive and cost-effective for Halifax Transit to operate. Successful transit routes that generate two-way ridership throughout the day from a diverse ridership market are those that connect dense, multiuse neighbourhoods, with multiple destinations.

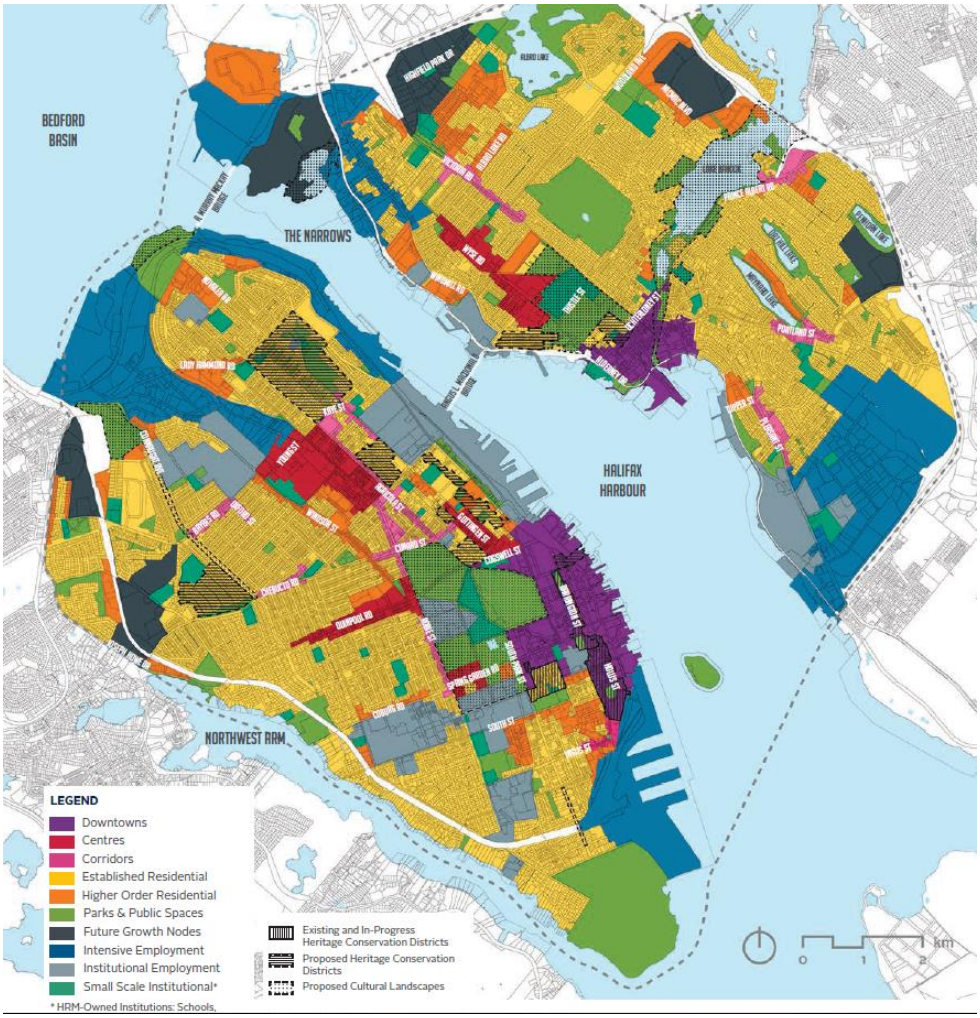
2.5 LAND USE

As discussed above in section 2.4, to build ridership and design successful routes, transit needs to connect many different land uses, such as retail, educational, and residential in order to be useful for many different people across the day.

The map below from the Draft Centre Plan shows the different types of land uses in the centre. Routes traversing the downtowns, centres, and corridors will likely generate high two-way ridership, while established residential neighbourhoods will most likely generate high one-way ridership, such as toward employment and retail centres in the morning, and away from these centres in the afternoon. These are typically peaked demand trips. The same can also be said of industrial, retail, and other areas that have only a single land use. Corridor Routes should aim to generate all day bidirectional demand as best possible by linking multiuse areas.

Finally, this map also demonstrates growth areas. Depending on the intensity of land development and its diversity, these communities could serve as nodes along the Corridor Route alignments.

Figure 5: Land Uses in the Regional Centre



2.6 SCHOOL ENROLMENT

Public transit tends to derive a substantial ridership base from students traveling to school, particularly in urban areas without yellow school bus service, as well as from parents or guardians who take children to school via transit. Moreover, students who are too young to drive are also transit users for other purposes than traveling to school, like visiting friends or traveling to recreational opportunities. Many lines of research have shown that users who start using transit at a young age tend to continue to ride transit into adulthood, suggesting that Halifax Transit should provide quality service to schools as a way to provide mobility to students, retain their ridership later in life, and enable parents to drop their children off without a personal vehicle.

School enrolment has increased for most schools on the peninsula, in particular at schools like Gorsebrook Junior High School (nearly 28%), and to a lesser degree Citadel High School (less than 1%). Corridor Routes 7 and 4 provide connections to these schools, as well as other transit generators, like hospitals and parks. Off the peninsula, there are also many schools with an increase in enrolment but there are also a large number of schools with a decrease in enrolment. Overall, Corridor Routes that provide service to schools is a good strategy for building ridership. Similar to discussions above, Corridor Route modifications need to look at school enrolment in the context

of the other factors discussed throughout section 2 such as land use, employment, income, and population density. It would be imprudent to propose a Corridor Route modification based solely on the purpose of connecting a school.

2.7 COMMUNITIES BEYOND HALIFAX AND DARTMOUTH

Beyond the urban centres of Halifax and Dartmouth, other communities vary with respect to their transit-supportive characteristics and therefore the level of transit service they can successfully sustain. For example, parts of Lower Sackville and Bedford northwest of Halifax display relatively high residential densities, as well as higher densities of public transit commuters. They also contain non-residential destinations such as the Sackville Business Park and Mill Cove Plaza. These denser areas with mixed land use are likely favourable for Corridor Route services.

On the other hand, some jurisdictions outside the urban centres have low residential densities in higher income neighbourhoods; perhaps unsurprisingly, these areas, such as Herring Cove and Cole Harbour have low densities of transit commuters. In the case of Herring Cove, Corridor Route 9 provides frequent service although the density is low and two-way passenger activity along the route (along Herring Cove Rd.) is sparse, indicating that Herring Cove may best be serviced as a branch of Corridor Route 9, or even an express route at peak hours, depending on predominant travel patterns.

Taken together, these more remote areas could benefit from frequent Corridor service, helping residents switch from vehicles to transit, at least for some trips. Nevertheless, many of these Corridors travel along segments where little two-demand is generated, mainly due to land uses, poor pedestrian infrastructure (if any) and long distances between major points of interest, such as along Bedford Hwy. This can typically result in a higher per passenger cost. While Corridor Routes may provide frequent and attractive service at major nodes with many points of interest, the ongoing MFTP process could leverage treatments to speed up travel for customers along Corridor Routes that serve more far flung areas by removing bus stops with low passenger activity, while trying to maintain an adequate distribution of bus stops such that at least 90% of residents remain within 500 metres of a stop. Alternatively, for certain communities, Corridor Route service may not be appropriate, and Express Routes may be able to better fulfill those communities' public transit needs.

3.0 HALIFAX TRANSIT ANALYSIS

3.1 PERFORMANCE ALONG CORRIDOR ROUTES

An initial review of the MFTP corridor routes revealed one notable strength and one notable opportunity for improvement. The corridor routes juxtaposed against the automatic passenger counter (APC) data revealed that the corridor service as proposed does an excellent job of providing coverage to the stops in Halifax Transit's network with the most significant boarding and alighting activity. While there are high activity stops that are missed, these stops are often isolated from other high activity stops, for example in the case of Hubley Centre Park and Ride, which is more appropriately served by a rural route than a corridor route. The other primary reason that high activity stops are missed is a due to inefficient routing options. This is the case of the high activity stops along Chain Lake Dr., which has limited connectivity to the rest of the Halifax road network, therefore creating limited opportunities for corridor service.

By and large, it appears as though there are limited opportunities to propose corridor route modifications for the purpose of extending coverage to other high activity stops. The Integrated Mobility Plan lists additional transit priority corridors along Victoria Rd. (NW of Primrose St.), Barrington St. (NW of North St.), and the Bi-Hi, however, none of these locations appear to be fruitful in terms of existing levels of service and existing passenger activity to warrant corridor level transit service. What is more interesting in terms of possibilities for future corridor route coverage is in growth areas such as Shannon Park. A discussion of these opportunities is provided in Section 5.2.

On the flip side, the one notable opportunity for improvement that became immediately apparent upon examining the corridor route network presented in the MFTP is the fact that there is significant overlap between some routes and that opportunities exist to improve the efficiency of service delivery if Halifax Transit were to better leverage transfer points. An example of some of this overlap is perhaps most evident in Route 2, which aside from the segment of the alignment running along Willett St., Dunbrack St., and Main Ave., is entirely overlapping with other routes in the corridor network. Admittedly, the Halifax Regional Municipality has challenging geography and no other routes in the corridor network fulfill the same purpose of connecting Clayton Park to Downtown Halifax with a one seat ride, but the extent of the overlap suggests there is room for improvement.

It is also acknowledged that some transfer points such as Mumford, Water, and Bridge Terminals are currently at or near capacity, though at the same time we note there are plans to redevelop Mumford Terminal, and that improving transferability does not necessarily have to be constrained to the existing terminals. By encouraging some on-street transferring, where appropriate, that alleviates the burden on each of the terminals individually. On-street transferring may help simplify trips by making passengers' journeys more direct, thereby also making total trip times shorter. Best practice is for on-street transfer points to include passenger amenities such as shelters and benches, to ensure that trips are not uncomfortable from the users' perspective.

The results of the January 2014 public consultation suggest that transferring is acceptable from the users' perspective provided it is not a detriment to their travel time. The statistics shown in the table below illustrate that 94% believe Metro Transit's priority involves transfers in some capacity, and 98% have indicated conditions in which it is okay to need to transfer.

Table 1: Public consultation results related to transferring

I think Metro Transit's Priority should be…		**Under what condition is it OK to need to transfer?**	
To try to strike a balance by encouraging transfers at strategic locations, and by otherwise offering single seat trips where possible	40%	When it makes the total trip time shorter	17%
To improve service reliability and frequency as much as possible, even if this might mean that more trips will require a transfer	36%	When there is a good place to wait for the next trip	13%
To simplify the transit system and make it easier to understand and use, even if that means more trips will require a transfer	18%	When it results in a less confusing transit network	6%
-	-	A combination of the above	62%
TOTAL % OPEN TO TRANSFERRING	**94%**	**TOTAL % OPEN TO TRANSFERRING**	**98%**
The provision of single-seat trips. Requiring transfers would likely discourage people from making use of transit at all	6%	None. I think that a single seat network is better	2%

The prospect of evaluating existing corridor route performance is limited in the sense that the only corridor routes that have been implemented at the time of this study are Routes 2, 3, 4, and 9, and only Corridor Route 9 has been implemented for a long enough period to have datasets sufficient for analysis. Instead, corridor route performance was evaluated by reviewing the performance of the current routes (prior to the August 20, 2018 update), which were similar enough to the MFTP corridor network that they were deemed to be acceptable proxies. In reviewing route performance, Stantec focused on Halifax Transit Q3 2017/18 data, as this was the most current dataset available at the time of the study. We took a comprehensive approach to data analysis, of which the most interesting results are summarized in the table below.

Table 2: Corridor route performance (Q3 2017/18)

Corridor Route #	Route # as of Q3 2017/18	Avg. weekday boardings	Passengers / hr	On-time Performance	Comments
1	1 (pre-update)	10,347	71	63%	Best performing route, though low on-time performance suggests scheduling may need review.
2	2 (old)	2,693	44	68%	Strong combined performance.
	4 (old)	2,474	40	77%	
3	52 (old)	5,775	48	76%	Second-best performing route and with better on-time performance.
4	17 (old)	1,307	32	54%	Moderate-to-strong combined performance. Low on-time performance to be addressed in new Route 4 scheduling.
	18 (old)	2,031	34	68%	
	42 (old)	1,422	38	65%	
5	59	2,019	26	81%	Strong combined performance in terms of ridership, but lowest passengers/hr suggests frequency may need review.
	61	2,247	29	72%	
	68	1,343	27	76%	
6	60	2,857	37	83%	Moderate combined performance.
	63	810	47	91%	
7	7 (pre-update)	5,315	46	74%	Strong performance.
8	80	4,215	33	64%	Moderate-to-strong performance, though low on-time performance suggests scheduling may need review.
9	9	5,291	31	79%	Strong performance.
10	10	5,167	47	80%	Strong performance.

Note: Since the implementation of Corridor Routes 2, 3, and 4, average weekday boardings and passengers/hour are as follows –

- *Route 2 average weekday: 4,315 boardings, 40 passengers/hr*
- *Route 3 average weekday: 6,208 boardings, 41 passengers/hr*
- *Route 4 average weekday: 4,950 boardings, 39 passengers/hr*

By and large, existing ridership data suggests that corridor routes are being implemented in the areas where they are most warranted in terms of routes with high existing levels of both service and ridership. Moreover, the MFTP corridor route network appears to consolidate routes that serve similar purposes, for instance in the case where routes 17, 18, and 42 were consolidated into route 4 running between Lacewood and St. Mary's and Dalhousie Universities. In the absence of trip origin and destination data, one can examine the underlying purposes of each of the corridor routes against the combined average daily boardings to get a better sense of which connections are most important within the Halifax Transit network. Table 3 below summarizes the connections from most important to tenth most important as suggested by the data available.

Table 3: Corridor route performance sorted by average boardings per stop

Corridor Route #	Route Purpose	Combined Avg. Weekday Boardings	# of Stops Along the Route	Avg. Boardings Per Stop[4]
4	To provide a one seat ride between Clayton Park and St. Mary's and Dalhousie Universities, and to provide coverage along Windsor St. Also to service the hospitals adjacent to Robie St.	4,760	78	61.03
1	To provide a high frequency connection between Bridge Terminal and Downtown Halifax, and between Mumford Terminal and Downtown Halifax. Also to provide service to Dalhousie University and along Spring Garden Rd.	10,347	199	51.99
10	To provide service to the Micmac Mall and beyond to NSCC and environs, and to provide a direct connection between Dartmouth and St. Mary's and Dalhousie Universities.	5,167	103	50.17
2	To provide a one-seat ride between Lacewood and Downtown Halifax, and to improve coverage in Clayton Park / Fairview.	5,167	107	48.29
5	To provide service to Portland Hills, including a Downtown Halifax connection.	5,609	120	46.74
7	A Halifax Peninsula circulator that provides coverage at the north end of the Peninsula and many transfer opportunities.	5,315	152	34.97
9	To provide service to Herring Cove and along Quinpool Rd., including a Downtown Halifax connection.	5,291	153	34.58
3	To provide a one-seat ride between Lacewood and Dartmouth, and to provide a fast connection between Mumford and Dartmouth. Also to provide corridor service to Burnside.	5,775	192	30.08
6	To provide service down Pleasant St. to Woodside and beyond.	3,667	164	22.36
8	To provide service to MSVU and up the Bedford Hwy. to Bedford and Sackville, and to connect all these destinations to Downtown Halifax.	4,215	235	17.94

Unsurprisingly, the best performing routes are those that remain within the highest demand areas of the Halifax Peninsula, Clayton Park, and Central Dartmouth, as well as those that serve a large number of important destinations, most notably Scotia Square, Spring Garden Rd., and the universities in the South End. The routes running further afield, such as Route 8 (to Sackville), Route 6 (to the Eastern Passage), and Route 9 (to Herring Cove) are lower performing by comparison, although their performance is still strong.

[4] A limitation of average boardings per stop is that it is inclusive of all routes serviced by the stop; not only the boardings relevant to the corridor route. It is nevertheless a useful proxy for understanding the relative importance of the corridors.

What is somewhat surprising is that the performance of Routes 3 and 7 is also lower by comparison, more akin to the performance of the corridor routes running further afield than to the performance of the corridor routes serving the areas of highest demand. Route 3 in particular is a surprise, given that it is the only corridor route to service the high employment area of Burnside, however, it is noted earlier in Table 2 that Route 3 has the second-highest passengers-per-hour (48), and also the second-highest average weekday boardings (5,775). This can be considered sufficient evidence that Route 3 is a critical component of the corridor route network despite the somewhat lower average boardings per stop. This is not to suggest that Route 3 necessarily needs to remain as-is following the proposed Corridor Route modifications, rather it is to suggest that the areas currently served by Route 3 should also continue to be served following the proposed modifications.

3.2 TRAFFIC COUNT CONSIDERATIONS

To supplement the evaluation of prior Halifax Transit performance along the corridor route alignments, traffic count data was also reviewed for intersections that were deemed relevant.[5] A summary of Stantec's review of traffic count data is shown below in Table 4. This table reveals that with few exceptions, even the most important corridors in HRM have sections with only 2 lanes of traffic. It also reveals that there are major transportation corridors in HRM that are not served by corridor routes. Most obviously this includes Lady Hammond Rd., but this also extends to Connaught Ave. which only has one corridor route operating along it, and only for a small 500 metre section from Chebucto Rd. to Quinpool Rd. This is not necessarily to suggest that these corridors lacking in corridor route service need to be serviced, as high average daily traffic (ADT) can be a detriment in the form of limiting on-time performance and prolonging travel times if buses get stuck in gridlock. In the case of Connaught Ave., the APC data indicated minimal passenger activity, which is likely due to the prevalence of adjacent neighbourhoods that are higher income and correspondingly also have lower transit uptake. Nonetheless, acknowledging that corridor routes are best if they are direct and with short travel times but at the same time that they are different from express routes, these corridors should be considered as possible alternatives for corridor route modifications.

Table 4: Summary of the corridors in HRM consisting of ADT>30,000

Corridor	Avg. Daily Traffic (ADT)	MFTP Corridor Routes	# of Lanes of Traffic
Top corridors with a minimum of 3 traffic count observations, averaged			
Connaught Ave.	39,205	9	4
Bayers Rd.	37,937	1, 8	3-4
Quinpool Rd.	35,085	9	4
Lady Hammond Rd.	32,634	none	2-4
Bell Rd.	32,351	9	2-3
Lacewood Dr.	32,079	2, 3, 4	4-5
Joseph Howe Dr.	31,269	2, 3, 4, 8	4
Chebucto Rd.	30,931	2, 3, 9	2-6
Portland St.	30,847	5, 6	2-5
Windsor St.	30,670	4	2-4
Other important corridors (listed alphabetically)			
Alderney Dr.	up to 14,645 (@ Ochterloney St.)	5, 6	4-5
Barrington St.	up to 40,105 (@ Cornwallis St.)	1, 2, 5, 7, 8, 9, 10	2-5
Bedford Hwy.	up to 31,848 (@ Bayview Rd.)	8	2-5
Cogswell St.	up to 52,348 (@ Robie/Quinpool/Bell)	1, 5, 7, 10	2-4
Main St.	up to 45,770 (@ Caledonia/Woodlawn)	10	4
Robie St.	up to 52,348 (@ Cogswell/Quinpool/Bell)	4, 7, 8, 10	3-6
South Park St.	up to 24,158 (@ Sackville/Bell)	4, 10	2-3
Victoria Rd.	up to 24,890 (@ Albro Lake Rd.)	3, 10	2-3
Wyse Rd.	up to 47,596 (@ Nantucket Ave.)	3	2-6

[5] Relevant intersections include those that lie along corridor route alignments and for which traffic count data was available, as well as those that do not lie along corridor route alignments but appear to be significant corridors in HRM's larger transportation network.

The purpose of this table is simply to highlight some of the most used transportation corridors in the Halifax Regional Municipality. An important clarification is that ADT is a transportation measure. It is not in itself a transit measure, or an indicator of ridership or performance. Rather, its purpose in this context is to provide further insights on each transportation corridor, to ensure that the interplay between transit and transportation is appropriately considered in strategic decision-making related to routing and scheduling. The purpose of the table is also *not* to diminish the importance of corridors that do not make this list. Although corridors such as Barrington St., Robie St., and Wyse Rd. are not listed in the table above under the "top corridors" subheading, they are also popular corridors but include sections with lower average daily traffic, thereby bringing down the average of the ADT across the corridor. For further clarification, Table 5 below summarizes the busier and the relatively less busy sections of these corridors.

Table 5: ADT of Barrington St., Robie St., and Wyse Rd.

Corridor	Higher ADT section	Lower ADT section
Barrington St.	North of Cogswell St.	South of Cogswell St.
Robie St.	In between Young St. and Spring Garden Rd.	South of Spring Garden Rd., North of Young St.
Wyse Rd.	East of Nantucket Ave.	West of Nantucket Ave.

The purpose of reviewing traffic counts is to get a sense of how traffic flows within HRM. This is important with regards to Corridor Routes because it sheds light on which transportation corridors have the largest travel demands, suggesting that Corridor Routes should be planned along these high-use transportation corridors where possible. In doing so, however, it is important to keep in mind the caveats that without transit priority measures, buses may get stuck in traffic thereby detracting from on-time performance, and that while high-use corridors may represent quick and efficient travel times, they may not necessarily generate high ridership if few points of interest lie along the corridor, or if there is not a mix of land use.

3.3 ROUTE AND CORRIDOR FREQUENCIES

Evaluating the performance of existing Halifax Transit routes and existing corridors is only valuable when it is contextualized. At what point, for example, do stops or segments need to be serviced by multiple corridor routes rather than a single one? This is a difficult question to answer, particularly in the Halifax Regional Municipality where there exists a challenging geography that can necessitate overlapping routes even if the combined level of service is more frequent than may be warranted by passenger demand.

Certain high passenger activity stops, such as those along Spring Garden Rd., are likely necessary to serve with multiple corridor routes. But it is important to also look past what is suggested by the APC data and exercise some professional judgment. That is, is the high passenger activity along Spring Garden Rd. a direct result of high demand along that corridor? Or might it be a result of user familiarity with using this corridor as a place to transfer between buses, or as a convenient place to alight before walking the final few hundred metres to the end destination? This is a difficult question to answer, particularly in the absence of origin-destination travel pattern data, but in reality there is probably truth to both. In the case of Spring Garden Rd., findings from the service area analysis in section 2 illustrate that the area around Spring Garden Rd. is considered a "centre" with high employment density, high transit use, low-to-medium income, and medium-to-high population density. Therefore, service along Spring Garden Rd. provided by multiple corridor routes is likely warranted.

The need to exercise professional judgment is also true of the opposite case. Does Connaught Ave. have little passenger activity because there is low demand along that corridor, or is it because buses do not provide frequent and convenient service along that corridor? Again, there is probably truth to both. In a look back at the service area data, it can be seen that Connaught Ave. runs along high income areas where there is low density and low employment relative to the rest of the peninsula. This helps rationalize the lack of Corridor Route service along Connaught Ave. at present.

For consideration in the analysis, the headways of the MFTP corridor routes are summarized in Table 6 below. Transit planning best practice is to maintain all routes within the same "layer" (all corridor routes can be considered a layer) at the same or similar frequencies. Doing so keeps the network simple and easy for the users to understand, as they come to associate the corridor, local, express, and rural layers with specific levels of service, and they are more likely to try new routes that they may by unfamiliar with. It is noted in Table 6 though that the levels of service within the corridor layer vary considerably, with Route 1 more than twice as frequent as Route 8 during the weekdays.

Table 6: Corridor Route Service Frequency, as described in the MFTP

Route #	Target Headways (min)			
	Weekday Peak	Weekday Off-Peak	Saturday	Sunday
1 – Spring Garden	5-10	10	15	15
2 – Clayton Park-Downtown	15-20	15-20	15	20
3 – Crosstown	15	20-30	30	30
4 – Lacewood-Universities	10-20	15-20	30	30
5 – Portland	15	15	20	30
6 – Eastern Passage	10-15	15-20	30	30
7 – Peninsula	15	15-20	20	30
8 – Sackville	20-30	20-30	30	30
9 – Herring Cove	10-15	15-20	30	30
10 – Mic Mac	5-10	10-15	20	30

The corridor route review will seek opportunities to bring more consistency to the corridor route frequencies while maintaining similar levels of frequency along HRM's transportation corridors to those which are proposed in the MFTP. In order to understand whether the proposed modifications will result in similar levels of frequency along the corridors, however, it is important to evaluate the composite frequencies, or effective average frequencies along important corridors in the MFTP corridor route network. Effective average frequencies can be defined as the frequency of buses, combined for all routes, travelling along a particular corridor. For example, if two routes are operating along the same corridor at 20 minute frequencies, then the effective average frequency would be 10 minutes because on average one bus would come every 10 minutes. (Though, depending on scheduling objectives, buses may arrive in intervals alternating between every 15 minutes and 5 minutes, for example.) Table 7 below summarizes the effective average frequencies along corridors in the MFTP network which are served by multiple corridor routes. As alluded to above, this acts as a basis for developing the proposed corridor route modifications, which will ensure consistency as best possible, and where appropriate, with the effective average frequencies shown below.

Table 7: Effective Average Frequencies along important corridors

Corridor	Routes	Target Headways (min)			
		Weekday Peak	Weekday Off-Peak	Saturday	Sunday
Alderney Dr.	5, 6	6-8	7.5-9	12	15
Barrington St.	2, 5, 10	3-5	4-6	6	9
Gottingen St.	1, 5, 7, 10	2-3	3-4	5	6
Joseph Howe Dr.	2, 3	7.5-9	9-12	10	12
Lacewood Dr.	3, 4	6-9	9-12	15	15
Macdonald Bridge	1, 3, 5, 10	2-3	4-5	5	6
Mumford Rd.	2, 3, 9	4-6	5-7.5	7.5	9
North St.	2, 3	7.5-9	9-12	10	12
Robie St.	4, 7, 8	5-7	5-7.5	9	10
South Park St.	4, 10	3-7	6-9	12	15
Spring Garden Rd.	1, 5, 8, 9, 10	2-3	2-3	4	5

3.4 ON-TIME PERFORMANCE

On-time performance, also referred to as 'reliability', is a key performance measure for both transit agencies and for customers. Agencies strive or should strive to maintain close adherence of service to published schedules, and transit riders accordingly plan their journeys and activities around transit schedules. When expectations are not met, customers are frustrated, voicing complaints to the agency, city council, or the media, and if given the chance, may abandon transit altogether. As such, service reliability is a key component that drives customer satisfaction and thus ridership.

How reliability or on-time performance is measured is important for not only reporting purposes, but also for helping agencies pinpoint areas that need improvement, understand what is happening along a route and at stops (time points), and from a customer's perspective, engender trust that an agency values their time and is not 'gaming' the statistic. There are different methods for tracking on-time performance including:

- Schedule adherence at the departing and arriving terminal points
- Schedule adherence at the departing and arriving terminal points and at various time points on route
- Excess waiting time, calculated by subtracting average waiting time from scheduled waiting time, which better captures the ridership profile along the route (often better suited to routes with more frequent service)

The discussion above is important because it also informs the notion of reliability and what customers care about from a bus service, which is informed by the service itself. If a service is frequent, typically every 10 minutes or less, customers generally do not consult a schedule, and arrive at a transit stop at random, and will, on average, wait half of the headway.[6] In these instances, excess waiting time, or the variation in headway between scheduled and actual headways are suitable measures because customers (and operations) benefit from consistent spacing between vehicles. This statistic can be considered as a measure of regularity. On the other hand, for less frequent service, usually every 15 minutes or greater, customers will consult a published schedule and thus care that a vehicle arrives "on time" or "on schedule"—the typical "on-time performance" metric used across the industry and at Halifax Transit. This statistic can be considered as a measure of punctuality.

Based on the quarterly performance measures reports, Halifax Transit defines "on-time" as the percentage of observed time point arrivals that are between one minute early and three minutes late—time points are defined as terminals and select bus stops along the routes with a published schedule. We note first that Halifax Transit uses 'arrival time', whereas other agencies use 'departure time' for calculating schedule adherence—departure time, although not readily appreciated by customers, is a better indicator of schedule adherence since early buses may be held at time points to get back on schedule. Departure time accounts for this, and similar to schedules for trains or ferries, it indicates to customers what time they can expect the bus to leave a time point. When buses arrive early, it may be a pleasant surprise to the customers boarding or alighting at the given stop, but holding back the buses prior to departure may be frustrating to the customers remaining on-board.

Halifax Transit's on-time performance (OTP) range is very reasonable; some agencies provide more generous standards, such as one minute before and five minutes after scheduled departure time. Other agencies have policies regarding no early departures. From a network level, Halifax does not have a target OTP (but notes that 85-90% is an industry best practice), and notes that its OTP is improving, and was 77% overall (2017/18).

It's clear that OTP would vary between route classes, such as between Corridor Routes, Local Routes, and so on, given the traffic and operating environments they face, as well as the passenger volumes, which all impact OTP. For the proposed Corridor Routes, we note that from Q3 to Q4 2017/18, all Corridor Routes (or those routes that are slated to become Corridor routes) improved in OTP, with the largest improvement for proposed Corridor Route 4 (gain on average of 10% in improvement[7]). On average, the routes that are or proposed to form the Corridor Route network had an average OTP of 72% in Q3, and 79% in Q4. The table below presents the full analysis of Q3 and Q4 statistics.

Table 8: Q3 and Q4 On-Time Performance Statistics

[6] Kittelson & Associates, et al. TCRP Report 165: Transit Capacity and Quality of Service Manual, Third Edition. 2013. TRB, Washington, DC.
[7] Based on routes 17, 18, 42

Route (existing)	Route (new)	OTP Q3	OTP Q4	OTP trend
1	1	63%	72%[8]	9%
4 (old)	2	77%	85%	8%
2 (old)	2	68%	76%	8%
52	3	76%	83%	7%
18 (old)	4	68%	73%	5%
42 (old)	4	65%	70%	5%
17 (old)	4	54%	69%	15%
59	5	81%	85%	4%
68	5	76%	83%	7%
61	5	72%	79%	7%
60	6	83%	84%	1%
63	6	91%	93%	2%
7	7	74%	79%	5%
80	8	64%	77%	13%
9	9	79%	83%	4%
10	10	80%	88%	8%

From Halifax Transit Q3 and Q4 2017/18 reports found online. A limitation of this data is that the trend shown may be impacted by seasonality. However, year-over-year data is also difficult to compare due to changes to the network, changes to the route numbering schemes, and the fact that on-time performance data was not reported prior to Q3 of 2016-17.

Halifax Transit should ensure that OTP is actively monitored across its entire network, but particularly for the Corridor Routes layer, since it forms the backbone of the network and sees the greatest amount of ridership of the network. While outside the scope of this study, Stantec would suggest that Halifax Transit review its schedules to ensure they are programmed with sufficient running and recovery time; too much running time is not good, neither is too little.

Furthermore, due to the design decision of a "simplified transfer-based network", reliability is all the more important, particularly between high and low frequency services (Corridor and Local Routes, for example), since missing a transfer may increase overall travel time, both actual and perceived. This becomes further amplified as Halifax Transit transitions to an increasingly transfer-reliant network with the continuing implementation of the MFTP routes as well as with future implementation of further efforts to simplify the route network, which might include the proposed Corridor Route modifications described further in Section 4. Halifax Transit benefits from its investment in AVLs aboard buses, and can monitor historic OTP and schedule adherence, and potentially, monitor route operations on-the-fly (active route monitoring).

To improve reliability, particularly along busy corridors and heavily used bus routes, Halifax Transit, in addition to bus priority infrastructure improvements, should also examine other strategies used successfully elsewhere, including all-door boarding, and off-board fare collection. These techniques help reduce dwell times, and can also help promote the 'premium' type service of the Corridor Routes. For example, in Los Angeles, Metro's "Rapid" service that features frequent buses with larger stop spacings has recently implemented all-door boarding, with cash payments only at the front door. If early departures (or arrivals) are an issue, then a different strategy regarding operator education for practices like holding at time points is necessary. Also as suggested previously, a review of running and recovery times by route for adequacy would serve the agency well.

Related to reliability and travel time, is the route alignment itself. As much as possible, routes should be straight, with minimal deviations or turns. Direct routes that avoid loops or turns not only reduce running times, but also tend to attract greater ridership because unless a deviation serves a major destination that results in high passenger activity,

[8] First full quarter of the Roslyn Road detour

deviations tend to add travel time for most riders, which discourages ridership. Section 6.4 of the MFTP (Route Directness Guideline) is particularly important for Corridor Routes given the intention of these routes to carry lots of passengers. Deviations and turns that add runtime, but are deemed necessary to fulfill coverage objectives, are best left for the Local Routes where possible.

Schedule revision is also necessary from time to time. As Halifax Transit captures actual operations data from its AVL, schedules should be revised seasonally to take actual running time into account, and also to reflect operating conditions (peak vs. non-peak, for instance). It is noted that routes that have been rescheduled through the MFTP have improved schedule reliability.

Technology itself cannot improve reliability and performance, but rather must be used to proactively manage headways and bus operations, as well as produce realistic schedules. Stantec recommends that route supervisors or inspectors actively manage routes using live Global Positioning System (GPS) information in order to prevent bunching and gaps along Corridor Routes.

Finally, as mentioned previously, the frequent service proposed along Corridor Routes suggests that schedule adherence, or "punctuality", is not as crucial as ensuring a reliable headway or spacing between buses. Put simply, if the schedule proposes a bus every 10 minutes, but allows a deviation for one minute before and three minutes after scheduled arrival time, then it's possible to have headways as small as 6 minutes, increasing the risk of bus bunching, lengthening the gap for subsequent buses (this is even worse on headways of less than 10 minutes—if a scheduled headway is five minutes, then if buses scheduled for 12:05 and 12:10 leave at 12:08 and 12:09, a headway of one minute will inevitably lead to bunching, and a larger gap behind). This becomes even more apparent when looking at the effective average frequencies along corridor streets and their intended route. Overly aggressive headways, particularly where routes converge on shared streets, may need to be revised into more conservative headways as a way to improve headway consistency.

Stantec thus proposes that Halifax Transit consider adopting two metrics for reliability:

- For routes or corridors with headways smaller than or equal to 10 minutes, we suggest adopting excess waiting time or variation between headways. These indicators are more meaningful for riders, since they tell riders how long they will wait for a subsequent bus (the consistency of service), rather than the bus is 'on-time' even though they may have waited much longer due to bus bunching. Active route management by route supervisors in communication with operators is essential for these frequent services. Excess wait time is calculated by deriving the difference from actual departure time and the scheduled departure time. In Section 5.3, we described an alternative metric that calculates the variability in headways to identify bus bunching and gapping.

- For services with headways greater than 10 minutes, we recommend a similar metric as employed currently, that is measuring the percentage of departure at time points outside of an acceptable window. We also propose that the lower limit be 0 rather than a minute early, and the upper limit remain at three minutes. So for buses departing before scheduled departure time, that bus or time point would be considered 'early', while buses departing more than three minutes from scheduled departure time would be considered 'late'. Capturing early, late, and on-time departures are important for Halifax Transit to diagnose route- and stop-level issues, since early departures signal different operational issues from late departures.

These metrics are both measurable using automatic vehicle location (AVL) and APC data, although it is noted that Halifax Transit's AVL only records arrival time. In adopting these metrics, Halifax Transit would first have to upgrade its current AVL capabilities.

4.0 PROPOSED CORRIDOR ROUTE MODIFICATIONS

4.1 TRANSIT PLANNING PRINCIPLES

The data upon which Stantec's proposed changes to the MFTP corridor route network were based is summarized as follows:

- Findings and priorities outlined in recent and ongoing regional planning studies
- Halifax Transit Annual Service Plans and Quarterly and Year-End Reports
- Automated Passenger Counter (APC) and Automated Vehicle Locator (AVL) data
- Traffic count data from 2014-2018 with an emphasis on the more recent data
- 2016 Census data: population, employment, commuter mode share, etc.
- Open data, such as public school enrollment and new development data

Review of this data led to the development of initial recommendations which were presented to the Halifax Regional Municipality. HRM and Halifax Transit staff were then given the opportunity to review and comment on the initial recommendations. Based on the feedback provided, refinements were made to the initial recommendations resulting in the final recommended modifications to the MFTP network which are described further down in this section. These final recommendations are ultimately a product of not only data analysis, but also qualitative inputs and transit planning best practices considered in the local HRM context.

In keeping with the principles of the MFTP and building upon them to include considerations that are reflective of best transit planning practices, summarized below are the key principles upon which the proposed corridor route modifications were based:

- Be respectful of what is working well in the current network, and of what is strong in the corridor route network in the MFTP. Make tweaks to the MFTP corridor route network but don't reinvent it.
- Ensure compatibility with the BRT Study, with planned and implemented transit priority measures, and with regional planning priorities as best possible
- Strike the balance between improving the directness of corridor routes (which can be detrimental to coverage), and improving corridor route coverage (which can be detrimental to directness)
- Endeavour to improve the directness of the corridor routes but without losing sight of the fact that their purpose is fundamentally different from that of express routes. Concurrently, seek opportunities to improve corridor route coverage.
- Simplify the network by reducing the amount of overlapping corridor routes, and by encouraging transfers at locations where there is capacity to accommodate increased transfer activity
- Improve user experience by improving consistency of corridor route service frequency, and by ensuring that corridor route modifications result in shorter travel times

Before discussing the specifics of what was changed on which route, it is important to first summarize the changes at the corridor network level which pertain to each of these key principles. This will set the stage for the deep dive into the modifications associated with each route, keeping in mind that proposed modifications were made with the corridor network as a whole in mind, more so than each of the routes individually. When evaluating the proposed modifications individually, it is sometimes tough to look past the negative aspects and appreciate the positive impact that the change is expected to have, without first seeing how the whole network comes together and reflecting on the ways in which the whole is greater than the sum of the parts.

The changes that correspond to each of the key principles are discussed as follows:

Be respectful of what is working well in the current network, and of what is strong in the corridor route network in the MFTP. Make tweaks to the MFTP corridor route network but don't reinvent it

The MFTP corridor route network has many positive attributes. Most notably, it represents excellent coverage of the Regional Municipality, with 83% of residents in the Halifax Transit service area located within an 800 metre walk of

the corridor route network.[9] It also involves many single-seat rides, built on the principle that the need to use multiple corridor routes for a single trip should be minimized, particularly when many residents will need to transfer to a local, rural, or express route for the beginning or end of their journey. Finally, both the current network and the MFTP corridor route network have lots of built-in redundancy with many important corridors being served by multiple routes. While redundancy can lead to overcomplication of the network and should be limited, we also acknowledge that some level of redundancy is necessary, particularly when there are challenging geographies including a peninsula and a harbour. This helps to ensure an adequate level of service is being provided, that routes do not become overcrowded, and that there is not a cascade effect with operational issues on one route creating operational issues throughout the network.

The proposed modifications to the MFTP corridor route network, therefore, are relatively minor for the most part. And, where there exist major modifications, these are borne not from an attempt to take the corridor routes in a different direction from the MFTP, but rather they are an attempt to combine positive attributes of multiple corridor routes. While they may appear to be major modifications on the surface, when viewing the modified corridor route network as a whole, these modifications are less obvious.

Ensure compatibility with the BRT Study, with planned and implemented transit priority measures, and with regional planning priorities as best possible

The proposed modifications to the MFTP corridor route network considers the transit priority measures implemented and planned along Bayers Rd., Gottingen St., Robie St., and Young St. All four of these corridors are located along the alignment of one proposed enhanced service route that we envision will be run at frequencies no less than every 5 minutes during weekday peak hours. In an effort to distinguish this route as having a higher level of service compared to the other corridor routes, we propose to use the term “H-Line” rather than assigning it a number from 1-19 like the other corridor routes.[10] The H-Line route was designed based on the principles of the BRT Study and planned and implemented transit priority measures. Its design was also based on an identification of the corridors with the highest passenger activity, as well as an evaluation of different assumed origin-destination pairs.
The H-Line helps ensure that each of the transit priority measures are leveraged to their full potential, running along the following segments, all of which contain existing or proposed priority measures:

- Bayers Rd. (Desmond Ave. to Windsor St.)
- Young St. (Windsor St. to Robie St.)
- Robie St. (Young St. to Spring Garden Rd.)
- Gottingen St. (Cogswell St. to North St.)

It is designed as a premium service that is the next evolution before BRT, with the intention that it can be upgraded as-is to a BRT route in the long term. This will negate the need to rejig the rest of the Halifax Transit network around BRT routes developed in isolation from other transit planning exercises. In addition to the H-Line, Robie St. and Gottingen St. are proposed to be serviced by multiple additional corridor routes, and Bayers Rd. will be serviced by one additional corridor route in between Windsor St. and Oxford St.

Strike the balance between improving the directness of corridor routes (which can be detrimental to coverage), and improving corridor route coverage (which can be detrimental to directness)

In most cases it was difficult to identify opportunities to improve route directness without suggesting that routes travel along the highways where there will be limited or no passenger activity. Nevertheless, small opportunities to improve route directness were identified and rectified. The MFTP corridor route network, for example, suggested a circuitous

[9] While 400 metres is more commonly used as an acceptable walk distance in the transit industry, in the case of high frequency services it has been observed that users are more likely to walk further distances (up to 800 metres as a rule of thumb) to access services that are frequent and reliable.
[10] Using letters to distinguish an enhanced level of service is a strategy that has been successful elsewhere, such as in the Metro Vancouver Area, where the term B-Line is used to distinguish a small handful of routes from the rest. In this case, the letter ‘H’ was selected since Halifax and HRM both start with ‘H’, although colloquially this route would just be referred to as H-Line.

approach to St. Mary's and Dalhousie Universities from the Clayton Park area – an approach which was rectified in the proposed modifications. As another example, Victoria Rd. is one of the most important corridors in Dartmouth and yet there was no convenient corridor route solution for users wishing to travel from one end to the other (for all intents and purposes, the "ends" can be defined as Highfield Park Dr. and Thistle St., as it is between these two streets where the important origins and destinations are located). This was also rectified in the proposed modifications.

With regards to coverage, Stantec's review confirmed that the MFTP corridor route proposes excellent coverage throughout the key areas with passenger activity in HRM. As such, there existed limited opportunities to improve coverage without creating more circuitous routes, adding service beyond the level proposed in the MFTP, or reducing/removing service in lieu in a way where the disbenefits outweigh the benefits. Some small opportunities were nonetheless identified. In particular, additional coverage is provided by the proposed modifications in Dartmouth along Albro Lake Rd. and Pinecrest Dr., as well as Victoria Rd. in between Albro Lake Rd. and Woodland Ave. These are areas with significant enough passenger activity and where development is anticipated to continue. In addition, medium-to-long-term considerations for additional coverage in developing areas are discussed further in section 5.2.

It is important to also note, however, that the proposed modifications involve the removal of corridor route coverage along Windsor St. between Bayers Rd. and Cunard St. Stantec does not believe this will have a material impact on the performance of the corridor route network because there is limited passenger activity along this corridor and because Windsor St. is within acceptable walking distance of Oxford and Robie Streets, both of which continue to have corridor service in the modified corridor route network. Additionally, the small 500 metre section of alignment running along East Perimeter Rd. near Mumford Terminal has been removed. For similar reasons as for Windsor St. we anticipate negligible negative effects.

Simplify the network by reducing the amount of overlapping corridor routes, and by encouraging transfers at locations where there is capacity to accommodate increased transfer activity

The proposed modifications to the MFTP corridor route network represent considerable network simplification. Most notably, the ten corridor routes have been collapsed into nine routes. Additionally, the overlap of corridor routes has been minimized. In the proposed modifications, Clayton Park and Lacewood Terminal are both served by two corridor routes rather than three, but at the same time are expected to have an improved level of service, largely due to the H-Line which is expected to bring improvements to frequency, reliability, and travel time. Similarly, the proposed modifications include a modest consolidation of service in the Spring Garden – Barrington corridors. The intention is that with the introduction of the H-Line route running along Spring Garden Rd. and Barrington St. to Scotia Square (and beyond), there will be less of a need to have a wide variety of corridor routes (and local routes) running into and out of Downtown Halifax.

The simplified network also encourages transfers throughout the network, at the terminals as well as at key intersections such as Robie St. and North St. Particularly, with the H-Line running every 5 minutes or less during peak hours, on-street transfers to or from this route become much more feasible with minimal transfer time. This has enabled the tweaking of the corridor route network in a way that encourages transfers but without overburdening terminals such as Mumford, Water, and Bridge which are already at or near capacity. Terminal capacity is an important consideration for all aspects of Halifax Transit's short term transit planning priorities, especially for the Corridor Route Review where the expectation is that many riders will transfer to or from a Corridor Route at some point on their trip. Moreover, the simplification of the corridor route network has opened up some new possibilities for route interlining, minimizing the need for passengers to alight at the terminal locations.

Improve user experience by improving consistency of corridor route service frequency, and by ensuring that corridor route modifications result in shorter travel times

In the current MFTP proposal, there is little consistency in terms of the service frequency of corridor routes. Using weekday peak as an example, there are six different permutations of route frequency including 5-10 minutes, 10-15 minutes, 15 minutes, 10-20 minutes, 15-20 minutes, and 20-30 minutes. Despite the ability for Halifax Transit to apply consistent marketing communications using phrases such as "20 minutes or less", this lack of operational

consistency can make it challenging for the users to understand what level of service to expect on corridor routes, and it can also make it difficult to time transfers at key locations. While it is prudent to match the service frequency with demand and never advisable to force consistency in service frequency where it may not be warranted, there are still opportunities for improvement. In the proposed modifications, Stantec is recommending three different permutations of route frequency including the following (weekday peak frequencies for illustrative purposes):

- 5 minutes or less for the H-Line
- 10 minutes for the other corridor routes (excluding routes 8 and 9)
- 20 minutes for routes 8 and 9

The rationale for these frequencies is discussed further in Section 4.3. The overall improved level of frequencies (discussed further in Section 4.3) translates into a more compelling corridor route service offering, which in turn serve to grow ridership. Stantec also advocates for a focus on improving on-time performance, as was discussed in Section 3.4. With the more frequent and consistent service, the corridor route modifications are anticipated to result in shorter travel times. This is due to a combination of shorter wait times for the buses, more efficient transfers, and quicker run times particularly with the proposed modifications placing a higher emphasis on travel through the Bayers, Young, Robie, and Gottingen corridors with the proposed and implemented transit priority measures.

4.2 ROUTING RECOMMENDATIONS

The modified Corridor Route network is shown in the screenshot below in

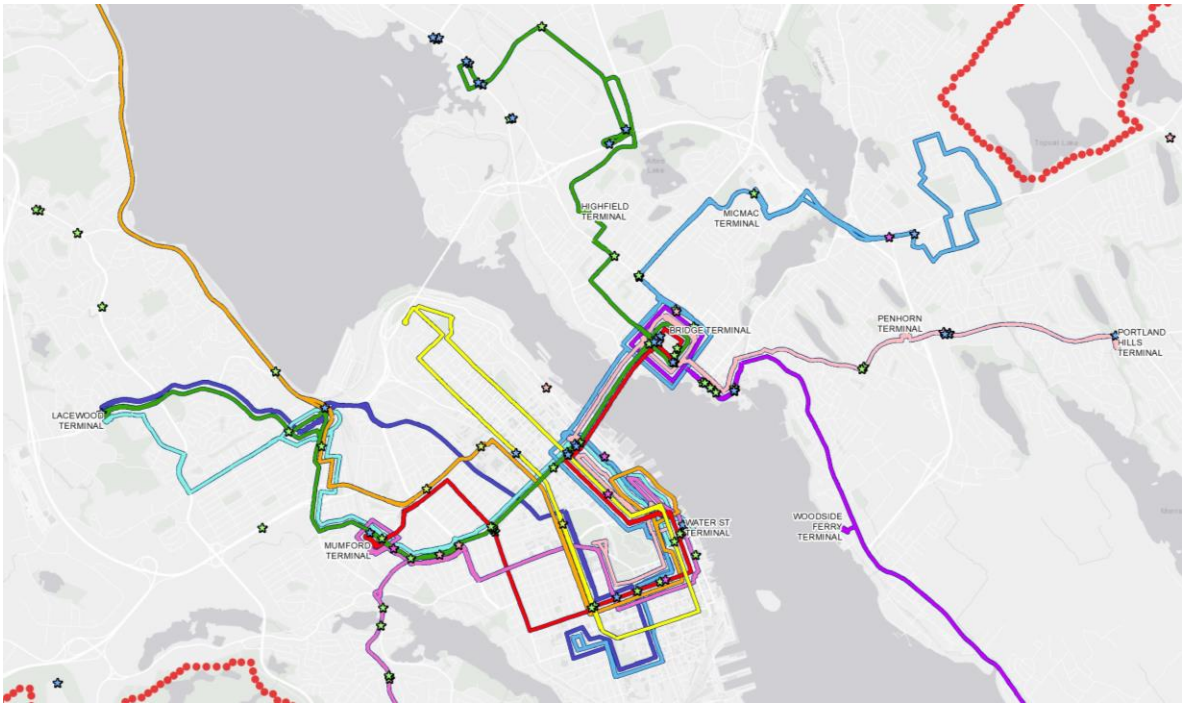


Figure 7 (compared to the MFTP Corridor Route network shown in Figure 6). Following this, the changes made to each of the routes are discussed one by one. It is acknowledged that as with any transit planning exercise, it is impossible to satisfy everybody. With every modification proposed there will be users who will be better off and those who will be worse off. The goal of this exercise, therefore, is not to ensure that everyone is better off, but rather to ensure that the number of people who will be better off with the modifications exceeds the number of people who will be worse off and that we are not disenfranchising already loyal customers. For each route, the advantages and drawbacks of the proposed modifications are listed, along with a supporting rationale for each drawback. This approach was taken in an effort to justify why each modification has been proposed, while also maintaining objectivity thereby allowing HRM and Halifax Transit staff to better understand the big picture and strategize implementation accordingly. A discussion of the results of travel time mapping is also included.

Figure 6: MFTP Corridor Route Network

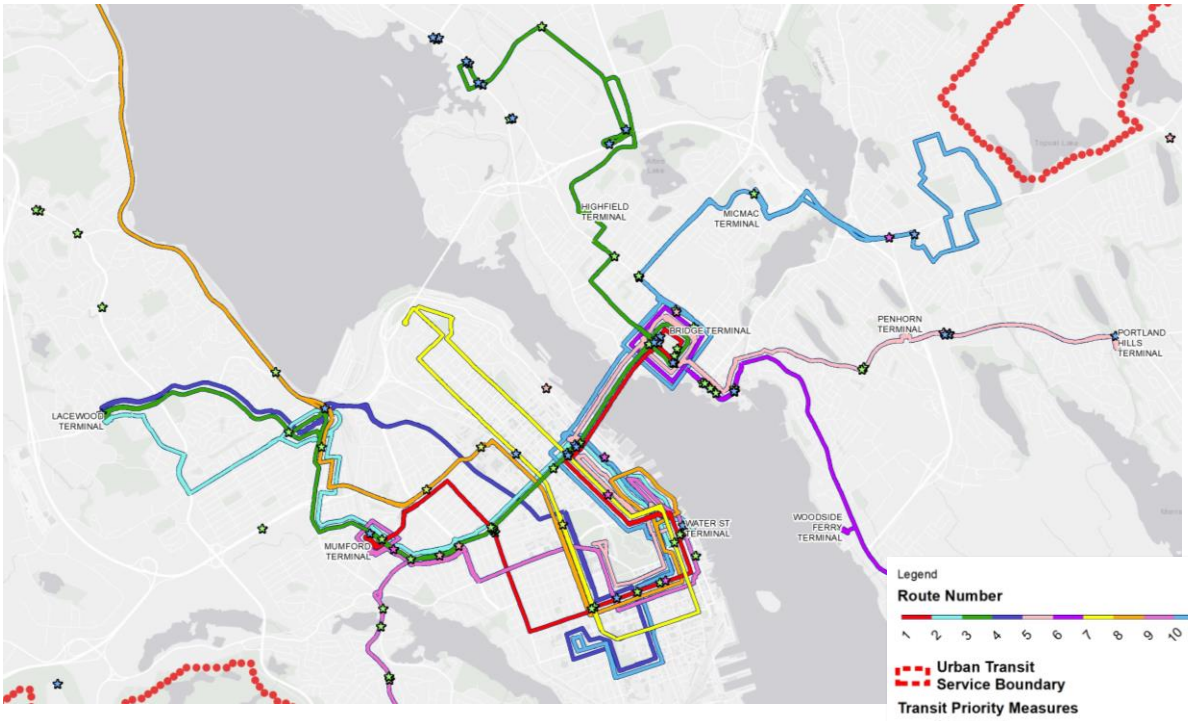
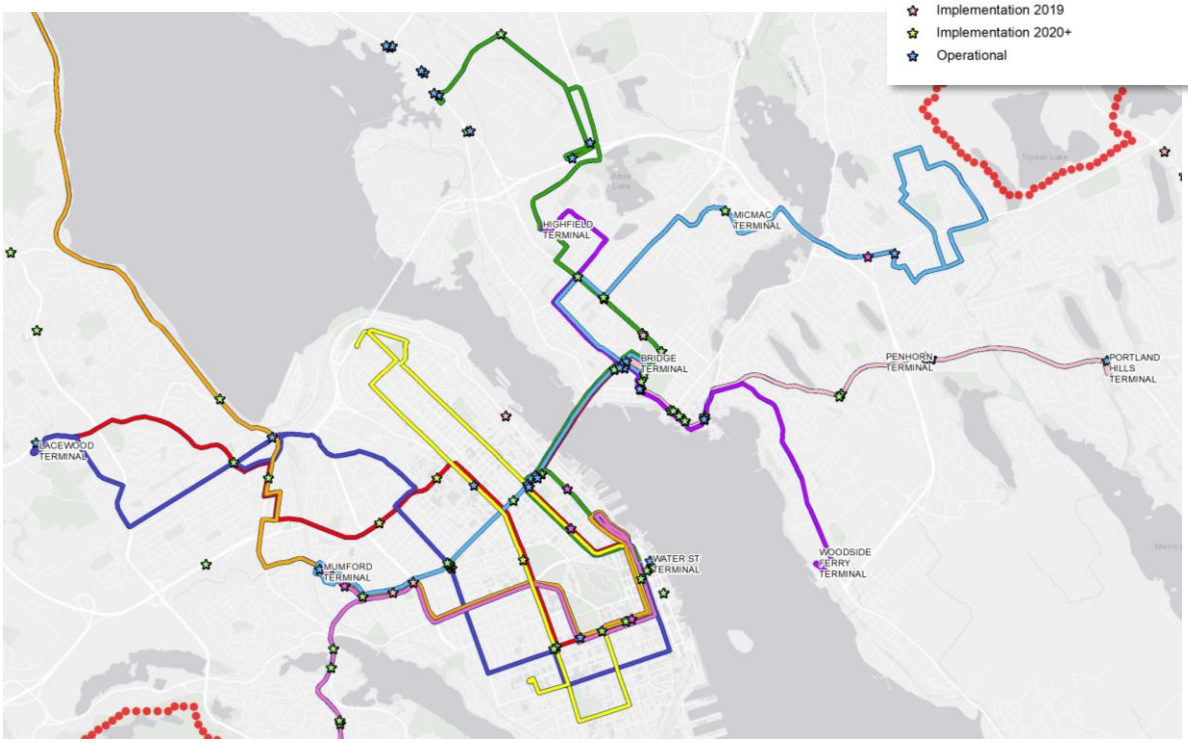


Figure 7: Proposed Modified Corridor Route Network



4.2.1 Route 1 / The H-Line

Figure 8: MFTP Alignment and Proposed Alignment (Route 1)

Stantec proposes that Route 1 be converted into the H-Line, an enhanced bus service maximizing the value of the transit priority measures. The intent is to run the route at frequencies of 5 minutes or less during weekday peak hours. The H-Line retains a similar structure to that of Route 1 from the MFTP with a few notable differences. First, the route's western terminus is in Clayton Park, with Lacewood Terminal and Bayers Rd. Centre receiving service instead of Mumford Terminal. Second, the alignment is proposed to run down Robie St. instead of Oxford St.

Advantages:

- Service is extended to Clayton Park and a higher number of terminals are served
- Takes advantage of transit priority corridors along Bayers Rd., Young St., Robie St., and Gottingen St.
- The proposed frequency of this route surpasses anything that is currently proposed in the MFTP
- Represents corridor route and BRT integration by opening the possibility for this route to be converted into a BRT route in the future
- The ability to interline with Route 5 opens the possibility for a one-seat ride to reach Downtown Dartmouth and the Penhorn and Portland Hills Terminals from many locations in Halifax
- Provides a frequent all-day connection from the hospitals to the Bridge Terminal and to Clayton Park
- Lacewood Dr. is the most direct path to Lacewood Terminal, and a high level of service along this stretch facilitates the elimination of corridor route overlap

Challenges:

- Requires Dalhousie students to walk between 250 and 1,000 metres (depending on their location within the campus) to the intersection of Robie St. and Spring Garden Rd. to catch this route, which is less convenient
    - Rationale: While 400 metres is often referred to in the transit industry as an acceptable walking distance, the reality is that people are willing to walk further distances for higher quality services. This is especially true for young, able-bodied individuals, who make up the majority of Dalhousie's student population. As such, the distance between Dalhousie and Robie/Spring Garden is not anticipated to be an issue.
- Mumford Terminal is no longer served

    - Rationale: Mumford Terminal is served by other corridor routes and would be a detour for accessing Downtown Halifax from Clayton Park, and it would also likely involve rerouting away from the TPMs on Bayers Rd. and Young St. The net benefit of servicing Clayton Park was deemed to be greater than the net benefit of servicing Mumford Terminal, and moreover it was not clear whether or not Mumford Terminal would have adequate capacity to support the increased frequency of vehicles and transferring prior to the terminal's redevelopment.
- Breaks the Mumford Terminal – Lacewood Terminal connection
    - Rationale: Users can transfer to/from the H-Line at Bayers Rd. Centre. As the H-Line is envisioned to be higher frequency than the remaining corridor routes, the impact to travel time is expected to be minimal. Moreover, the demand between Clayton Park and Halifax Shopping Centre is unproven, with many users likely satisfying their shopping needs at the closer Bayers Rd. Centre.
- Inconvenient as a connection between Clayton Park and Dartmouth
    - Rationale: It is important to ensure that Downtown Halifax and environs (Dalhousie and St. Mary's Universities, as well as the hospitals, etc.) are serviced by the H-Line as they are all important destinations and trip generators. There are other means to facilitate a quick connection between Clayton Park and Dartmouth discussed further in the 'challenges' section of 4.2.3.

Rating Against MFTP Principles:

- **Principle 1 – Increase the proportion of resources allocated towards high ridership services.**

  Rating: Excellent
  The H-Line is intended to have a higher proportion of resources than other Corridor Routes, and it is expected to attract the highest ridership of any route.

- **Principle 2 – Build a simplified transfer based system.**

  Rating: Good
  Due to the enhanced service, users are encouraged to transfer to the H-Line for part of their journey.

- **Principle 3 – Invest in service quality and reliability.**

  Rating: Excellent
  The H-Line is intended to be a high quality service due to the frequency of service and the improved ability for buses to maintain the schedule.

- **Principle 4 – Give transit increased priority in the transportation network.**

  Rating: Excellent
  The H-Line leverages all transit priority measures (Bayers Rd., Young St., Robie St., and Gottingen St.).

4.2.2 Route 2

It is proposed that MFTP Route 2 be eliminated. In the MFTP, the only unique section of the Route 2 alignment is the portion that runs along Willett St., Dunbrack St., and Main Ave. in Clayton Park. This section of the alignment, however, will be fulfilled by Route 4. Moreover, it is acknowledged that the purpose of MFTP Route 2 is to provide a direct connection between Clayton Park and Downtown Halifax, however, the creation of the H-Line as a modification to MFTP Route 1 fulfills this travel need. Therefore, it was deemed acceptable to eliminate MFTP Route 2 to simplify the corridor route network while still fulfilling the core principles of the MFTP. Moreover, eliminating MFTP Route 2 frees up resources to reallocate elsewhere into the Corridor Route network – particularly to the H-Line which assumes greater frequencies than the other Corridor Routes. In comparing the travel time between Clayton Park and Downtown Halifax on MFTP Route 2 versus the H-Line, and assuming an origin of Lacewood Terminal and a destination of Barrington/Spring Garden, the H-Line is estimated to save an average of 3.7 minutes due to its shorter alignment. This does not include waiting time benefits due to improved frequencies or time savings due to the benefits of transit priority measures. It also does not account for the additional dwell time needed at Mumford Terminal. Travel time savings are revisited in detail in Section 4.4 of this report.

Rating Against MFTP Principles:

- **Principle 1 – Increase the proportion of resources allocated towards high ridership services.**

  Rating: Excellent
  The removal of Route 2 frees up resources to allocate to the H-Line.

- **Principle 2 – Build a simplified transfer based system.**

  Rating: Excellent
  The removal of Route 2 reduces redundancy and streamlines existing routes, making the network easier to understand.

- **Principle 3 – Invest in service quality and reliability.**

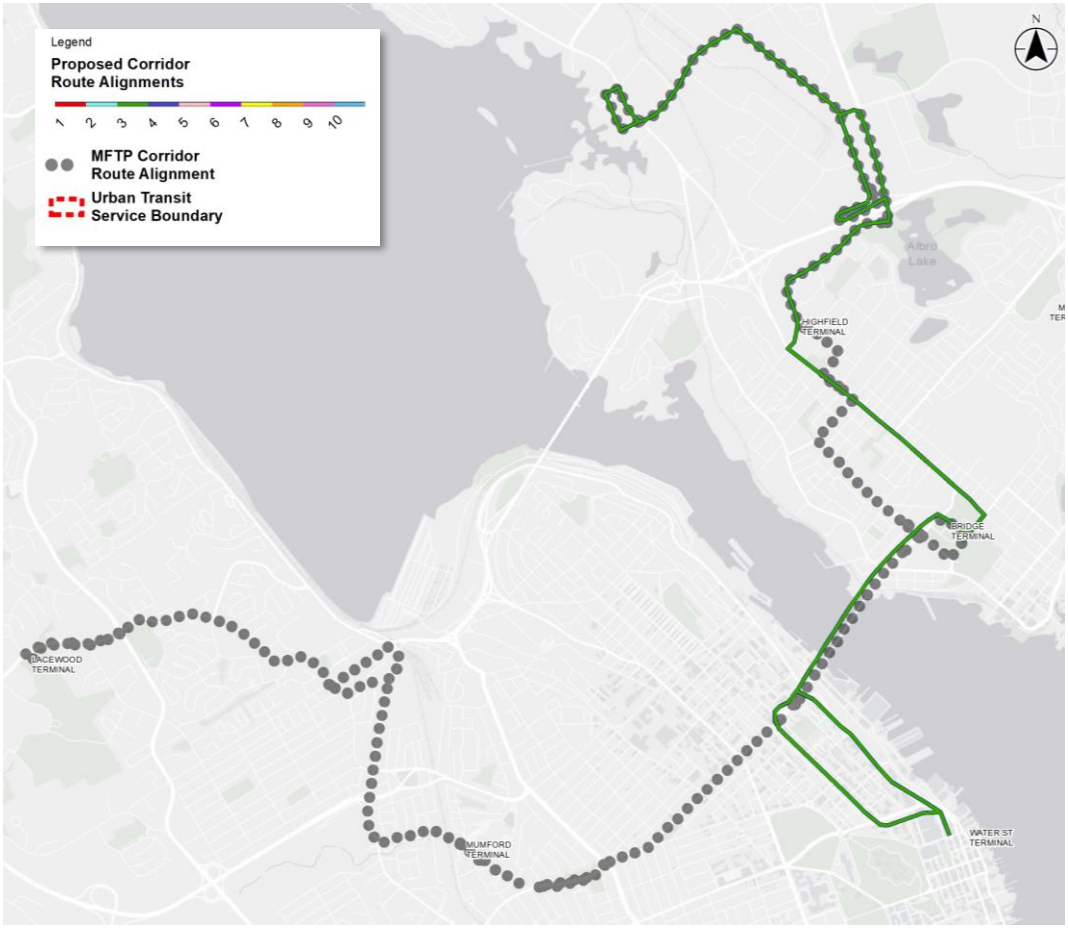
  Rating: Satisfactory
  The removal of Route 2 may inconvenience some passengers, however, it also means more attention can be paid to the remaining Corridor Routes and they can be managed more closely for service quality and reliability.

- **Principle 4 – Give transit increased priority in the transportation network.**

  Rating: N/A
  Route is proposed for removal.

4.2.3 Route 3

Figure 9: MFTP Alignment and Proposed Alignment (Route 3)



Several modifications are proposed to Route 3. Most notably, much of the alignment in Halifax has been removed, with the route now terminating at Scotia Square rather than continuing down North St. to Mumford Terminal, and then up Joseph Howe Dr. and across Lacewood Dr. to Lacewood Terminal. In addition, the route has been moved off of Wyse Rd., Albro Lake Rd., and Primrose St. in Dartmouth in an effort to serve Victoria Rd. from Thistle St. to Highfield Park Dr.

Advantages:

- Provides end-to-end service along the busy section of Victoria Rd., an element missing from the MFTP corridor route network.
- Eliminates overlap with other corridor routes in Halifax, thereby saving revenue-hours of runtime which can be reallocated elsewhere in the corridor route network (reallocated to the H-Line for instance, allowing for an increase in service frequency to 5 minutes or less during weekday peak)
- Connects Burnside with Downtown Halifax. This connection is missing in the MFTP corridor route network and is an important one due to the importance of Burnside as an employment region combined with the population and commuter density of Downtown Halifax, as well as the prevalence of points of interest such as Scotia Square.
- The potential to interline with Route 4 opens the possibility for a one-seat ride to Dartmouth from Dalhousie University and the environs of St. Mary's University

Challenges:

- Slower service as Victoria Rd. is unlikely to benefit from transit priority measures whereas Wyse Rd. is
    - Rationale: Victoria Rd. is still important enough of a corridor to warrant service, and Wyse Rd. is already proposed to be serviced by the modifications to Routes 6 and 10. There is always the option to re-evaluate this decision in the future once the priority measures have been implemented along Wyse Rd., but for the time being Victoria Rd. remains equally as compelling. Many points of interest are located along Victoria Rd. and moreover it is shown as an important corridor in the Draft Centre Plan.
- No direct connection between Dartmouth and Clayton Park (and peninsular Halifax along North St.)
    - Rationale: If Routes 3 and 4 were to be interlined, a direct connection is provided, albeit inconvenient. Rather what would likely happen is a transfer from the H-Line to Route 10 at North St./Robie St., or even a transfer from the H-Line at North St./Robie St. to Route 3 (or back to the H-Line) at North St./Gottingen St. by walking 400 metres. The time lost by walking the 400 metres would be offset by the time gained by travelling along the H-Line's priority corridors of Bayers Rd., Young St., and Robie St., as well as the minimal time waiting for the bus in the first place.
- Service removed along North St. eliminating the connection between Mumford Terminal and Dartmouth
    - Rationale: A modified Route 10 now delivers this service instead.

Rating Against MFTP Principles:

- **Principle 1 – Increase the proportion of resources allocated towards high ridership services.**

  Rating: Good
  The removal of a redundant section of the alignment frees up resources to boost frequencies along the proposed Route 3 alignment.

- **Principle 2 – Build a simplified transfer based system.**

  Rating: Good
  The shortening of Route 3 helps streamline the network, making it easier to understand, and encourages transferring.

- **Principle 3 – Invest in service quality and reliability.**

  Rating: Good
  The improved frequency along Route 3 and the improved offering of an end-to-end ride along Victoria Rd. are both reflective of improved service quality.

- **Principle 4 – Give transit increased priority in the transportation network.**

  Rating: Satisfactory
  The modified Route 3 operates along the Gottingen St. transit priority corridor, however, moving it off of Wyse Rd. onto Victoria Rd. may become inconvenient pending future transit priority measure developments.

4.2.4 Route 4

Figure 10: MFTP Alignment and Proposed Alignment (Route 4)

Route 4 was modified to follow the same general path as the H-Line from Clayton Park to Downtown Halifax, but running on different streets to provide a coverage solution for those living (or going) off of the H-Line alignment. In Clayton Park, the route was moved off of Lacewood Dr. and onto Willett St., Dunbrack St., and Main Ave. similar to the path currently followed by MFTP Route 2. At the Windsor St./Bayers Rd. intersection, the alignment also diverts onto Bayers Rd. and then runs down Oxford St. to Coburg Rd. Finally, the modifications involve terminating the route in Downtown Halifax rather than at Dalhousie University. It was considered to reroute Route 4 through Mumford Terminal, but this was decided against in the interest of maintaining a coverage solution along Oxford St. (and to a lesser extent, Windsor St.), and to avoid the overcrowding of buses at Mumford Terminal and along Joseph Howe Dr.

Advantages:

- Provides additional coverage in Clayton Park
- Quicker access to Dalhousie University (via Coburg Rd.) from Clayton Park
- Provides service along Oxford St. and South St.
- Provides an option for University students to access Downtown Halifax (and Dartmouth if Routes 3 and 4 are interlined)

Challenges:

- St. Mary's University is not directly serviced
    - Rationale: St. Mary's University is approximately a 450 metre walk. With the quicker approach down Oxford St. and Coburg St., it is expected that travel times between Clayton Park and St. Mary's University will be comparable even after factoring in the walk.
- Windsor St. loses corridor service south of Bayers Rd.
    - Rationale: Windsor St. south of Bayers Rd. is less than 400 metres from at least one of Robie St. and Oxford St. at all parts, so the corridor remains within an acceptable walking distance of corridor route service. Also, Windsor St. is not a particularly fruitful corridor in terms of passenger activity. Out of Windsor St. and Oxford St., it is more important for Oxford St. to be serviced by a Corridor Route.
- The Dalhousie University stop along Lemarchant St. loses service

    - Rationale: The routing to this location in the MFTP network is quite inconvenient for those that want to travel in a northbound direction from Lemarchant St. People travelling to Dalhousie University are best to alight at Coburg St. for a quicker travel time, or alternately they may take the modified Route 7.
- Eliminates advantage of operating along the Robie St. transit priority corridor
    - Rationale: Only a 1.2-kilometre segment of Robie St. loses this advantage, and Robie St. is well-serviced by other Corridor Routes, so this challenge is less critical. Moreover, by running the alignment along Oxford St., this provides an important coverage solution, as well as more convenient travel between the neighbourhoods to the north and the Universities, so in this instance there is net benefit to moving the alignment off of Robie St.

Rating Against MFTP Principles:

- **Principle 1 – Increase the proportion of resources allocated towards high ridership services.**

  Rating: Satisfactory
  The objective of Route 4 is more to maintain a Corridor Route coverage solution along streets such as Willett St., Main Ave., and Oxford St., rather than to increase resources along corridors such as Lacewood Dr. and Robie St.

- **Principle 2 – Build a simplified transfer based system.**

  Rating: Good
  The connection of the route to Downtown Halifax helps improve regionwide connectivity and encourages transfers.

- **Principle 3 – Invest in service quality and reliability.**

  Rating: Excellent
  The more direct routing to Dalhousie and St. Mary's Universities represents an improved service quality.

- **Principle 4 – Give transit increased priority in the transportation network.**

  Rating: Satisfactory
  Aside from a minimal stretch along Bayers Rd., none of the transit priority corridors are leveraged. As referenced above, Route 4 is intended to fulfill Corridor Route coverage objectives.

4.2.5 Route 5

Figure 11: MFTP Alignment and Proposed Alignment (Route 5)

Route 5 was only modified insofar as it is now proposed to terminate at Bridge Terminal rather than travelling across the Macdonald Bridge to Downtown Halifax (and onward to Summer St./Bell Rd. during weekday peak hours). The rest of the alignment remains the same.

Advantages:

- Eliminates overlap with other corridor routes in Halifax, thereby saving revenue-hours of runtime which can be reallocated elsewhere in the corridor route network (reallocated to the H-Line for instance, allowing for an increase in service frequency to 5 minutes or less during weekday peak)
- In combination with the introduction of the H-Line, the need for peak-only segments of Corridor Routes is eliminated

Challenges:

- There is no longer a one-seat ride for users to travel from Portland Hills to Downtown Halifax, and this may increase the strain on the Bridge Terminal which is near capacity.
    - Rationale: The intention is for Route 5 to interline with the H-Line, i.e. every Route 5 bus would turn into an H-Line bus at Bridge Terminal and continue on to Halifax. (Due to the different frequencies, however, the inverse is not true – not every H-Line bus would turn into a Route 5 bus. In practice, Route 5 would operate more as a branch rather than a separate route, however, for marketing purposes it is recommended that it retain the name Route 5 as it may be confusing for the user to understand what service frequencies may be expected from a branch of an enhanced H-Line service). Eventually, if the users prove the need, Route 5 can be absorbed by the H-Line which could be extended to Downtown Dartmouth, Penhorn Terminal, and Portland Hills Terminal, negating the need for a separate and distinct Route 5. By implementing the route this way operationally, the one-seat ride will remain intact.

Rating Against MFTP Principles:

- **Principle 1 – Increase the proportion of resources allocated towards high ridership services.**

  Rating: Good
  The removal of a redundant section of the alignment frees up resources to boost frequencies along the modified Route 5 alignment (and elsewhere in the network).

- **Principle 2 – Build a simplified transfer based system.**

  Rating: Excellent
  The shortening of Route 5 helps streamline the network and encourages transferring (in particular at locations outside of Downtown Halifax). The network is also easier to understand and no longer requires service extension during peak hours.

- **Principle 3 – Invest in service quality and reliability.**

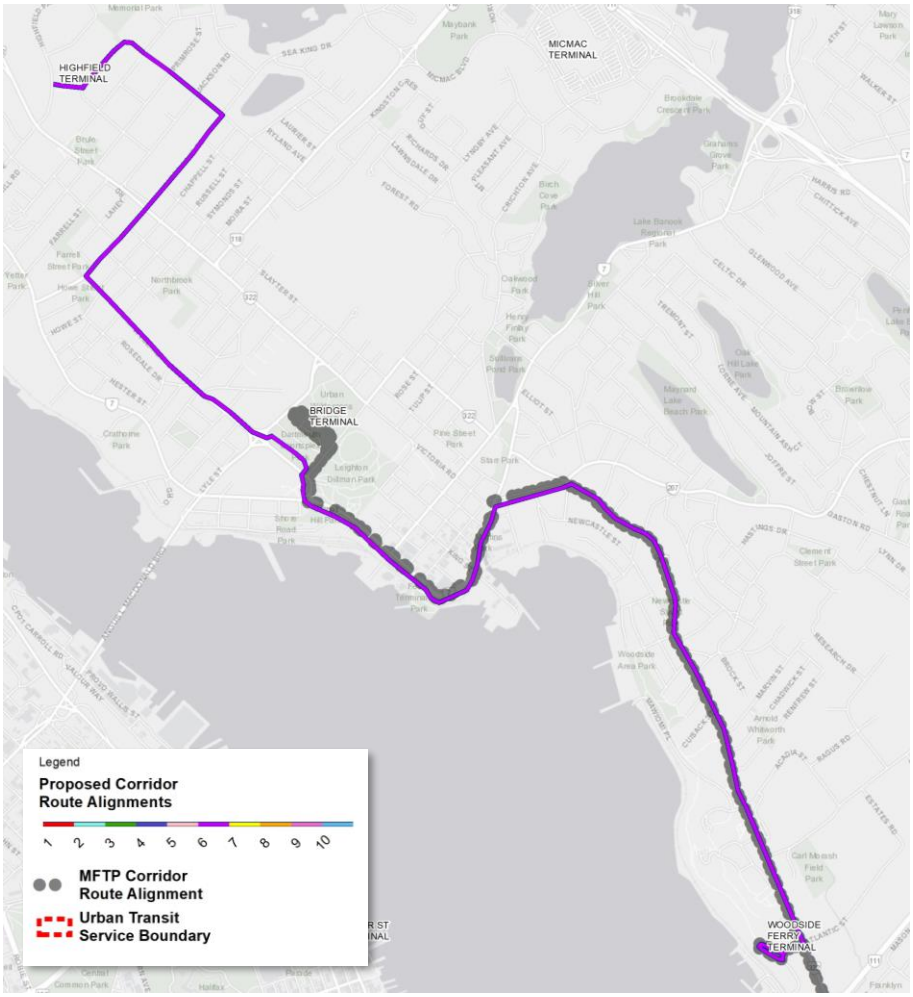
  Rating: Good
  The improved frequency along Route 5 during weekday peak is reflective of improved service quality. The eliminated need for peak-only extensions will help reliability.

- **Principle 4 – Give transit increased priority in the transportation network.**

  Rating: N/A
  There are no transit priority corridors in the vicinity of modified Route 5.

4.2.6 Route 6

Figure 12: MFTP Alignment and Proposed Alignment (Route 6)



An extension is proposed for Route 6, whereby rather than terminating at Bridge Terminal, Route 6 continues along Wyse Rd., turns up Albro Lake Rd., and then across Pinecrest Dr. to Highfield Terminal. This alignment is sufficiently different from Route 3 in that it provides new coverage in the Highfield Park and Albro Lake neighbourhoods and provides new transferring opportunities at Highfield Terminal. It also represents an increased supply of vehicles to service the significant demand between Bridge and Highfield Terminals and helps make transit a more compelling alternative for car users and discretionary riders. The rest of the alignment to the southeast of Bridge Terminal remains the same, with the assumption that the service south of Woodside Ferry Terminal runs on lower frequency and is more characteristic of local service, continuing to operate as a branch of Route 6.

Advantages:

- Provides a single-seat east-west connection in Dartmouth, which is missing from the MFTP corridor route network
- Provides new corridor route coverage along Albro Lake Rd. and Pinecrest Dr., where there is sufficient passenger activity to warrant it (this captures an additional 551 average daily boardings and alightings, plus hundreds more along Robert Burns Dr., Crystal Dr., and Leaman Dr. which would now be within an acceptable walking distance)

- Creates a more compelling service offering around Highfield Terminal with more opportunities to transfer

Challenges:

- Extended alignment translates into additional operating costs
    - Rationale: This should be considered a worthwhile investment given the advantages stated above, and particularly given that budget has been freed up by cuts made elsewhere. The cut to Route 5, for example, should more than offset the extension to Route 6 from an operations and cost perspective. Moreover, if the areas in and around Albro Lake and Highfield Park (and eventually Shannon Park) are developing, promoting a "transit first" mentality is advisable. Bolstering service in this part of HRM to attract residents, development, and to provide a travel option to new residents before their travel habits get formed using non-transit modes is advantageous and likely to generate new customers for the agency. Considerations for Shannon Park are discussed further in section 5.2.2.

Rating Against MFTP Principles:

- **Principle 1 – Increase the proportion of resources allocated towards high ridership services.**

  Rating: Satisfactory
  The modifications to Route 6 represent an extension of coverage of Corridor Route service, though the route itself is proposed to be run on more compelling weekday frequencies.

- **Principle 2 – Build a simplified transfer based system.**

  Rating: Excellent
  The additional coverage provided by Route 6 is expected to directly result in improved utilization of the Highfield Terminal.

- **Principle 3 – Invest in service quality and reliability.**

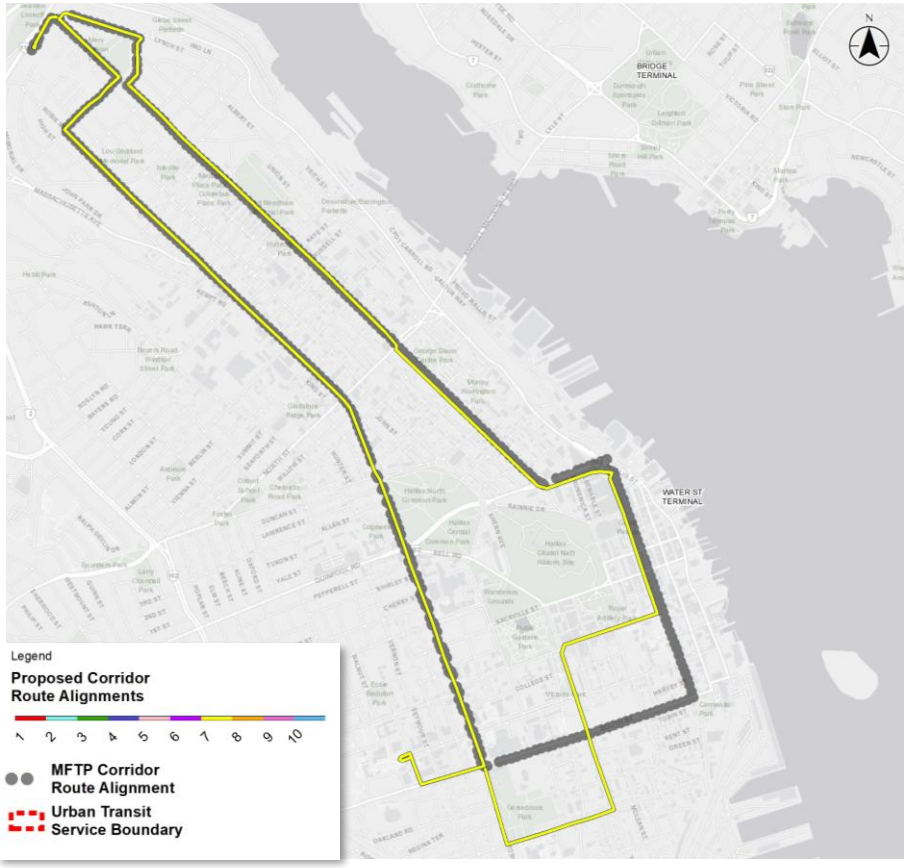
  Rating: Excellent
  The improved service in Highfield and the provision of a route that runs east-west through Dartmouth without needing to transfer at Bridge Terminal contributes to overall service quality.

- **Principle 4 – Give transit increased priority in the transportation network.**

  Rating: N/A
  There are no transit priority corridors in the vicinity of modified Route 6.

4.2.7 Route 7

Figure 13: MFTP Alignment and Proposed Alignment (Route 7)



Route 7 involves a modification at the south end of the alignment. Rather than running down Robie St. to South St. and then up Barrington St., the route is instead proposed to run down Robie St. to Inglis St., and then up South Park St. to Spring Garden Rd., before turning onto Barrington St. The proposed modification also includes a diversion from Robie St. onto South St. and Lemarchant St. to service Dalhousie University.

Advantages:

- Provides service to both Dalhousie University and St. Mary's University. Although it was previously indicated that Robie St. is within an acceptable walking distance of Dalhousie University, a diversion of the route along Lemarchant St. was deemed necessary to avoid negative perceptions from the student population and to provide service in a more convenient manner, in particular for the students who would be travelling to the bus stop from the west side of campus, near Oxford St.
- Provides coverage along South Park St. Herein lies the rationale for moving part of the east-west alignment up to Spring Garden Rd., in turn also helping to maintain Spring Garden Rd. as a corridor of principal importance to the Halifax Transit network.
- The diversion into Dalhousie University at Lemarchant St. also provides an additional layover point. This is ideal not only for the students, but also for the operator as an additional point to take a break, for scheduling purposes to maintain on-time performance, and to lessen the need to layover the bus for any significant amount of time at Scotia Square.

Challenges:

- End-to-end coverage along South St. is removed

    - Rationale: This is provided instead in the modifications to Route 4.
- The route alignment is slightly longer leading to increased operating costs
    - Rationale: The benefit to students attending Dalhousie and St. Mary's Universities is worth the relatively small additional cost for the minor alignment extensions, particularly when Corridor Route service to the campuses might otherwise be somewhat limited. The benefit is also realized by North End residents, who are only serviced by one Corridor Route, who now have access to more destinations without needing to transfer. Moreover, sufficient operating budget has been freed up elsewhere in the corridor network to facilitate this change.

Rating Against MFTP Principles:

- **Principle 1 – Increase the proportion of resources allocated towards high ridership services.**

  Rating: Good
  The alignment has been slightly extended for improved coverage, although the route will have improved weekday frequencies.

- **Principle 2 – Build a simplified transfer based system.**

  Rating: Good
  The servicing of Dalhousie and St. Mary's Universities provides more travel options for students and unlocks new transferring possibilities away from the at-capacity terminal locations.

- **Principle 3 – Invest in service quality and reliability.**

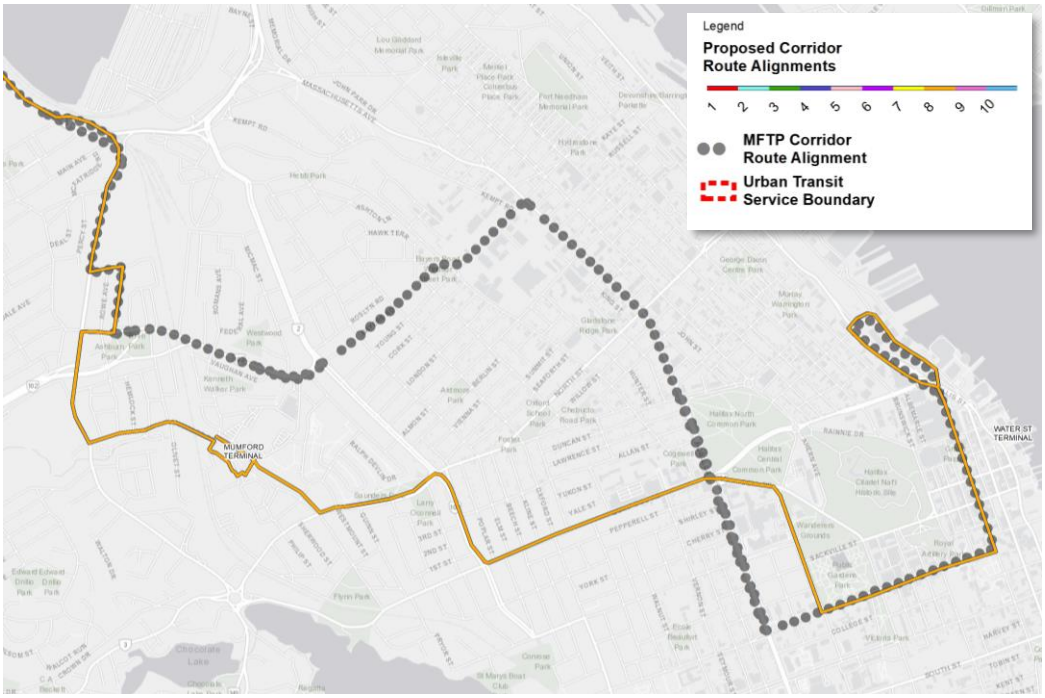
  Rating: Excellent
  The additional layover point at Dalhousie University will assist with scheduling and reliability, and the additional destinations without significant alignment extension contributes to overall service quality.

- **Principle 4 – Give transit increased priority in the transportation network.**

  Rating: Good
  The alignment remains along the priority corridors of Robie St. and Gottingen St.

4.2.8 Route 8

Figure 14: MFTP Alignment and Proposed Alignment (Route 8)



No modifications are proposed for Route 8 north of the Bayers Rd. Centre Terminal. South of here, the route is proposed to continue along Joseph Howe Dr. and Mumford Rd. to Mumford Terminal. From here, Route 8 follows the same alignment as Route 9 across Quinpool Rd., down Bell Rd. and Summer St., and into Downtown Halifax. Due to high passenger activity along Bell Rd. and Summer St., and due to the high level of Corridor Route service that already exists on Robie St., it was deemed preferable to maintain coverage along Bell Rd. and Summer St., and forego the advantages of the transit priority corridor in this instance.

Advantages:

- Increased connectivity at Mumford Terminal, and this is an added destination now accessible via Route 8 without any significant destinations removed
- Increased level of service along the Quinpool Rd. corridor, and on Bell Rd. and Summer St.
- By transferring to Route 9 at Mumford Terminal, this facilitates the ability to travel north-south in Halifax without needing to enter Downtown
- Matching the alignment to that of Route 9 east of Mumford Terminal brings operational benefits in that Routes 8 and 9 individually can be run on reduced frequency. This allows for relatively infrequent service (every 20 minutes during weekday peak) up to Sackville and down to Herring Cove where the demand is lower, and a composite frequency of every 10 minutes along Quinpool Rd., Bell Rd., and Summer St., and into Downtown Halifax where the demand is higher.

Challenges:

- The journey from Sackville to Downtown Halifax no longer runs along the transit priority corridors of Bayers Rd., Young St., and Robie St.
    - Rationale: These roads are sufficiently served by other corridor routes and it is important to maintain corridor route coverage of these priority corridors too. In particular, the connection between Bayers Rd. Centre and Downtown Halifax, which was deemed important during

consultation, is well-served already by the H-Line. Additionally, matching the alignment to Route 9 east of Mumford Terminal would not be possible without accepting this as a necessary trade-off.

- The increased runtime with the additional stop/layover at Mumford Terminal makes the route a long travel time when coming from Sackville or Bedford
    - Rationale: In the context of a corridor route, the connectivity at Mumford Terminal (and related advantages) was deemed to be more important than the shorter travel time to Downtown Halifax. Stopping at Mumford Terminal also provides another transit-accessible destination within easy reach of Mount Saint Vincent University (MSVU) students. Moreover, on principle, the desire to satisfy the need to travel from origin to destination as quickly as possible should be fulfilled by express routes, not corridor routes.

Rating Against MFTP Principles:

- **Principle 1 – Increase the proportion of resources allocated towards high ridership services.**

  Rating: Excellent
  Helps establish Quinpool Rd. – Bell Rd. – Summer St. as a high frequency corridor (in combination with Route 9), enabling higher frequencies for the higher ridership segments and lower frequencies for the lower ridership segments.

- **Principle 2 – Build a simplified transfer based system.**

  Rating: Good
  Mumford Terminal can be leveraged as a transfer point for riders in Halifax traveling north-south without needing to connect in the peninsula.

- **Principle 3 – Invest in service quality and reliability.**

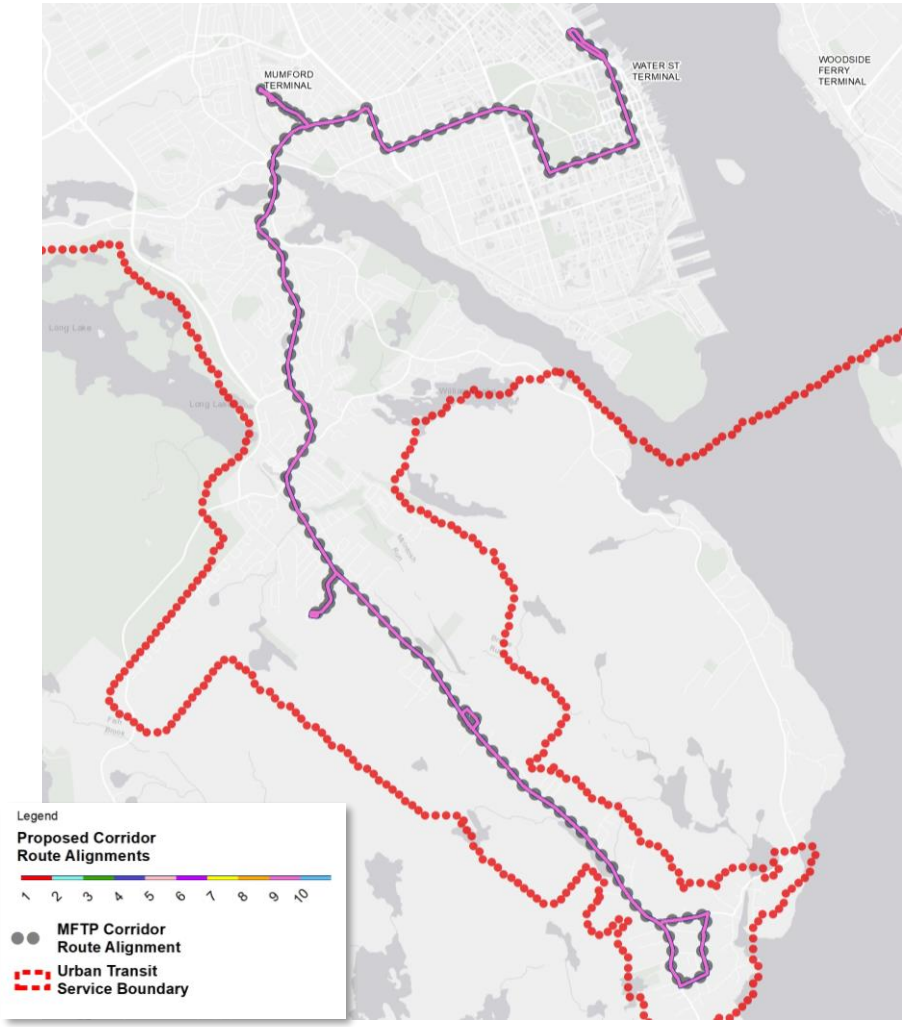
  Rating: Good
  Halifax Shopping Centre becomes more easily accessible for residents living in the direction of Bedford and Sackville. Service quality is improved along the Quinpool Rd. – Bell Rd. – Summer St. corridor.

- **Principle 4 – Give transit increased priority in the transportation network.**

  Rating: N/A
  The modified Route 8 does not make use of transit priority corridors, however, the benefits of improved scheduling and frequencies permitted by matching the peninsula alignment to Route 9 outweigh the foregone benefits of transit priority.

4.2.9 Route 9

Figure 15: MFTP Alignment and Proposed Alignment (Route 9)



No modifications are proposed to MFTP Route 9 other than to suggest that the frequency can be dropped from every 10-15 minutes at peak to every 20 minutes at peak. It is acknowledged that the section of alignment east of Mumford Terminal, which has the highest passenger activity, will have service every 10 minutes at peak as a result of the combined frequency with Route 8. It is the section of the alignment south of Mumford Terminal to Herring Cove that is proposed to run every 20 minutes. While this section of the alignment still has high passenger activity, in the context of a corridor route 20 minute frequencies should suffice. If additional service is deemed necessary, as passenger counts along Herring Cove Rd. are still fairly high, it is recommended that Halifax Transit explore a local route solution to supplement service.

Rating Against MFTP Principles:

- **Principle 1 – Increase the proportion of resources allocated towards high ridership services.**

  Rating: Good
  Adjusting the service frequency on Route 9 is a means of achieving the strategy of increasing the proportion of resources allocated towards high ridership services.

- **Principle 2 – Build a simplified transfer based system.**

  Rating: N/A
  No route modifications proposed.

- **Principle 3 – Invest in service quality and reliability.**

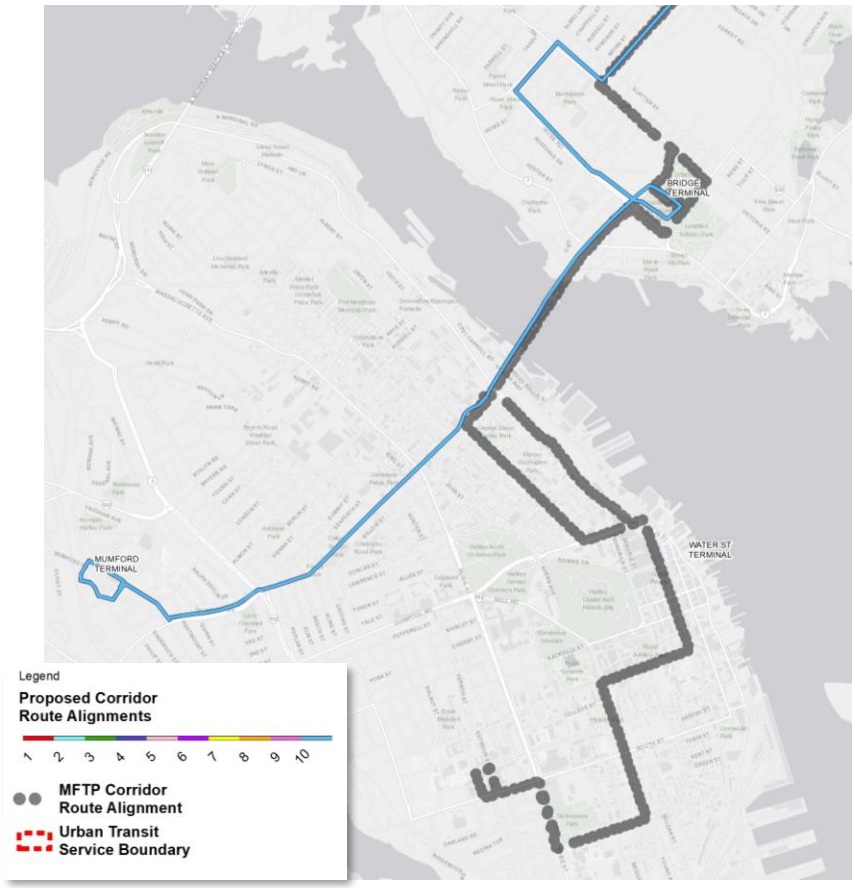
  Rating: Good
  Less aggressive headways during weekdays should help with reliability and on-time performance.

- **Principle 4 – Give transit increased priority in the transportation network.**

  Rating: N/A
  No route modifications proposed.

4.2.10 Route 10

Figure 16: MFTP Alignment and Proposed Alignment (Route 10)



On the Dartmouth side, one minor modification to Route 10 is proposed in that the route is proposed to run along from Bridge Terminal along Wyse Rd. to Albro Lake Rd., and then back along Victoria St. to Woodland Ave. On the Halifax side, rather than running through Downtown and down South Park St. to St. Mary's and Dalhousie

Universities, it is proposed to continue along North St. upon exiting the Macdonald Bridge, and then continue to Mumford Terminal terminating there.

Advantages:

- Wyse Rd. is a candidate for future transit priority measures, and in general it is deemed to be a faster corridor than Victoria Rd. This is further justified by the direction in the Centre Plan to further develop the area around Wyse Rd. as a designated "centre".
- Maintains coverage along North St. as well as the direct connection between Mumford Terminal and Bridge Terminal. After removing the coverage along North St. from MFTP Route 3 to facilitate a connection to Downtown Halifax, Route 10 was deemed to be the best alternative to provide coverage along North St., given that Route 5 may eventually be absorbed by the H-Line and given Route 6's purpose is to provide an east-west connection in Dartmouth. Given the more varied land uses along the Dartmouth section of Route 10 compared Route 3 to in terms residential, retail, and employment lands, it is more suited to a Mumford Terminal connection while Route 3 is more suited to a Downtown Halifax connection.
- Enables significant on-street transfer opportunities at Oxford St., Robie St., and Gottingen St. for users looking for a time-efficient way to make various trips starting on one side of the harbour and finishing on the other side. Relatedly, this modification helps Halifax Transit exploit the benefits of H-Line's frequent service whereby on-street transfers are more feasible.
- Shortens the route alignment enabling operating cost savings

Challenges:

- Dalhousie and St. Mary's Universities are no longer accessible from Dartmouth on a one-seat ride
    - Rationale: If Routes 3 and 4 interline (or are possibly even combined into a single route), the one-seat ride is maintained. Additionally, where Dalhousie University is concerned, the H-Line provides frequent, reliable service between Bridge Terminal and Robie/Spring Garden, which is an acceptable walking distance for the enhanced level of service permitted by the H-Line.
- Dalhousie and St. Mary's Universities have an overall lower level of corridor service compared to the MFTP
    - Rationale:
        - Dalhousie University remains serviced by Routes 4, 7, and the H-Line within a 400 metre walking distance (suitable given the H-Line's level of service exceeding that even of corridor routes)
        - St. Mary's University remains serviced by Routes 4 and 7 within a 500 metre walking distance, as well as the H-Line and Routes 8 and 9 within a 1,000 metre walking distance (less than 10 minutes' walk)
        - Considering MSVU in addition to Dalhousie and St. Mary's Universities (including the relative levels of enrollment in each institution), the proposed modifications as a whole represent a more equitable distribution of service across the three universities, taking enrollment levels into account
- The right turns onto and off of Albro Lake Rd. implied by the proposed modifications to the Route 10 alignment may currently be challenging or impossible for buses to make.
    - Rationale: If the infrastructure cannot be improved accordingly, it is recommended for Route 10 to instead follow the same alignment illustrated in the MFTP. From a coverage perspective, Albro Lake Rd. is addressed by the modified Route 6, and Victoria Rd. west of Woodland Ave. is addressed by the modified Route 3.

Rating Against MFTP Principles:

- **Principle 1 – Increase the proportion of resources allocated towards high ridership services.**

  Rating: Satisfactory
  Mumford Terminal and North St., while popular, do not see the same ridership levels as Downtown Halifax; however, without this route modification there would be no Corridor Route service between Mumford Terminal and Dartmouth which is a high ridership segment currently served by Route 3.

- **Principle 2 – Build a simplified transfer based system.**

Rating: Good
Ensures that Mumford Terminal remains utilized to a similar extent as in the present network, while not being stretched past capacity.

- **Principle 3 – Invest in service quality and reliability.**

  Rating: Excellent
  Provides new on-street transferring opportunities along North St. for users travelling between Dartmouth and various peninsula destinations. Service is more reliable when there are more viable options for reaching one's destination.

- **Principle 4 – Give transit increased priority in the transportation network.**

  Rating: N/A
  The modified Route 10 does not make use of transit priority corridors.

4.3 SCHEDULING CONSIDERATIONS

The level of service consolidation and overlap minimization is best quantified by looking at the number of total kilometres covered by corridor routes before and after the proposed modifications (refer back to Figure 6 and Figure 7 for a map of the MFTP and modified Corridor Route networks respectively). The total kilometre figures are shown in Table 9 below.

Table 9: An estimation of one-way route kilometrage

Route #	One-way KM (MFTP network)	One-way KM (modified network)	Change
1 / H-Line	12.6	15.4	+2.8
2	12.0	-	-12.0
3	18.6	14.1	-4.5
4	11.6	13.6	+2.0
5	13.1	7.1	-6.0
6 (to Woodside)	5.0	8.0	+3.0
7	12.1	13.4	+1.3
8	29.0	28.0	-1.0
9 (to Greystone Dr.)	12.9	12.9	none
10	22.6	18.5	-4.1
TOTAL	**149.5**	**131.0**	**-18.5**

Overall, the modified corridor route network represents a reduction in total one-way route kilometrage by 18.5. If service frequencies remain the same, the represents a net reduction in revenue-kilometres and consequently a net reduction in revenue-hours for corridor level service. However, if we add in an additional 15.4 kilometres to the total of 131.0 kilometres shown above for the modified network, on the assumption that the H-Line will run twice as frequently as Route 1 is currently proposed to run, we arrive at total one-way kilometrage of 146.4 kilometres, which remains less than the 149.5 kilometres of the original concept MFTP Corridor Route network.

Cost-Neutral Scheduling

Although the revenue-kilometres remain lower, we can conservatively assume that the revenue-hours are approximately equal. We can make this assumption considering that although travel times will be faster with the increased reliance on the corridors with transit priority measures, it is desirable to formally schedule appropriate running and recovery time to improve on-time performance. As such, Halifax Transit can theoretically implement the routes at the following headways at *no* additional cost to the operation.

Table 10: Plausible (cost neutral) route headways for corridor route modifications

Route #	Headways (min)			
	Weekday Peak	Weekday Off-Peak	Saturday	Sunday
H-Line	2.5-5	5	7.5	7.5
Route 2	n/a	n/a	n/a	n/a
Route 3	15	20-30	30	30
Route 4	10-20	15-20	30	30
Route 5	15	15	20	30
Route 6	10-15	15-20	30	30
Route 7	15	15-20	20	30
Route 8	20-30	20-30	30	30
Route 9	10-15	15-20	30	30
Route 10	5-10	10-15	20	30

Note: H-Line frequencies are twice as frequent as MFTP Route 1 frequencies

As recommended by Stantec, it is desirable to standardize the route frequencies as best possible, with the H-Line having the most frequent service, and Routes 8 and 9 having the least frequent service, with the other corridor routes falling somewhere in the middle. We propose the following adjusted service frequencies in the implementation of the corridor routes.

Table 11: Recommended route frequencies for corridor route modifications[11]

Route #	**Frequencies (min)**				**Change compared to Table 10** + = increased frequency - = decreased frequency 0 = no change in frequency ? = unclear			
	Weekday Peak	Weekday Off-Peak	Saturday	Sunday	Weekday Peak	Weekday Off-Peak	Saturday	Sunday
H-Line	3-5	5-10	10	10	-	-	-	-
Route 3	10	15	30	30	+	+	0	0
Route 4	10	15	30	30	+	+	0	0
Route 5	10	15	30	30	+	0	-	0
Route 6	10	15	30	30	+	+	0	0
Route 7	10	15	30	30	+	+	-	0
Route 8	20	30	30	30	+	+	0	0
Route 9	20	30	30	30	-	-	0	0
Route 10	10	15	30	30	-	-	-	0

As shown above, there are 11 instances of decreased frequency and 11 instances of increased frequency. This would suggest that the recommended route frequencies for the corridor route modifications are plausible, however we also note that there are many more weekdays in a calendar year compared to Saturdays and Sundays, therefore the changes in frequency on the weekdays have a greater impact than the changes in frequency on the weekends. Factoring this in would suggest that the frequencies proposed may be somewhat aggressive. At the same time, many of the cells showing pluses and minuses have proposed frequencies (Table 11) on the lower and upper bound respectively of the range quoted in the table of plausible frequencies (Table 10). Therefore, it is difficult to determine with a degree of confidence whether or not Halifax Transit will be able to implement the route modifications at the frequencies shown in the table above without requiring an increase in revenue-hours allotted to the corridor route layer.

[11] The figures in Table 11 are intended to illustrate both a cost neutral solution and a solution for which additional funding will be required. H-Line frequencies are specified as a range for weekday peak and weekday off-peak with the expectation that the upper end of this range will be cost-neutral and the lower end of this range will require additional funding.

Recommended Scheduling

Stantec recommends as a next step that Halifax Transit investigate scheduling possibilities with the aim of delivering the service at the frequencies specified in Table 11 above. The H-Line was left as a range of frequencies during the weekday with the intention that the frequency can be calibrated to the resources available, with the intention that the higher end of this range is expected to be cost-neutral or "zero sum", i.e. implementable without budget increases. Then, should more operations and maintenance funding for corridor routes become available in the future, Halifax Transit can invest these dollars into improving the frequency of the H-Line from the upper end of the range described above (i.e. every 5 minutes during weekday peak) to the lower end of that range (i.e. every 3 minutes during weekday peak). In the long-term, there may be additional considerations for route updates or for new Corridor Routes, particularly if additional funding is available. These additional considerations are described further in section 5.2.

Another important scheduling consideration is with respect to how the proposed Corridor Route network is integrated with the ferry routes. The Alderney ferry may see a decline in ridership with users opting for the H-Line instead. The Woodside ferry, however, will continue to be critical for many users as travel between Woodside and Downtown Halifax using the corridor routes is circuitous and requires a transfer at Bridge Terminal. Depending on how Alderney ferry ridership pans out following implementation of the corridor route modifications, it may be appropriate for Halifax Transit to reallocate some resources from the Alderney ferry to the Woodside ferry. In terms of connectivity of the Halifax Ferry Terminal, it is assumed that users will walk from either Water St. Terminal or Scotia Square.

Interlining Considerations

Throughout section 4.2 of this report, considerations for interlining were raised. Interlining is an important concept to explore further in the development of schedules. To summarize, Stantec is recommending the following:

- Route 5 is recommended to operate as a branch of the H-Line, but be advertised as its own route. That is, every other H-Line bus (or every third bus depending on the target headways at a given point in time) will continue from the Bridge Terminal towards Portland Hills, becoming a Route 5 bus; and every Route 5 bus will continue from the Bridge Terminal across the Macdonald Bridge, becoming an H-Line bus. In the long-term, if demand proves itself, the H-Line could be extended to cover the full alignment of Route 5, and then Route 5 would no longer be needed.

- Routes 3 and 4 are recommended to be operated as if they were a single route, with one turning into the other at Scotia Square, in an effort to minimize the need for transferring. Due to the length of the combined route alignment, Routes 3 and 4 are presented in this report as separate routes. It is recommended from a marketing perspective that they also remain as separate routes when implemented, such that they can be given distinct names since they serve different travel needs.

It should be noted that interlining can impact the measures referenced below in Section 4.4. In an effort to be conservative in the travel time estimates with the proposed recommendations, no interlining was assumed. However, if these routes do indeed interline, travel time estimates will further be in favour of the proposed recommendations, given the lesser amount of transferring implied. This is not to suggest that travel will be completely seamless, as layovers will still be necessary at the terminals to allow for drivers to take breaks, runs to stay on schedule, and users to transfer between other routes. However, interlining will result in improved reliability, an improved travel experience, and likely also modest improvements to travel time. A final consideration is the operational benefits in terms of reliability and on-time performance, in the case of Routes 3 and 4 in particular, where interlining would mitigate the need to make too many turns in Downtown Halifax where the roads can be congested.

4.4 TRAVEL TIME MAPPING

Stantec performed a series of travel time mapping exercises to both support the analysis of the existing corridor routes as well as provide data-driven, transparent, and defendable arguments for our proposed recommendations. The travel time analyses were done in three capacities: (1) The estimated number of residents and jobs within a comfortable five-minute walking distance of corridor route bus stops, (2) the estimated travel time as a transit rider on corridor routes between popular origins and destinations across the service area, and (3) estimated travel time using isochronal mapping from selected locations to any arbitrary location across the service area.

4.4.1 Travel Time to Bus Stops

Reasoning

We investigated the estimated walking time to both existing and proposed corridor route bus stops to ensure that the level of accessibility to the network was not negatively impacted by our recommended optimizations. Specifically, we needed to ensure that at least 50% of the population and 50% of the jobs within the Urban Transit Service Boundary (UTSB) remained within a comfortable 5 min walk to the nearest corridor route bus stop[12].

Methodology

Estimating the distribution of population and jobs

The most refined population and job data we were able to locate for this assignment were totaled at the Census Dissemination Area level (DA). In order to evaluate the number of people and jobs within the subsections of the DA within a comfortable walking distance from corridor bus stops, we needed to estimate a more precise distribution of these values. To do so, we first summed the total number of addresses within each DA; due to the nature of the address dataset we obtained from the Halifax Regional Municipality, we were not able to distinguish addresses by the type of establishment (i.e. residential vs commercial). Secondly, we divided the population totals and job totals for each DA by the number of address points to arrive at an equalized average number of people and jobs per address within the UTSB.

Calculating Walksheds

To calculate walking distance to bus stops, we first need to find the actual corridor route stops associated with the existing as well as the proposed network. To do so, we performed an initial spatial intersection using Geographic Information Systems (GIS) to find all bus stops near to corridor route alignments. Then, we performed a detailed visual inspection of each stop and each route to ensure that the appropriate stops servicing the planned corridor routes were being included and that neighbouring stops servicing other non-corridor routes were not included.

For each set of stops, we ran a network analysis tool using ArcGIS to delineate 'walk-sheds' of 0-5 minutes (0-400m) and 5-10 minutes (400-800m). We then grouped selected the addresses located within each walk-shed and summed the average population and jobs to arrive at our final calculations. To calculate the proportion of jobs and population within the UTSB serviced by the corridor routes, we used the same set of addresses to estimate the total number of population and jobs within the UTSB, the results of which are presented in the following section.

Results

The results of this exercise are summarized in the following figures:

[12] A 5 minute walk assumes an average walking speed of 1.33 mps, which equates to a distance of roughly 400m.

Figure 17: Relative passenger activity of Halifax Transit bus stops

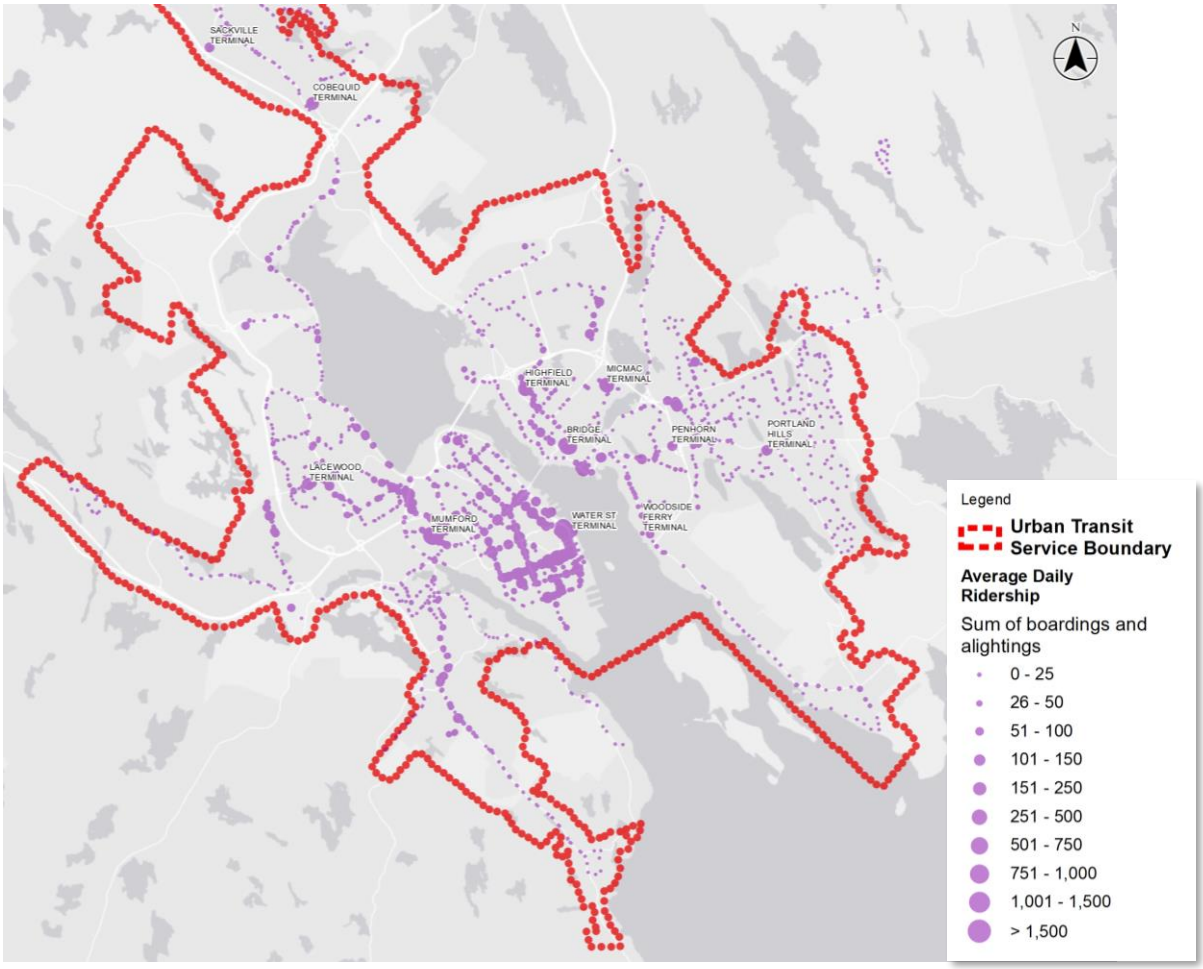


Figure 18: Relative passenger activity in the Halifax Peninsula

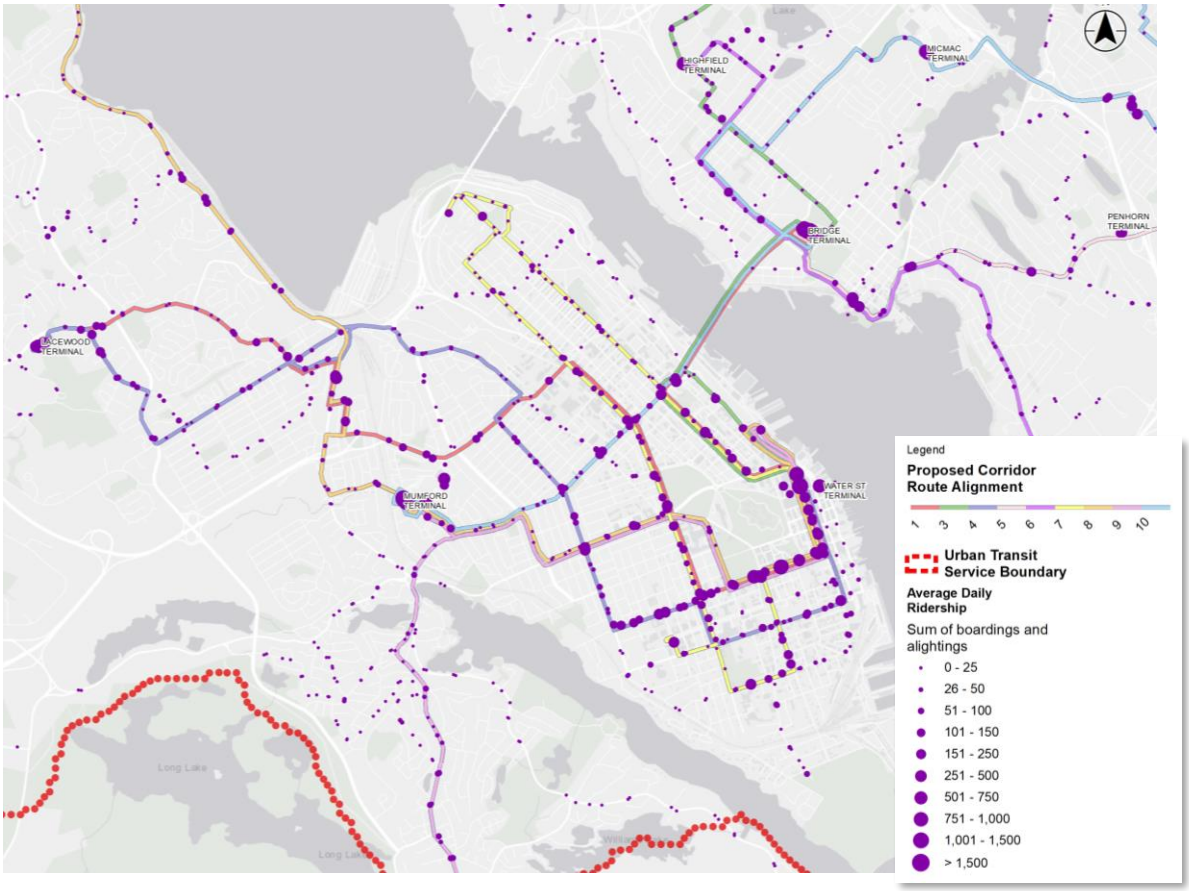


Table 12: Population and Job Estimates for the Urban Transit Service Boundary (UTSB)

Population	303,000
Jobs	170,000

Table 13: Pedestrian accessibility to existing and proposed corridor route bus stops

	Existing	Proposed
Number of Bus Stops on Corridor Routes	1,580	1,472
UTSB population within 400m walking distance to bus stops	63%	61%
UTSB jobs within 400m walking distance to bus stops	70%	69%
UTSB population between 400m-800m walking distance to bus stops	20%	19%
UTSB jobs between 400m-800m walking distance to bus stops	15%	15%
Average Population and Jobs within 400m per UTSB bus stop	223	233
Average Population and Jobs between 400m-800m per UTSB bus stop	61	64

Figure 19: Walking time to Proposed Corridor Route Bus Stops

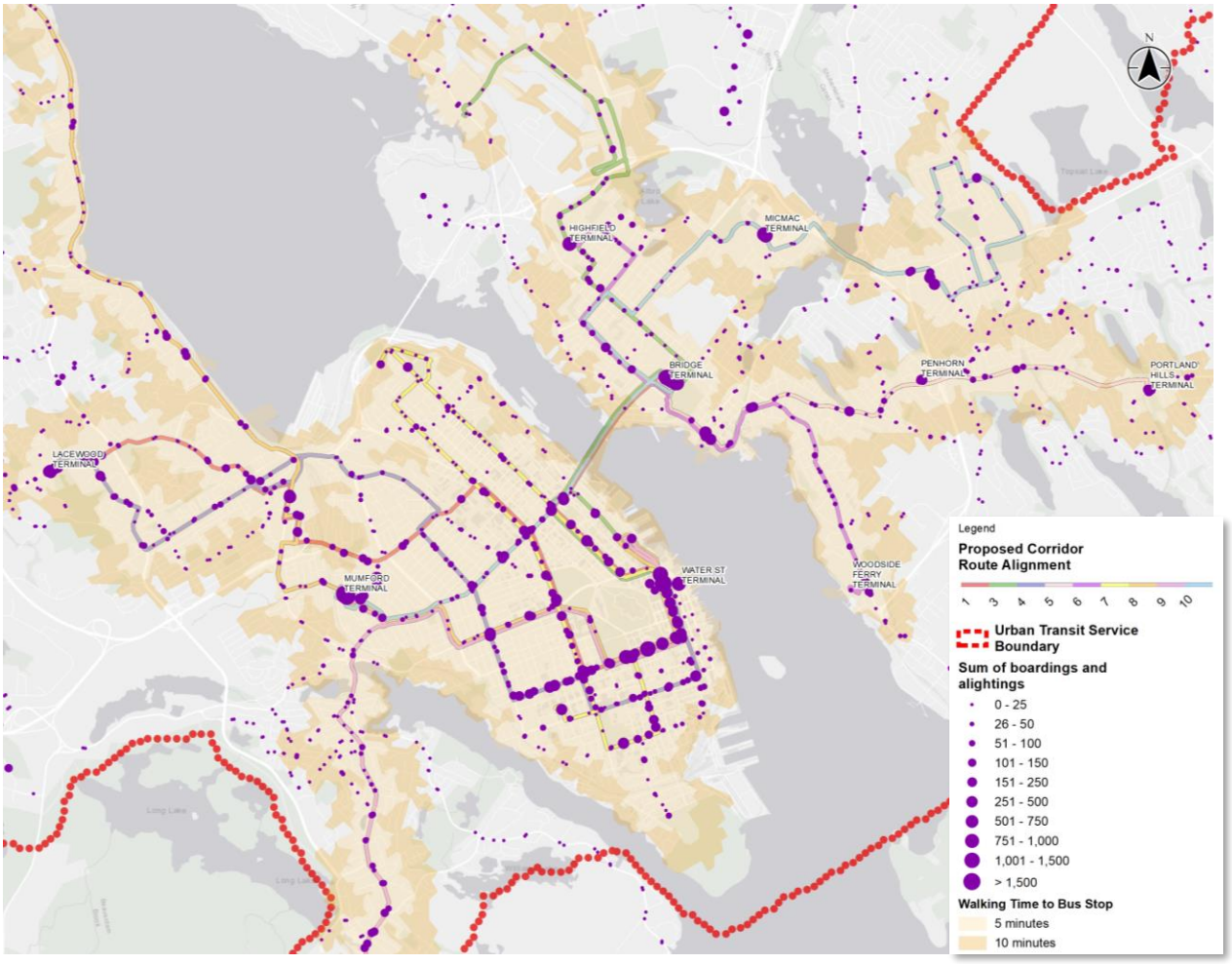
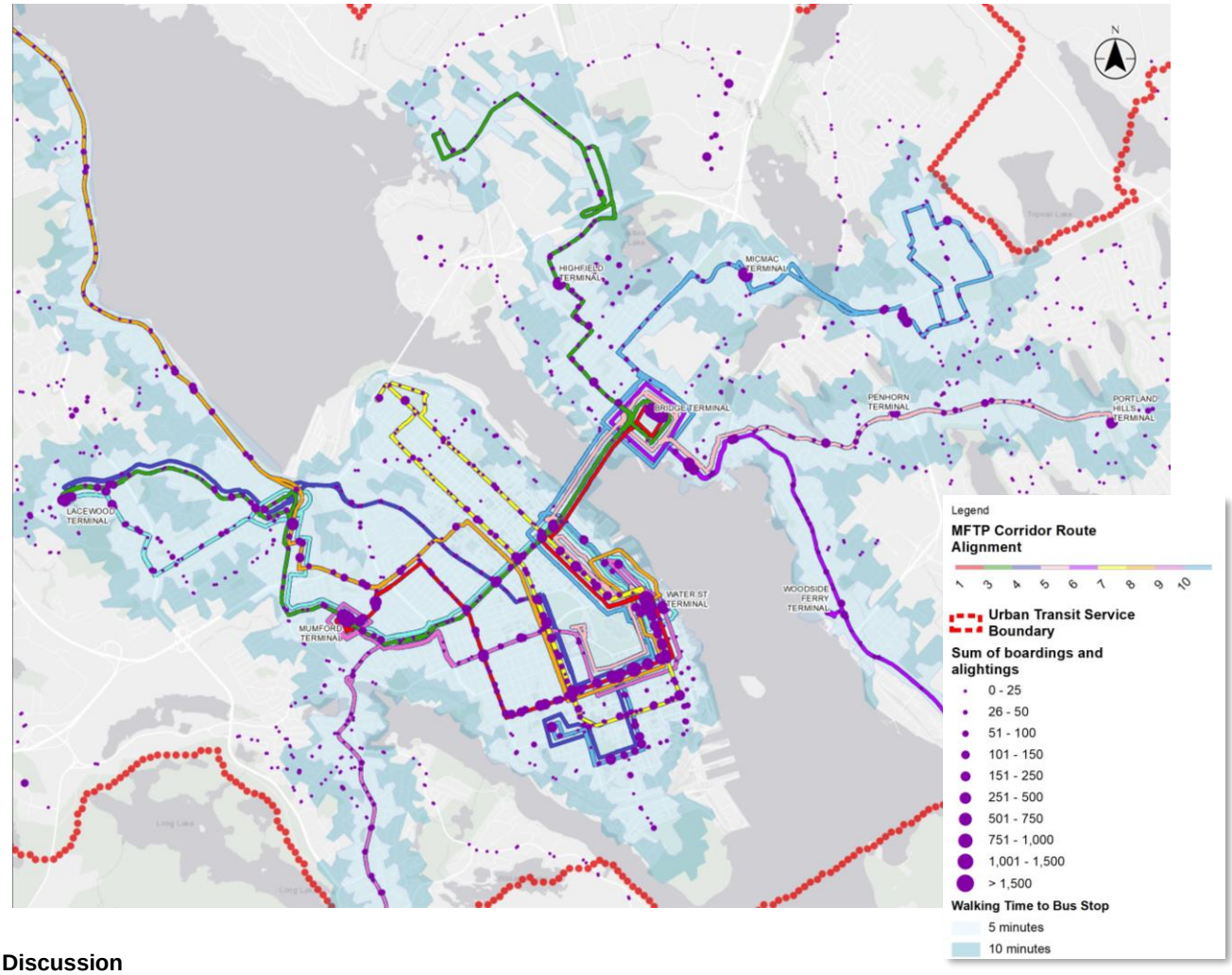


Figure 20: Walking Time to MFTP Corridor Route Bus stops



Discussion

We note that both the existing network and the proposed network provide for a majority of the population and jobs within a comfortable walking distance to corridor route bus stops. There is a slight decline in the total estimate of people and jobs serviced in the proposed network when compared to the existing MFTP Corridor Route network. However, the number of routes and stops is also decreased which could lead to increased operational efficiencies and additional revenues for increasing service frequency and/or quality. We note additionally that the average ratio between the total number of people and jobs per bus stop actually increased in the proposed network; which suggests that our recommendations could utilize less resources and allow for a more efficient and optimized service.

4.4.2 Travel Time Between Popular Origins and Destinations

Reasoning

One of the greatest potential impacts of recommending routing realignments is the effect it would have on each user's travel experience, most notably calculated through variations in travel time and the number of transfers required. Thus, and proposed modifications we made to the existing network must be evaluated against these data points.

Methodology

Using ridership data to identify popular origins and destinations

Stantec received roughly one year of ridership data from August 21st, 2017 through to August 17th, 2018 from Halifax Transit, as generated from their on-board Automatic Passenger Counters (APC). For each stop on the network, we calculated the daily averages of boardings and alightings to develop a measure for the relative frequency or popularity of origins/destinations across the network. Using the Getis Ord-Gi* algorithm to identify the relative popularity of individual stops, we arrived with a shortlist of locations: Scotia Square / Water St. Terminal, Spring Garden at Robie St., Mumford Terminal, Bridge Terminal, and Micmac Terminal. In addition to this shortlist, we also wanted to evaluate the impact of travel time from other key locations across the network. We therefore added Sackville, Penhorn and Lacewood Terminals to the list of key origins and destinations.

Generating travel time between bus stops

Next, we needed to generate a series of values to accurately reflect travel time via transit across the network. To do so, Stantec received roughly one year of Automatic Vehicle Location (AVL) data from August 21st, 2017 through to August 17th, 2018 from Halifax Transit. This data provided departure time, arrival time, and dwell time for each route and each route segment across the network. From this table, we calculated the total elapsed time between departure times at the origin and destination stops and derived daily average travel times per segment. Additionally, we also derived travel times for four distinct time periods throughout the day: Morning Peak – 7am to 10am; Evening Peak – 4pm to 7pm; Midday – 10am to 4pm; and Overnight – 7pm to 7am.

As we proposed new route alignments for the corridors, certain stop to stop connections were not previously serviced by an existing Halifax Transit Route and thus required an addition means of calculating travel time. To derive the travel time for these segments, we first calculated the overall average cruising speed of Halifax Transit vehicles by taking the average of travel time over travel distance. We then used this figure to estimate the travel speeds for these newly established segments.

Modeling the corridor routes

With the stop to stop segment links prepared, we set about preparing a model of the corridor routes upon which we could run our analysis. As the focus of this project was strictly a review of the corridor routes, our model did not include other transit options along non-corridor routes. To have included non-corridor routes we would have needed to also evaluate the impact of local route modifications as a function of our proposed corridor realignments the details of which were beyond the scope of this assignment.

Alongside the segment links for corridor routes, we added a pedestrian access network which enabled stop to stop connections between all stops within a 400m walking distance from one another. The pedestrian access network enables the modelling of transferring between different bays at terminals as well as stops at all sides of an intersection.

To model the impact of transfers between routes, and the riders motivation to begin walking rather than waiting for the next bus/transfer, we estimated a range of values for the increase in travel time for the behaviours specified in Table 14.

Table 14: Transit User Behaviours

Behaviours	Impact to travel time
Switching routes at the same stop	0 to 10 minutes
Exiting the bus to begin walking	1 minute
Walking and then boarding a bus	0 to 10 minutes
Walking Speed	As a function of walking distance at a speed of 1.33 m/s

Generating travel times

To compare the impact of our proposed recommendation on travel time we ran a series of shortest path calculations (Dijkstra algorithm[13]) between the previously identified key locations in the network, using travel time averages for the whole day as well as for each time period within the day. Additionally, we performed a sensitivity analysis on the impacts on transfer time using the following scenarios:

- Riders planned their route and attempted transfers if they thought they could catch the next bus within 3 minutes after alighting, and they actually were able to catch the bus within 0 to 10 minutes.
- Riders planned their route and attempted transfers if they thought they could catch the next bus within 10 minutes after alighting, and they actually were able to catch the bus within 0 to 15 minutes
- We then took the total average, minimum, and maximum values for each origin-destination trip pair across all times of day and all travel scenarios. The results of this analysis are included in the following section.

Results

Table 15 provides a summary of the relative change in travel time between the existing corridor network and our proposed corridor network. Please note that a positive value corresponds to an increase in travel time, and a negative value relates to a decrease in travel time, however the margin of error is also important as in some cases it is large enough to render unclear which alignment is the fastest. Thus, for the sake of clarity, we have colour coded the cells such that a value of green means the proposed alignment is relatively faster, the colour of red where the proposed alignment is relatively slower, and black where there is either no difference or the difference is unclear. Although there are quite a few instances of slightly increased travel time, it is noted that in no case is travel time impacted negatively by more than 4.5 minutes, and the travel time increases at Highfield Terminal are expected to be digestible by riders given the improved corridor route travel options and overall improved connectivity provided in lieu. Also, this table does not consider the impact of TPMs on reducing travel time, which we expect to have a larger effect given the increased reliance of the proposed network on TPM corridors. Appendix 2 provides an additional table detailing the change in number of transfers, the possible routes taken and the total ranges in travel time for each origin-destination pair.

[13] https://en.wikipedia.org/wiki/Dijkstra%27s_algorithm

Table 15: Change in Travel Time between MFTP and Proposed Corridor Routes (minutes)

		Destinations										
		Bridge Terminal	Highfield Terminal	Lacewood Terminal	Micmac Terminal	Mumford Terminal	Penhorn Terminal	Robie at Spring Garden	Sackville Terminal	Scotia Square	Water St Terminal	Woodside Ferry Terminal
Origins	Bridge Terminal		2 (+/- 0)	-5 (+/- 6)	0 (+/- 0)	0 (+/- 0)	0 (+/- 0)	2 (+/- 0)	1.5 (+/- 2)	2 (+/- 0)	2 (+/- 0)	0 (+/- 0)
	Highfield Terminal	2 (+/- 0)		-2 (+/- 6)	2.5 (+/- 1)	3 (+/- 0)	2 (+/- 0)	4 (+/- 0)	4.5 (+/- 2)	4 (+/- 0)	4 (+/- 0)	2 (+/- 0)
	Lacewood Terminal	-2.5 (+/- 7)	-0.5 (+/- 7)		-2.5 (+/- 7)	-2 (+/- 7)	-2.5 (+/- 7)	-4 (+/- 0)	2 (+/- 0)	-2 (+/- 6)	-2 (+/- 6)	-2.5 (+/- 7)
	Micmac Terminal	0 (+/- 0)	3 (+/- 1)	-5 (+/- 6)		0 (+/- 0)	0 (+/- 0)	2 (+/- 0)	1.5 (+/- 2)	2 (+/- 0)	2 (+/- 0)	0 (+/- 0)
	Mumford Terminal	0 (+/- 0)	2 (+/- 0)	-6.5 (+/- 9)	0 (+/- 0)		0 (+/- 0)	2.5 (+/- 5)	2.5 (+/- 9)	-4 (+/- 12)	-4 (+/- 12)	0 (+/- 0)
	Penhorn Terminal	0 (+/- 0)	2 (+/- 0)	-5 (+/- 6)	0 (+/- 0)	0 (+/- 0)		2 (+/- 0)	1.5 (+/- 2)	2 (+/- 0)	2 (+/- 0)	0 (+/- 0)
	Robie at Spring Garden	0 (+/- 0)	2 (+/- 0)	-4 (+/- 0)	0 (+/- 0)	-4 (+/- 6)	0 (+/- 0)		-4.5 (+/- 9)	-0.5 (+/- 1)	-0.5 (+/- 1)	0 (+/- 0)
	Sackville Terminal	1.5 (+/- 10)	3 (+/- 9)	0 (+/- 0)	1.5 (+/- 10)	2.5 (+/- 9)	1.5 (+/- 10)	-1.5 (+/- 4)		-0.5 (+/- 8)	-0.5 (+/- 8)	1.5 (+/- 10)
	Scotia Square	0 (+/- 0)	2 (+/- 0)	-2 (+/- 2)	0 (+/- 0)	0 (+/- 0)	0 (+/- 0)	0 (+/- 0)	-2 (+/- 7)		0 (+/- 0)	0 (+/- 0)
	Water St Terminal	0 (+/- 0)	2 (+/- 0)	-2 (+/- 9)	0 (+/- 0)	0 (+/- 0)	0 (+/- 0)	0 (+/- 0)	-3 (+/- 6)	0 (+/- 0)		0 (+/- 0)
	Woodside Ferry Terminal	0 (+/- 0)	2 (+/- 0)	-5 (+/- 6)	0 (+/- 0)	0 (+/- 0)	0 (+/- 0)	2 (+/- 0)	1.5 (+/- 2)	2 (+/- 0)	2 (+/- 0)	

Figures 21 to 36 in Appendix 3 provide a graphic representation of the data contained in Table 15.

4.4.3 Isochronal Mapping

Reasoning

Although origin to destination estimates between key locations are valuable approximates for travel across the network, and does provide more quantitative data to compare differences with, isochronal mapping allows for a wider "birds-eye view" of the differences between the networks for accessing a variety of destinations across the service area.

Methodology

To generate the isochrone mapping, we utilized the Open Trip Planner tool which produces isochronal geometries given an input start time and standardizes GTFS feed. To prepare the GTFS feed, we calculated the average stop to stop travel time from the reported AVL information from existing Halifax Transit operations. For each alignment in both the MFTP Corridors as well as our Proposed Corridors, we identified the sequences of stops for each trip, and prepared the GTFS feeds accordingly.

We prepared isochronal mapping to compare the differences between the MFTP and Proposed Corridor Routes for five (5) locations, each for three (3) times of day. Specifically, these locations are:

- Halifax Central Library
- Mic Mac Mall
- Keshen Goodman Public Library
- Sunnyside Mall
- Sackville Public Library

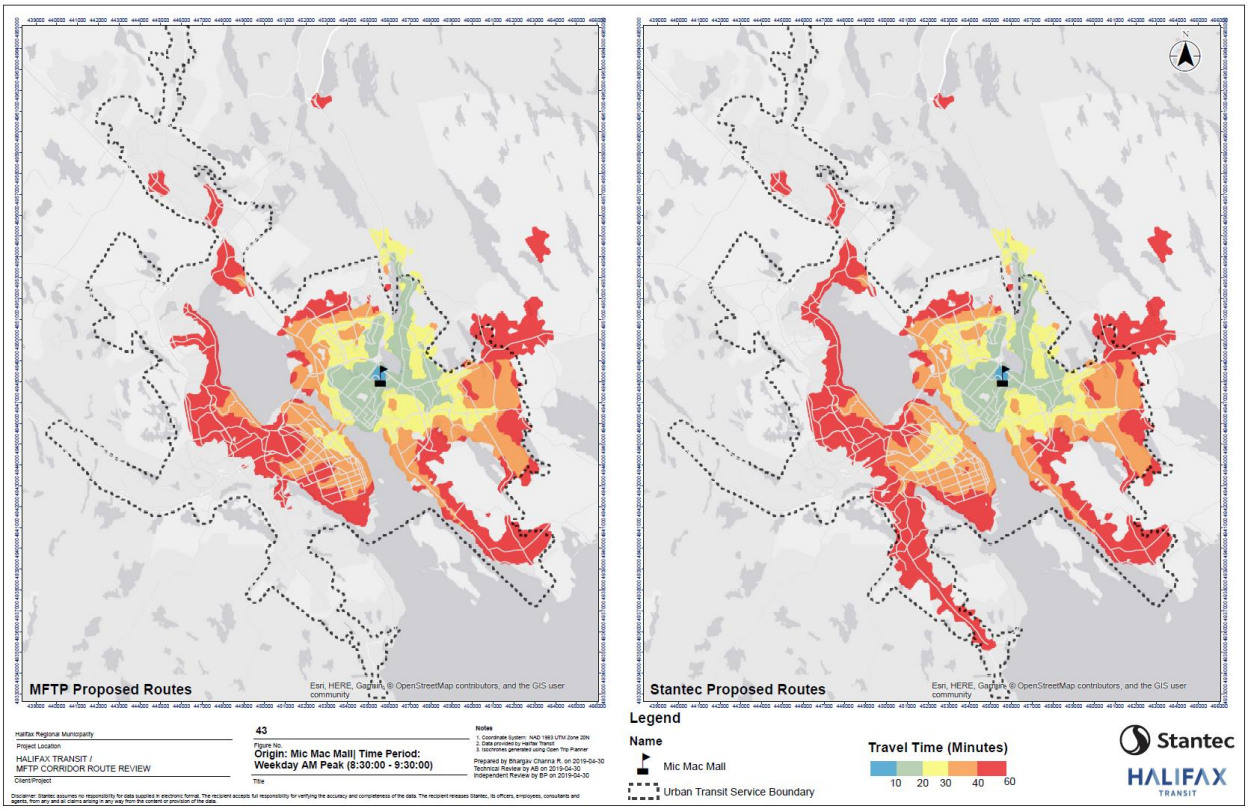
The times of day used were:

- AM Peak (8:30am)
- Midday (12:30pm)
- PM Peak (5:00pm)

Results

Our complete results are included as Figures 37 to 51 in Appendix 3. As an example of these maps, we have included a reduced resolution version of Figure 43 below.

Figure 43 – Example of Isochronal Mapping



4.4.4 Discussion

As a whole across the network, travel time remains similar when comparing the MFTP and proposed network alignments. For some routes there were higher variabilities in travel time, such as those in and out of Lacewood Terminal. This indicates that special attention should be paid to service planning and scheduling when implementing the routes, and should be informed by real observed origin-destination habits by Halifax Transit riders to ensure the most amount of trips are able take the most direct or fastest routes.

Additionally, our sensitivity analysis suggests that as transfer time increases, the total average travel time across the origin-destination trip matrix on the existing network generally increases compared to the proposed network. The average decrease in travel time between the existing and the proposed networks can be described by the following equation:

$$Average\ Decrease\ in\ Travel\ Time\ Per\ Trip = 0.13 * Average\ Tranfer\ Time - 1.56$$

This equation demonstrates that as *Average Transfer Time* increases, the *Average Decrease in Travel Time Per Trip* will also decrease. This suggests that the new network may be slightly more resilient to the impacts of increased transfer time through either planned or unforeseen issues that would affect the travel experiences of Halifax Transit riders.

Another important consideration is the number of transfers that are required. Transfer-based systems are a useful strategy for limiting the need for overlapping routes, especially for jurisdictions such as HRM which have challenging geography. The more efficient resource deployment permitted by transfer-based systems means average service frequencies are better compared to systems that rely on one-seat rides. However, despite this, transfers remain an inconvenience for riders, with the time spent transferring partially offsetting the time saved in improved route frequencies. As such, it is important to evaluate common trips to ensure that the number of transfers required is not excessive. In developing the proposed corridor route modifications, an objective was set of no more than one transfer between origins and destinations lying along corridor routes as best possible, in an effort to ensure that the journey is not a frustrating experience for riders. Table 16 provides an overview of the number of transfers required to travel between points of interest.

Table 16: Number of Transfers Required Between Origins and Destinations

		Destinations										
		Bridge Terminal	Highfield Terminal	Lacewood Terminal	Micmac Terminal	Mumford Terminal	Penhorn Terminal	Robie at Spring Garden	Sackville Terminal	Scotia Square	Water St Terminal	Woodside Ferry Terminal
Origins	Bridge Terminal	-	0	0*	0	0	0	0	1	0	0	0
	Highfield Terminal	0	-	1*	1	1	1	1	1	0	0	0
	Lacewood Terminal	0*	1*	-	1	1	1*	0	1	0	0	1*
	Micmac Terminal	0	1	1	-	0	1	1	1	1	1	1
	Mumford Terminal	0	1	1	0	-	1	0	0	0	0	1
	Penhorn Terminal	0	1	1*	1	1	-	1	2	1	1	1
	Robie at Spring Garden	0	1	0	1	0	1	-	0	0	0	1
	Sackville Terminal	1	1	1	1	0	2	0	-	0	0	1
	Scotia Square	0	0	0	1	0	1	0	0	-	0	0
	Water St Terminal	0	0	0	1	0	1	0	0	0	-	0
	Woodside Ferry Terminal	0	0	1	1	1	1	1	1	0	0	-

Notes:

- *0* indicates that no transfers are required but a transfer is nevertheless advised to avoid circuitous routing and long travel times. Likewise 1* indicates that a transfer is required but a second transfer is advised.*
- *No interlining is assumed in the number of transfers required; however, if the H-Line and Route 5 were to interline, and if Routes 3 and 4 were to interline, fewer transfers would be required in some instances.*
- *With regards to travel to/from Woodside Ferry Terminal, the number of transfers to locations such as Scotia Square and Sackville Terminal can be reduced by travelling by ferry. This is considered in the table above.*

5.0 IMPLEMENTATION CONSIDERATIONS

5.1 PHASING

Stantec acknowledges that MFTP Corridor Routes 2, 3, 4, and 9 have already been implemented at the time of writing this report. There are little concerns related to Corridor Route 9 as the alignment remains the same following the proposed modifications, however, before implementing the modified schedule, Halifax Transit may want to consider whether there is a need to bolster local service along Herring Cove Rd. to offset the somewhat reduced service frequencies of Route 9. Any changes to local service should be made at the same time as the scheduling changes for Route 9. Additionally, because Routes 8 and 9 are intended to be closely related operationally, sharing the same alignment east of Mumford Terminal, it is also recommended for the proposed modifications for Route 8 to be implemented at the same time as the updated schedule for Route 9 and local considerations along Herring Cove Rd. Stantec recommends that Routes 8 and 9 depart Mumford Terminal in the inbound direction offset 10 minutes from each other, so that way the 10 minute composite frequencies along Quinpool Rd., Bell Rd., Summer St., and beyond may be achieved.

For Corridor Routes 2, 3, and 4, this is not so easy as the proposed modifications to these routes are more significant. With regards to implementing these proposed modifications, it is recommended to implement them alongside the implementation of the H-Line. The H-Line can be marketed as a new and improved version of both Routes 1 and 2, which is supported by Routes 3 and 4 that follow the same general trajectory (Clayton Park – Downtown Halifax – Dartmouth) albeit servicing different locations. As a package, the H-Line and Routes 3 and 4 provide adequate service from Dartmouth and Clayton Park, whereas if implemented individually, there may be some locations left temporarily without adequate service.

As Halifax Transit evaluates the operational impacts of the proposed corridor route modifications, it is recommended that it start by first implementing the modifications to Corridor Routes 5-9. More modest changes have been proposed to these routes compared to the others, so it should require less lead time to evaluate the scheduling and operational impacts. Furthermore, the changes to these routes should have relatively low impact on the performance of the other corridor routes as their underlying purposes do not involve connecting Clayton Park, Downtown Halifax, and Dartmouth. Then, once the changes to Routes 5-9 have been implemented, the second phase of implementation can involve implementing the H-Line, as well as Routes 3, 4, and 10, and removing Route 2.

It is recommended that Halifax Transit consolidate the implementation of all proposed modifications into these two phases (or even one phase, if possible). It is not recommended to implement these routes piecemeal, spread out over three or more phases. The value of the proposed corridor route modifications is in their synergies and ridership potential of the corridor route network as a whole – a whole which exceeds the sum of the parts. By implementing these routes piecemeal, Halifax Transit would run the risk of leaving critical gaps in transit service to certain neighbourhoods.

With regards to BRT, it is recommended that BRT implementation occur after the two phases of corridor route implementation have already passed. The design of the H-Line is predicated on the principle that it can be upgraded to a BRT route, so it would not make sense to implement BRT before these corridor routes have already been implemented.

5.2 FUTURE CORRIDOR ROUTE PROSPECTS

In addition to the proposed modifications discussed above, Stantec offers the following discussions on areas of the Halifax Regional Municipality which do not have corridor route service but may be appropriate to include in the corridor network in the future. An important distinction is that this discussion focuses on areas rather than routes. It is acknowledged that Route 14 has the highest ridership out of the non-corridor routes, however, in the proposed modifications the high-ridership elements of Route 14 are adequately covered by Routes 7, 4, and 9. Areas for consideration are as follows.

5.2.1 Dartmouth Crossing

Dartmouth Crossing in Burnside has significant passenger activity at the stops along Countryview Dr. and along the roads south of Commodore Dr. that corridor service is plausible not only in the future but at present as well. In total, the bus stops located in Dartmouth Crossing (including Wright Ave.) combine for 900 average weekday boardings and alightings, and 851 average weekend boardings and alightings. The MFTP corridor route network, however, does not propose any corridor service here, rather Dartmouth Crossing is serviced instead by local routes 56 and 72, both of which operate every 30 minutes during peak hours, for an effective average frequency of 15 minutes.

The most logical option for proposing a corridor network modification to service Dartmouth Crossing would be an extension of Route 3 or Route 10. However, such a modification was not recommended. While the passenger activity is significant enough to warrant corridor level service, it is not large to the point that it would be worthwhile to significantly divert either of those two routes to service Dartmouth Crossing. Such an extension would be costly to operate and it would also detract from the underlying principle of seeking to improve route directness. Moreover, it would be inconvenient for the users travelling between destinations located along Routes 3 or 10 as proposed, adding to their travel time significantly. As such, it is recommended, for now, not to service Dartmouth Crossing with a corridor route. In the future, if the demand for service to Dartmouth Crossing grows, and especially if development progresses nearby Dartmouth Crossing and in areas such as Shannon Park, there may be a case for an addition of a new corridor route, however, it is not should not be considered as a possible modification to Routes 3 or 10 unless the underlying purpose of either of these routes is changed.

5.2.2 Local Route 39 and considerations for Shannon Park

Local Route 39 (identified as Route 32 in the MFTP) starts in Lacewood Terminal, running up Parkland Dr. and across Farnham Gate Rd., Knightsridge Dr., and Flamingo Dr. to MSVU. From here it takes the Bedford Hwy. and the MacKay Bridge to Dartmouth where it terminates at Bridge Terminal via Highfield Terminal. This route runs approximately every 30 minutes during weekdays before 6:30pm after which it drops down to every 60 minutes. On Saturdays it operates every 30 minutes, and on Sundays, every 60 minutes.

We recommend that this route be “flagged” as a possible route that may warrant an upgrade to corridor route status. Firstly, the stops located along Parkland Dr., Farnham Gate Rd., and Knightsridge Dr., while not significant enough to warrant corridor route status presently, are some of the highest passenger activity stops that are not proposed to be serviced by one or more corridor routes. Second, we recognize that the direct connection between MSVU and Lacewood Terminal running along Flamingo Dr. through Clayton Park West is important, and that the limited service to MSVU is a contentious issue the MSVU Students’ Union is currently lobbying against. Third, for users travelling between Clayton Park and Dartmouth, there is perhaps no more quick and convenient way to travel on transit. Fourth, this route is probably the best candidate for tweaking to provide service to Shannon Park as this neighbourhood becomes more developed and warrants service.

At this point, options may be evaluated to run the route from Shannon Park along Windmill Rd. or a combination of Windmill Rd. and Wyse Rd. to Downtown Dartmouth, or alternatively the route might continue to Burnside and along Commodore Dr. through Dartmouth Crossing before terminating at Micmac Terminal. For a combination of all of these reasons, Route 39 should be considered a candidate for an upgrade, further keeping in mind that it may be appropriate to tweak in the future to accommodate Shannon Park residents.

The consideration of upgrading Route 39 in the future is a more desirable prospect than leaving Route 3 as described in the MFTP due to the additional destinations served by Route 39 (such as MSVU), the faster travel time (due to more direct routing along the MacKay Bridge), and the ability to tweak it to serve Shannon Park more effectively and efficiently than Route 3 may be tweaked. Rather, Route 39 might be considered instead to operate as an extension of the proposed Route 6.

5.2.3 SmartCentres Halifax

SmartCentres Halifax is a large shopping centre located along Chain Lake Dr. in Clayton Park West. Due to the prevalence of major shopping destinations, the stops along Chain Lake Dr., particularly those that are located north of Washmill Lake Dr., have high passenger activity. Chain Lake Dr. is currently served by Routes 21 and 28 as of December 2018. (Route 28 was identified as Route 31 in the MFTP).

Despite the high passenger activity, due to SmartCentres Halifax's relatively secluded location, no corridor route modifications to service Chain Lake Dr. are recommended. While this location is important to serve with transit, the design of the shopping centre and the fact that many of the tenants are businesses such as The Home Depot, Costco, Walmart, and Canadian Tire, it is likely that the preferred mode of transportation to access SmartCentres will continue to be personal vehicles, regardless of how much transit can be improved here. It is of the opinion of Stantec that two local routes are sufficient to provide the level of service that is appropriate for Chain Lake Dr. Nonetheless, this location is worth flagging for future review in case further development may warrant a westward extension of Corridor Route 4.

5.2.4 Tower Rd. and Point Pleasant Park

Tower Rd. and Point Pleasant Park are currently served by the local route, Route 29. As the extension down Tower Rd. to Point Pleasant Park is a relatively small section of the route alignment, it would be imprudent to assume that route performance is reflective of performance along Tower Rd. However, what we do know based on the schedule of Route 29 is that this segment is already used to seeing a relatively frequent level of service, with service every 15 minutes during weekday peak hours, and every 30 minutes during off-peak hours and on Saturdays and Sundays. It would not be too much of a stretch to think of Tower Rd. as receiving corridor level service.

There are also high activity stops that would benefit from corridor service including at the Tower Rd./Atlantic St. intersection, where students can more conveniently access St. Mary's University, and at the Tower Rd. Turning Loop adjacent to an entrance to Point Pleasant Park. The level of passenger activity was not significant enough to warrant a corridor route modification at this time, but stop performance along Tower Rd. should be monitored. Not only might this road warrant corridor level service in the future, but it could provide a means of more efficiently routing buses if a turnaround location outside of Downtown Halifax is deemed desirable in an effort to decrease the network's reliance on Scotia Square and Spring Garden Rd. At the same time, it is important to note that servicing Tower Rd. and Point Pleasant Park would not warrant its own Corridor Route, rather it would likely involve an update to Corridor Routes 4 and 7 if warranted.

5.2.5 Barrington St. north of North St.

Barrington St. north of North St. is a proposed corridor for several express routes as well as two local routes, but the MFTP does not propose it be serviced by any corridor routes. In the evaluation of MFTP Route 7, the possibility of moving the alignment off of Novalea Dr. and onto Barrington St. was considered, however, this was not recommended as the passenger activity along Barrington St. did not appear to be more compelling than on Novalea Dr., and we did not want to unnecessarily extend the alignment or otherwise make the routing by Nova Scotia Community College (NSCC) and along North Ridge Rd. more inconvenient.

If priority measures become installed here in the future – a possibility which is illustrated in Figure 20 of the Integrated Mobility Plan – then the possibility of adjusting Route 7's alignment off of Novalea Dr. and onto Barrington St. may be worth reconsidering. Not only would taking advantage of the transit priority measures be ideal operationally speaking, but it would have benefits in terms of coverage. We observe that Novalea Dr. and Robie St. are only approximately 415 metres apart, and Novalea Dr. and Barrington St. are similarly spaced. By providing service along

Robie and Barrington, this becomes more convenient for users living near Barrington St. (or whose destination is on or near Barrington St.), and for those nearby Novalea Dr., they have the option to walk either to Robie St. or to Barrington St., both of which are within acceptable walking distances, to use Route 7 in the direction that is most convenient for them.

5.2.6 Millview / Larry Uteck Blvd.

A final neighbourhood worth considering for future corridor route service is Millview, in particular along Larry Uteck Blvd. which has passenger activity that is relatively high for stops without proposed corridor route service (but not high enough to warrant corridor route service today). It is recommended that HRM monitor development in this area, as well as performance of Local Route 90 accordingly.

Options to provide service to Millview can take several different forms. First, it might be operated as a branch of Corridor Route 8, operating along Larry Uteck Blvd. using the same alignment as Route 90 operates today, terminating with a loop at Peakview Way and Starboard Dr. Another option, also operated as a branch of Corridor Route 8, is to use the same alignment as the MFTP-proposed Route 90, whereby the route continues along Larry Uteck Blvd. to Broad St., Gary Martin Dr., and Innovation Dr., before terminating at the West Bedford Terminal. This second option would result in more low-productivity service, but it would also add a corridor route connection at the West Bedford Terminal, helping to fulfill the MFTP principle of ensuring that all of Halifax Transit's terminals are serviced by at least one corridor route.

5.3 PERFORMANCE MONITORING AND DECISION-MAKING

Corridor Routes were designed to provide frequent service along corridors with high demand, linking multiple trip generators where two-way all-day demand exists. Corridor Routes also are supportive of densification and changing land uses in HRM. As discussed in the MFTP, performance measures and service guidelines or standards are key to determining how routes perform. Routes are classified into different layers or service types, and the performance measures and standards inform when routes require monitoring or corrective action. When routes perform above or below their targeted values or ranges, this triggers a review of the route whereby a successful or productive route may be allocated more resources, while a less successful or productive route may be targeting for adjustment or allocated fewer resources.

Nevertheless, some triggers are vague and review periods are unspecified. Guidelines and performance measures are important to ensure that routes are performing as intended, delivering service that customers expect, while maintaining some level of financial sustainability.

First, we discuss some key performance measures and their service standards particularly for Corridor Routes. Then, we discuss triggers that would help Halifax Transit determine appropriate classification of routes based on actual performance, as well as changes or adjustments to service.

5.3.1 Performance Measures

Figure 21: MFTP Screenshot of Corridor Route Service Span

Service Type	Route Number	Weekday				Saturday			Sunday		
		Span		Service Frequency		Span		Frequency	Span		Frequency
		Service Start	Service End	Rush Hour (AM & PM)	Midday/ Evening	Service Start	Service End	Day	Service Start	Service End	Day
Corridor Routes	1	5:00 AM	1:00 AM	5-10	10	5:00 AM	1:00 AM	15	6:00 AM	12:00 AM	15
	2	5:30 AM	1:00 AM	15-20	15-20	6:00 AM	1:00 AM	15	6:00 AM	12:00 AM	20
	3	5:00 AM	1:00 AM	15	20-30	6:00 AM	1:00 AM	30	6:00 AM	12:00 AM	30
	4	6:00 AM	1:00 AM	10-20	15-20	6:00 AM	12:00 AM	30	7:00 AM	12:00 AM	30
	5	5:00 AM	1:00 AM	15	15	6:00 AM	1:00 AM	20	6:00 AM	12:00 AM	30
	6*	5:00 AM	1:00 AM	10-15	15-20	5:00 AM	1:00 AM	30	5:00 AM	1:00 AM	30
	7	6:00 AM	1:00 AM	15	15-20	6:00 AM	12:00 AM	20	6:00 AM	12:00 AM	30
	8	5:00 AM	1:00 AM	20-30	20-30**	5:30 AM	1:00 AM	30	5:30 AM	12:00 AM	30
	9*	5:00 AM	1:00 AM	10-15	15-20	6:00 AM	12:00 AM	30	6:00 AM	12:00 AM	30
	10*	5:30 AM	1:00 AM	5-10	10-15	6:00 AM	12:00 AM	20	6:00 AM	12:00 AM	30

* On routes with branches, combined frequency is shown. For example, all branches of the route 9 combine to have a 10 minute frequency on the section of the route shared by all branches. This is subject to detailed scheduling.

** A range is shown here to indicate that a route may have higher frequency in the peak direction during rush hour than in the off-peak direction, based on ridership demand.

In the MFTP, Halifax Transit specifies service spans and service levels (frequencies or headways) for each of the 10 proposed corridor routes. Apparent from the table above is that Corridor Routes display varying policy headways such as to be commensurate with the anticipated demand. The varying headways can be misleading to some customers, as the Corridor Route service type is the highest tier of service, and customers may expect frequent service that is similar across all routes either throughout most of the day, or at least during peak hours. By providing greater levels of service across fewer routes (having more stringent targets or standards), this can help develop more aspirational goals, while providing consistency across routes of a given service type. This scheme can also lend to marketing, so that routes can be advertised, for example, as “15 minutes or better service (all day or at rush hours)”, despite frequencies varying between 15 minutes, or 5 minutes.

Put simply, reducing the number of Corridor Routes (or developing well-defined standards) by removing certain routes that cannot support the level of service promised or expected for Corridor Routes could allow Halifax Transit to present a more uniform set of guidelines and standards for these Routes which are easier to communicate and market to existing and potential customers (saying route 8 is a Corridor Route like route 4 is misleading since frequencies are vastly different; some Local Routes have frequencies in the same range as certain Corridor Routes). Indeed, in section 6.6.4 of the MFTP, service frequency guidelines for Corridor Routes during peak hours are 5-15 minutes; compared with the table above, route 8 would not conform to the guideline, and routes 2 and 4 skirt the upper limit of the guideline.

Because Corridor Routes are expected to carry high passenger volumes, particularly during peak hours, crowding is definitely a concern as customer comfort is an important service quality attribute. Indeed, heavy loads could be indicative of productive service, but they can also indicate issues in scheduling and operations; conversely, empty buses along frequent routes suggest low demand or other issues. Measuring and tracking loading is possible with Halifax Transit’s archived APC data. In the MFTP, Corridor Routes and Local Routes have the same service standard—no more than 150% of seated capacity over a 30-minute period. Exceeding this limit can trigger a review (more on this below). Typically, transit agencies will set loading standards differently according to service types (frequent, standard, etc.) as well as differently across day parts (peak, off-peak, evenings, weekends, etc.). Stantec recommends a similar approach for Halifax, where Corridor Routes could have a higher crowding threshold than Local Routes, and that this could vary by day part. With more historic loading data, Halifax Transit should set realistic and measurable targets. If loading consistently exceeds standards, then corrective actions need to be taken.

Reliability is an important criterion that persuades or dissuades people from using transit. While Halifax Transit tracks on-time performance (OTP) as departures (MFTP; arrivals in Quarterly reports) within one minute early and three minutes late of published schedules at time points, it hasn’t set an explicit goal as of yet, but notes that industry standards typically target 85-90%. As discussed earlier, the reliability of Corridor Routes, by virtue of being frequent

routes, would likely be better captured by measuring the regularity or consistency of actual headways versus scheduled headways rather than OTP (or punctuality). For frequent service, TransLink in Vancouver specifies that actual headways should not exceed 120% of scheduled headways (for 10-minute frequencies, actual headways should not exceed 12 minutes) 80% of the time. This metric will track gapping of buses. On the other hand, to track bunching, TransLink specifies that actual headways should not fall below 25% of scheduled headways (for 10-minute frequencies, actual headways should not be lower that 2.5 minutes) 95% of the time. Halifax Transit should adopt similar metrics, and if performance is consistently beyond these bounds across quarters, then routes should be targeted for improvement.

Transit is successful at attracting ridership when it provides convenient service and when it's provided when customers need to travel. Service availability or service span typically describes when service operates. The MFTP specifies that Corridor Routes operate starting between 5:00am and 7:00am, and ending between 12:00am and 1:00am, depending on the route and depending on whether it is a weekday, Saturday, or Sunday. Demand can lead to adjustment of these hours, but it's unclear what 'demand' entails. Stantec suggests that Halifax Transit provide some qualification of this statement, such as, when the last two trips of a route are above a certain range of boardings (or boardings per hour during a time period), then additional service is added, or when a certain number of customer requests are made. Conversely, service may be reduced depending on consistently low boardings on the last two trips of a route. We also recommend that service span be more clearly defined, meaning that service start should be defined, for example as the first departure time of the day, or the first arrival time at a certain terminal, and that service end be defined too, for example as the last arrive time of the day, or the last departure time from a certain terminal. Clearly defining what these start and end times mean will help passengers avoid confusion and potentially avoid being left stranded once service has ended.

Taken together, we've discussed four important service standards: frequency (or headway), loading, reliability, and service span. Halifax Transit needs to clearly define what the standards are for each attribute, how they are measured, and what they mean for the customer.

Next, we focus on performance indicators and metrics aimed at evaluating how individual routes are performing (relative to the system and one another) so that they can be targeted for adjustment or improvements when they perform below expectations, or receive additional resources when performing above expectations.

5.3.2 Triggers and Decision-Making

Throughout the MFTP, Halifax Transit describes different performance indicators and measures (in Chapter 6, Measuring Success and in Appendix C: Alternative Measures of Route Productivity) that aim at evaluating route performance. The goal is to apply consistent criteria and evaluate each route to know where to allocate resources, and when to provide corrective actions to routes that are underperforming.

We reviewed the different criteria and indicators in the MFTP, as well as service standards from other agencies to understand gaps and opportunities for Halifax Transit. Furthermore, we took one step back and reviewed how the MFTP considers classifying an existing route as a Corridor Route. We also identified shortcomings in Halifax Transit's methodology that with refinement, can help Halifax Transit better identify where and how to improve route performance, while telling passengers what to expect from different service types.

We propose the following metrics in the table below as measures that should be tracked and evaluated for each route, every quarter. As opposed to evaluating routes on one or two metrics, compiling a succinct but varied list can help diagnose different issues with a route, for example whether few customers are using the route (productivity), or if service levels are too low leading to overcrowding. If desired, Halifax Transit may also wish to weight each measure according to different objectives, so that productivity may be weighted more than bidirectional load factor, for instance. Regardless, this multicriteria evaluation will result in final grade or score for each route that can then be used to ordinally rank routes from best to worst performing, as well as into quartiles or other statistically relevant groups.

Table 17: Proposed Metrics for Route Evaluation

Goal	Measure	Purpose	Calculation	Desired trend or range	Diagnoses
Productivity	Boardings per revenue hour	Effectiveness of attracting customers to the service, relative to the service provided	Boardings / revenue hours	Greater	Whether services allocated (hours) is justified based on the number of passengers attracted
Economic	Net cost per boarding	The subsidy required per boarding	[Cost of route – fare revenue of route] / boardings	Lower	Whether fare revenue and boardings justify the level of service
Reliability	Trip time variation	Trip times should vary as little as possible, indicating consistent trip times and reliability for customers	Average maximum trip time – average minimum trip time	Closer to 0	Operational issues along a route related to travel speeds, traffic, etc.
Comfort	Maximum load factor (or loading)	Tracks crowding levels	Passengers onboard at maximum load point / allowable passengers (seats + standees) by vehicle	Not above service standard (ex. ≤150% for 30 minutes during peak)	Whether service adjustments are needed to reduce crowding (or reduce service levels)
Two-way demand	Bidirectional load factor	Corridor routes should have “ridership in all directions” (pg. 38, MFTP). Measures ridership in both directions	Ratio of busiest load point of the off-peak direction compared to busiest load point in the peak direction during AM peak period.	Values should not be larger than 100% (off-peak not greater than peak). Closer to 100% more bidirectional use, implying priority treatments	Whether two-way demand or ridership exists along the corridor, or if it is peaked in a certain direction

Based on experience, historical data, and community goals, appropriate ranges for these values or indicators should be determined for each route class. We’ll use productivity measured as boardings per revenue hours as an example throughout this section for simplicity, but the same could be said for any of the measures above.

First, Halifax Transit needs to set a range that would allow each indicator to be assigned a score, such as “3” for “performing well”, “2” for “performing adequately”, and “1” for “performing poorly”; these scores can help diagnose and treat the individual factors accordingly. A simple approach could be to set an initial target of boardings per revenue hour at the mean plus and minus one standard deviation and score routes within this range as “2”, and

routes below this range would scored a “1” and be targeted for improvements, while routes falling above this range would be a scored a “3” could be considered for additional service.

Next, all the scores would be summed for each indicator for each route, and a final score would then be used to rank the routes from ‘best’ to ‘worst’. In this way, routes are evaluated on a variety of indicators, again helping target specific issues, while also avoiding judging a route solely based on one or two indicators. This balanced approach should be tracked every quarter, and routes consistently falling into the lower quartile would require corrective actions, dependent on the outcome of each performance indicator. Meanwhile routes in the second and third quartiles would be monitored and potentially targeted for preventative action. Top performing routes could be targeted for service enhancements. Halifax Transit may opt for greater granularity in the scoring mechanisms, ranking, and so on.

Finally, we also propose that route classification be dynamic, meaning that routes could shift between classes, depending on actual performance in relation to targets or guidelines. At its simplest, referring to the MFTP, ridership guidelines should be graduated, so that routes exceeding the guidelines for Local Routes be placed into the Corridor Route class or service type, which would necessitate more frequent service, transit priority and so on. Conversely, a Corridor Route consistently falling below the threshold for Corridor Routes would be placed into the Local Routes service type, and frequency reduced and so on. As such, Table 7 in the MFTP is insufficient for making these determinations because Corridor, Local and Rural Routes all have a minimum of 25 passengers per service hour. Corridor Routes should be more ambitious and as such set a higher threshold for productivity that distinguishes these routes from Local and Rural routes. It is also recommended that Halifax Transit maintain a defined schedule of service updates and ensure that routes that have borderline performance do not continuously jump back and forth between being Corridor Route and being a Local Route. This will help avoid user confusion that might arise if routes are frequently changing.

Stantec recommends that rather than focusing only one metric for determining route service type, Halifax Transit should leverage a suite of indicators, such as in the table above to provide a comprehensive evaluation of a route. Routes that consistently perform well, coupled with qualitative appraisal and public consultation, could be promoted to Corridor Route status, receive more service, etc. Meanwhile, routes that do not perform well even after corrective action could be specified as a Local Route and receive commensurate service. It is also acknowledged that effective tracking of these measures may be challenging until all of the old APC technology has been replaced with the newer more accurate versions. The old APC technology is limited in its ability to accurately capture alightings.

Overall, the MFTP and layered approach to transit is one that allows for tiered allocation of resources, recognizing however that performance must be measured using appropriate and objective indicators, defined and transparent scoring mechanisms, and evaluated in a timely manner.

6.0 CONCLUSION

The proposed modifications to the MFTP corridor routes discussed in this report represents Stantec’s best assessment of what will be most fruitful in terms of providing a high-quality service that will result in increased ridership, while being respectful to the current operating and fiscal constraints. As an independent third party able to review Halifax Transit operations and MFTP principles with a fresh set of eyes, our review was grounded in the data we analyzed, in our firsthand observations of the Halifax Regional Municipality, in our discussions with HRM and Halifax Transit staff, and in transit planning best practices.

To summarize, the advantages of the proposed modifications to the MFTP corridor route network are as follows:

- It builds upon the strengths of the current network and the proposed MFTP network, and does not reinvent the system unnecessarily. This ensures that what works well will continue to work well into the future, and helps make the recommendations more digestible to riders and other stakeholders.

- It is compatible with planned and implemented transit priority measures and with regional planning objectives. The transit priority measures are better leveraged in the proposed recommendations, most notably in the H-Line, and important corridors and BRT principles have been given consideration.

- It strikes the balance between improving the directness of corridor routes (which can be detrimental to coverage) and improving corridor route coverage (which can be detrimental to directness). Circuitous routes have been rectified as best possible given the challenging geography, most notably by St. Mary's and Dalhousie Universities, and coverage has been improved most notably in Dartmouth.

- It simplifies the network through reduction of overlapping corridor routes, and through encouraging transfers at appropriate locations. Ten corridor routes have been collapsed into nine routes, with interlining proposed between the H-Line and Route 5, and between Routes 3 and 4. There is some consolidation along the Spring Garden Rd. and Barrington St. corridors and transfers are encouraged at non-terminal locations such as Robie St. and North St.

- It brings more consistency to the service frequency of corridor routes. This helps make the network simpler for the user to understand, and with overall improved frequencies also comes more pleasant travel experiences and faster travel times.

- Overall, it is deemed to be better aligned with the MFTP principles of increasing the proportion of resources allocated towards high ridership services, building a simplified transfer-based system, investing in service quality and reliability, and giving transit increased priority in the transportation network.

The next steps resulting from this study are for HRM and Halifax Transit to carefully review the proposed modifications and evaluate them in more detail. Before implementation, it will be necessary to determine scheduling and timed transfer impacts, and also to consider whether it might be necessary to tweak other elements of the Halifax Transit network accordingly, including the local, rural, and express routes. Only when repercussions to the transit network as a whole are considered would it make sense to action the recommendations described in this report.

7.0 APPENDICES

APPENDIX 1

EXAMPLES FROM THE INTERACTIVE MAP

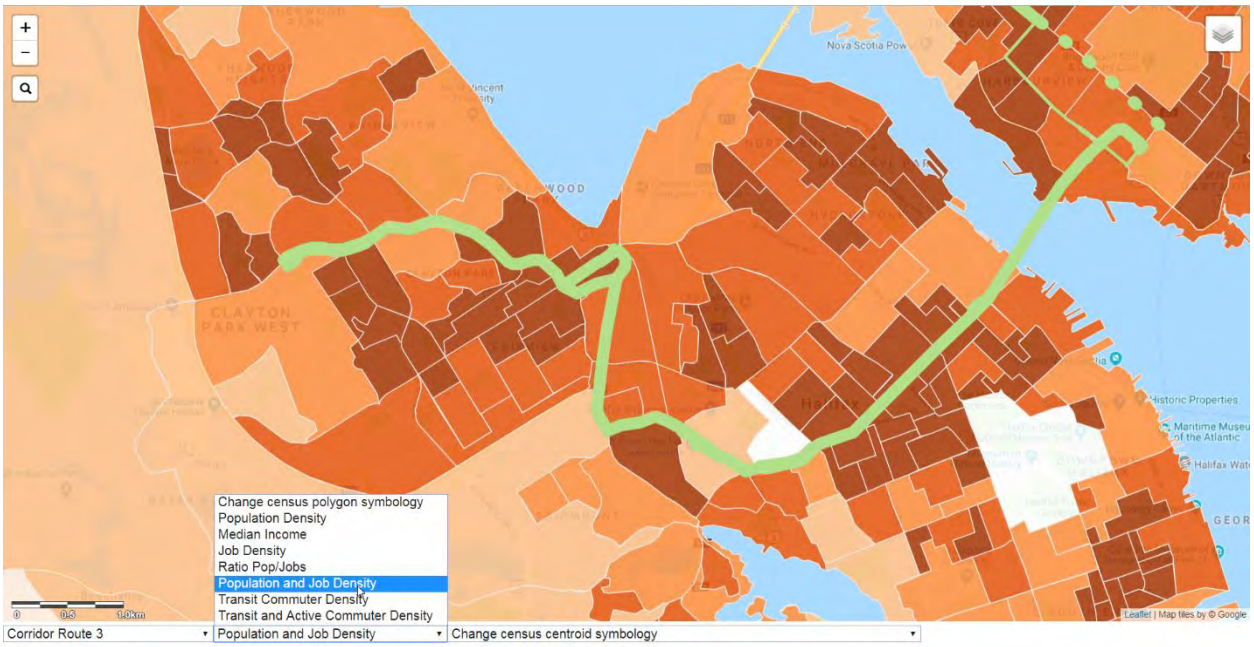
For the purposes of this study, Stantec prepared an interactive mapping environment which allowed us to more freely navigate, explore and interact with the underlying spatial data supporting our analysis. This tool was developed to allow for a rapid and intuitive means to communicate findings between study team members, without the time required to produce series of static maps and accompanying data tables. To illustrate the utility of this tool, we have included a few screenshots in the following figures.

Figure 1: Selecting and viewing individual corridor routes

Figure 2: Viewing all corridor routes and investigating changes in school enrollment

Figure 3: Investigating boardings, alightings, and on-time performance at the stop level

Figure 4: Evaluating the distribution of sociodemographic and place of work census data



APPENDIX 2

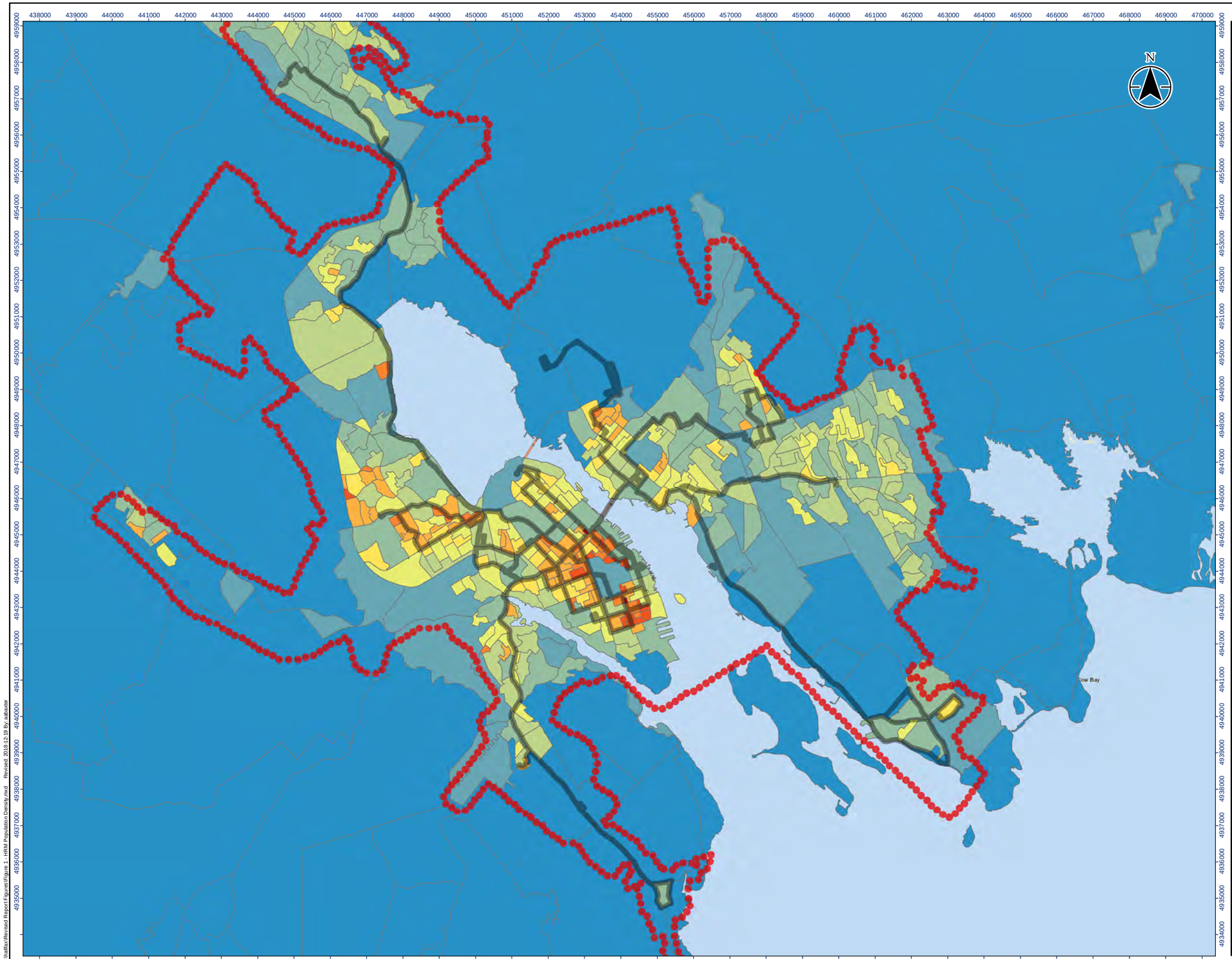
DETAILS FROM THE ORIGIN-DESTINATION TRAVEL TIME MAPPING

Trip	Possible Routes		Travel Time (minutes)		Number of Transfers	
	Proposed	MFTP	Proposed	MFTP	Proposed	MFTP
Bridge Terminal to Highfield Terminal	3	3	5 to 10	6 to 7	0	0
Bridge Terminal to Lacewood Terminal	1,10 OR 1,10,3,4 OR 1,10,4	2,5 OR 3,4	30 to 33	24 to 34	1 to 3	1
Bridge Terminal to Micmac Terminal	10	10	6 to 11	6 to 11	0	0
Bridge Terminal to Mumford Terminal	10 OR 10,3	2,5 OR 3	11 to 15	12 to 15	0 to 1	0 to 1
Bridge Terminal to Penhorn Terminal	5	5	8 to 11	8 to 11	0	0
Bridge Terminal to Robie at Spring Garden	1 OR 1,3	1	11 to 15	11 to 15	0 to 1	0
Bridge Terminal to Sackville Terminal	10,3,8 OR 10,8	2,5,8 OR 3,8	56 to 69	55 to 67	1 to 2	1 to 2
Bridge Terminal to Scotia Square	1 OR 3	1	7 to 7	7 to 8	0	0
Bridge Terminal to Water St Terminal	1 OR 3	1	7 to 7	7 to 8	0	0
Bridge Terminal to Woodside Ferry Terminal	6	6	10 to 12	10 to 12	0	0
Highfield Terminal to Bridge Terminal	3	3	6 to 8	7 to 9	0	0
Highfield Terminal to Lacewood Terminal	1,10,3 OR 1,10,3,4	2,3,5 OR 3,4	36 to 40	32 to 41	2 to 3	1 to 2
Highfield Terminal to Micmac Terminal	10,3	10,3	10 to 13	10 to 17	1	1
Highfield Terminal to Mumford Terminal	10,3	2,3,5 OR 3	17 to 23	19 to 24	1	0 to 2
Highfield Terminal to Penhorn Terminal	3,5	3,5	14 to 19	16 to 20	1	1
Highfield Terminal to Robie at Spring Garden	1,3	1,3	17 to 23	18 to 25	1	1
Highfield Terminal to Sackville Terminal	10,3,8	2,3,5,8 OR 3,8	62 to 75	63 to 75	2	1 to 3
Highfield Terminal to Scotia Square	1,3 OR 3	1,3	13 to 16	14 to 17	0 to 1	1
Highfield Terminal to Water St Terminal	1,3 OR 3	1,3	13 to 16	14 to 17	0 to 1	1
Highfield Terminal to Woodside Ferry Terminal	3,6	3,6	16 to 20	17 to 21	1	1
Lacewood Terminal to Bridge Terminal	1,10 OR 1,10,8 OR 10,4,8	2,3 OR 3,4	30 to 36	25 to 33	1 to 2	1
Lacewood Terminal to Highfield Terminal	1,10,3 OR 1,10,3,8 OR 10,3,4,8	2,3 OR 3,4	35 to 46	31 to 40	2 to 3	1
Lacewood Terminal to Micmac Terminal	1,10 OR 1,10,8 OR 10,4,8	10,2,3 OR 10,3,4	37 to 47	32 to 44	1 to 2	2
Lacewood Terminal to Mumford Terminal	1,8 OR 4,8	2 OR 3	17 to 24	14 to 21	1	0
Lacewood Terminal to Penhorn Terminal	1,10,5 OR 1,10,5,8 OR 10,4,5,8	2,3,5 OR 3,4,5	42 to 44	35 to 41	2 to 3	2
Lacewood Terminal to Robie at Spring Garden	1 OR 1,4,8 OR 1,8,9	2,8 OR 4	29 to 37	23 to 34	0 to 2	0 to 1
Lacewood Terminal to Sackville Terminal	1,8 OR 4,8	2,8 OR 3,8	47 to 58	48 to 58	1	1
Lacewood Terminal to Scotia Square	1,10,7,8 OR 1,7 OR 4,8,9	1,2,4,7 OR 2 OR 2,4	27 to 39	26 to 34	1 to 3	0 to 3
Lacewood Terminal to Water St Terminal	1,10,7,8 OR 1,7 OR 4,8,9	1,2,4,7 OR 2 OR 2,4	27 to 39	26 to 34	1 to 3	0 to 3
Lacewood Terminal to Woodside Ferry Termina	1,10,6 OR 1,10,6,8 OR 10,4,6,8	2,3,6 OR 3,4,6	41 to 46	36 to 43	2 to 3	2
Micmac Terminal to Bridge Terminal	10	10	9 to 13	9 to 13	0	0
Micmac Terminal to Highfield Terminal	10,3	10,3	11 to 15	16 to 20	1	1
Micmac Terminal to Lacewood Terminal	1,10 OR 1,10,3,4 OR 1,10,4	10,2,5 OR 10,3,4	41 to 43	34 to 42	1 to 3	2
Micmac Terminal to Mumford Terminal	10 OR 10,3	10,2,5 OR 10,3	20 to 25	20 to 25	0 to 1	1 to 2
Micmac Terminal to Penhorn Terminal	10,5	10,5	17 to 24	17 to 24	1	1
Micmac Terminal to Robie at Spring Garden	1,10 OR 1,10,3	1,10	19 to 25	19 to 26	1 to 2	1
Micmac Terminal to Sackville Terminal	10,3,8 OR 10,8	10,2,5,8 OR 10,3,8	65 to 82	64 to 79	1 to 2	2 to 3
Micmac Terminal to Scotia Square	1,10 OR 10,3	1,10	15 to 19	15 to 21	1	1
Micmac Terminal to Water St Terminal	1,10 OR 10,3	1,10	15 to 19	15 to 21	1	1
Micmac Terminal to Woodside Ferry Terminal	10,6	10,6	19 to 24	19 to 24	1	1
Mumford Terminal to Bridge Terminal	10	3	12 to 19	12 to 19	0	0
Mumford Terminal to Highfield Terminal	10,3	3	19 to 24	20 to 26	1	0
Mumford Terminal to Lacewood Terminal	1,4,8 OR 1,8	2 OR 3	23 to 26	18 to 22	1 to 2	0
Mumford Terminal to Micmac Terminal	10	10,3	20 to 27	20 to 26	0	1
Mumford Terminal to Penhorn Terminal	10,5	3,5	21 to 29	21 to 29	1	1
Mumford Terminal to Robie at Spring Garden	1,9 OR 7,9	1 OR 1,9	13 to 18	14 to 17	1	0 to 1
Mumford Terminal to Sackville Terminal	8	2,8 OR 3,8	45 to 57	47 to 58	0	1
Mumford Terminal to Scotia Square	1,10,7 OR 9	1,3,7 OR 2	15 to 18	13 to 19	0 to 2	0 to 2
Mumford Terminal to Water St Terminal	1,10,7 OR 9	1,3,7 OR 2	15 to 18	13 to 19	0 to 2	0 to 2
Mumford Terminal to Woodside Ferry Terminal	10,6	3,6	22 to 30	22 to 30	1	1
Penhorn Terminal to Bridge Terminal	5	5	9 to 13	9 to 13	0	0
Penhorn Terminal to Highfield Terminal	3,5	3,5	15 to 21	17 to 20	1	1
Penhorn Terminal to Lacewood Terminal	1,10,3,4,5 OR 1,10,4,5 OR 1,10,5	2,5 OR 3,4,5	41 to 44	35 to 45	2 to 4	1 to 2
Penhorn Terminal to Micmac Terminal	10,5	10,5	17 to 23	17 to 23	1	1
Penhorn Terminal to Mumford Terminal	10,3,5 OR 10,5	2,5 OR 3,5	23 to 25	23 to 25	1 to 2	1
Penhorn Terminal to Robie at Spring Garden	1,3,5 OR 1,5	1,5	23 to 25	23 to 27	1 to 2	1
Penhorn Terminal to Sackville Terminal	10,3,5,8 OR 10,5,8	2,5,8 OR 3,5,8	68 to 82	67 to 80	2 to 3	2
Penhorn Terminal to Scotia Square	1,5 OR 3,5	1,5	17 to 19	17 to 21	1	1
Penhorn Terminal to Water St Terminal	1,5 OR 3,5	1,5	17 to 19	17 to 21	1	1
Penhorn Terminal to Woodside Ferry Terminal	5,6	5,6	12 to 14	12 to 14	1	1
Robie at Spring Garden to Bridge Terminal	1,10	3,8	13 to 17	13 to 17	1	1
Robie at Spring Garden to Highfield Terminal	1,10,3	3,8	18 to 22	20 to 24	2	1
Robie at Spring Garden to Lacewood Terminal	1 OR 1,4	2,3,8 OR 4	28 to 32	21 to 33	0 to 1	0 to 2
Robie at Spring Garden to Micmac Terminal	1,10	10,3,8	19 to 25	19 to 24	1	2
Robie at Spring Garden to Mumford Terminal	4,9	1 OR 1,9	11 to 14	12 to 15	1	0 to 1
Robie at Spring Garden to Penhorn Terminal	1,10,5	3,5,8	21 to 27	21 to 27	2	2
Robie at Spring Garden to Sackville Terminal	1,8 OR 4,8	4,8 OR 8	55 to 68	52 to 65	1	0 to 1
Robie at Spring Garden to Scotia Square	1	1	7 to 10	7 to 10	0	0
Robie at Spring Garden to Water St Terminal	1	1	7 to 10	7 to 10	0	0
Robie at Spring Garden to Woodside Ferry Term	1,10,6	3,6,8	23 to 28	23 to 28	2	2
Sackville Terminal to Bridge Terminal	1,10,4,8 OR 10,8	3,4,8 OR 3,8	55 to 68	53 to 65	1 to 3	1 to 2
Sackville Terminal to Highfield Terminal	1,10,3,4,8 OR 10,3,8	3,4,8 OR 3,8	65 to 75	60 to 72	2 to 4	1 to 2
Sackville Terminal to Lacewood Terminal	1,4,8 OR 1,8	2,3,8 OR 3,8	51 to 57	51 to 57	1 to 2	1 to 2
Sackville Terminal to Micmac Terminal	1,10,4,8 OR 10,8	10,3,4,8 OR 10,3,8	66 to 76	64 to 72	1 to 3	2 to 3
Sackville Terminal to Mumford Terminal	8	2,8 OR 3,8	43 to 54	46 to 54	0	1
Sackville Terminal to Penhorn Terminal	1,10,4,5,8 OR 10,5,8	3,4,5,8 OR 3,5,8	63 to 78	61 to 76	2 to 4	2 to 3
Sackville Terminal to Robie at Spring Garden	1,4,8 OR 1,8	4,8 OR 8	56 to 66	53 to 64	1 to 2	0 to 1
Sackville Terminal to Scotia Square	1,10,7,8 OR 1,4,7,8 OR 8,9	1,2,4,7,8 OR 2,4,8 OR 2,8	57 to 69	54 to 65	1 to 3	1 to 4
Sackville Terminal to Water St Terminal	1,10,7,8 OR 1,4,7,8 OR 8,9	1,2,4,7,8 OR 2,4,8 OR 2,8	57 to 69	54 to 65	1 to 3	1 to 4
Sackville Terminal to Woodside Ferry Terminal	1,10,4,6,8 OR 10,6,8	3,4,6,8 OR 3,6,8	65 to 80	63 to 76	2 to 4	2 to 3
Scotia Square to Bridge Terminal	1	1	8 to 10	8 to 10	0	0
Scotia Square to Highfield Terminal	1,3 OR 3	1,3	13 to 19	15 to 18	0 to 1	1
Scotia Square to Lacewood Terminal	1 OR 1,4	2 OR 2,4	34 to 39	26 to 34	0 to 1	0 to 1
Scotia Square to Micmac Terminal	1,10	1,10 OR 10	15 to 20	15 to 20	1	0 to 1
Scotia Square to Mumford Terminal	10,7 OR 9	2 OR 9	13 to 20	12 to 17	0 to 1	0
Scotia Square to Penhorn Terminal	1,5	1,5	18 to 21	18 to 21	1	1
Scotia Square to Robie at Spring Garden	1	1	4 to 8	4 to 8	0	0
Scotia Square to Sackville Terminal	10,7,8 OR 8 OR 8,9	2,3,8 OR 2,8 OR 8	58 to 73	57 to 68	0 to 2	0 to 2
Scotia Square to Woodside Ferry Terminal	1,6	1,6	19 to 22	19 to 22	1	1
Water St Terminal to Bridge Terminal	1	1	8 to 10	8 to 10	0	0
Water St Terminal to Highfield Terminal	1,3 OR 3	1,3	13 to 19	15 to 18	0 to 1	1
Water St Terminal to Lacewood Terminal	1 OR 1,4	2 OR 2,4	34 to 39	26 to 34	0 to 1	0 to 1
Water St Terminal to Micmac Terminal	1,10	1,10 OR 10	15 to 20	15 to 20	1	0 to 1
Water St Terminal to Mumford Terminal	10,7 OR 9	2 OR 9	13 to 20	12 to 17	0 to 1	0
Water St Terminal to Penhorn Terminal	1,5	1,5	18 to 21	18 to 21	1	1
Water St Terminal to Robie at Spring Garden	1	1	4 to 8	4 to 8	0	0
Water St Terminal to Sackville Terminal	10,7,8 OR 8 OR 8,9	2,3,8 OR 2,8 OR 8	58 to 73	57 to 68	0 to 2	0 to 2
Water St Terminal to Woodside Ferry Terminal	1,6	1,6	19 to 22	19 to 22	1	1
Woodside Ferry Terminal to Bridge Terminal	6	6	10 to 11	10 to 11	0	0
Woodside Ferry Terminal to Highfield Terminal	3,6	3,6	16 to 19	17 to 19	1	1
Woodside Ferry Terminal to Lacewood Termina	1,10,3,4,6 OR 1,10,4,6 OR 1,10,6	2,5,6 OR 3,4,6	41 to 44	35 to 43	2 to 4	2
Woodside Ferry Terminal to Micmac Terminal	10,6	10,6	18 to 21	18 to 21	1	1
Woodside Ferry Terminal to Mumford Terminal	10,3,6 OR 10,6	2,5,6 OR 3,6	21 to 25	21 to 25	1 to 2	1 to 2
Woodside Ferry Terminal to Penhorn Terminal	5,6	5,6	10 to 12	10 to 12	1	1
Woodside Ferry Terminal to Robie at Spring Gar	1,3,6 OR 1,6	1,6	20 to 25	20 to 26	1 to 2	1
Woodside Ferry Terminal to Sackville Terminal	10,3,6,8 OR 10,6,8	2,5,6,8 OR 3,6,8	66 to 80	65 to 78	2 to 3	2 to 3
Woodside Ferry Terminal to Scotia Square	1,6 OR 3,6	1,6	16 to 19	16 to 20	1	1
Woodside Ferry Terminal to Water St Terminal	1,6 OR 3,6	1,6	16 to 19	16 to 20	1	1

APPENDIX 3

HIGH RESOLUTION MAPS

Please note, all maps using 2016 Statistics Canada Census information are at the Dissemination Area (DA) level.



Stantec

HALIFAX TRANSIT

Legend

Urban Transit Service Boundary

MFTP Corridor Route Network

Population Density

Residents / Sq.Km

- 0 - 500
- 501 - 1,000
- 1,001 - 2,000
- 2,001 - 3,000
- 3,001 - 4,000
- 4,001 - 5,000
- 5,001 - 7,500
- 7,501 - 10,000
- 10,001 - 20,000
- > 20,000

0 1 2 Kilometers

1:106,052 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Population Data from Statistics Canada 2016 Census
3. Urban Transit Service Boundary is approximate

Project Location
Municipality of

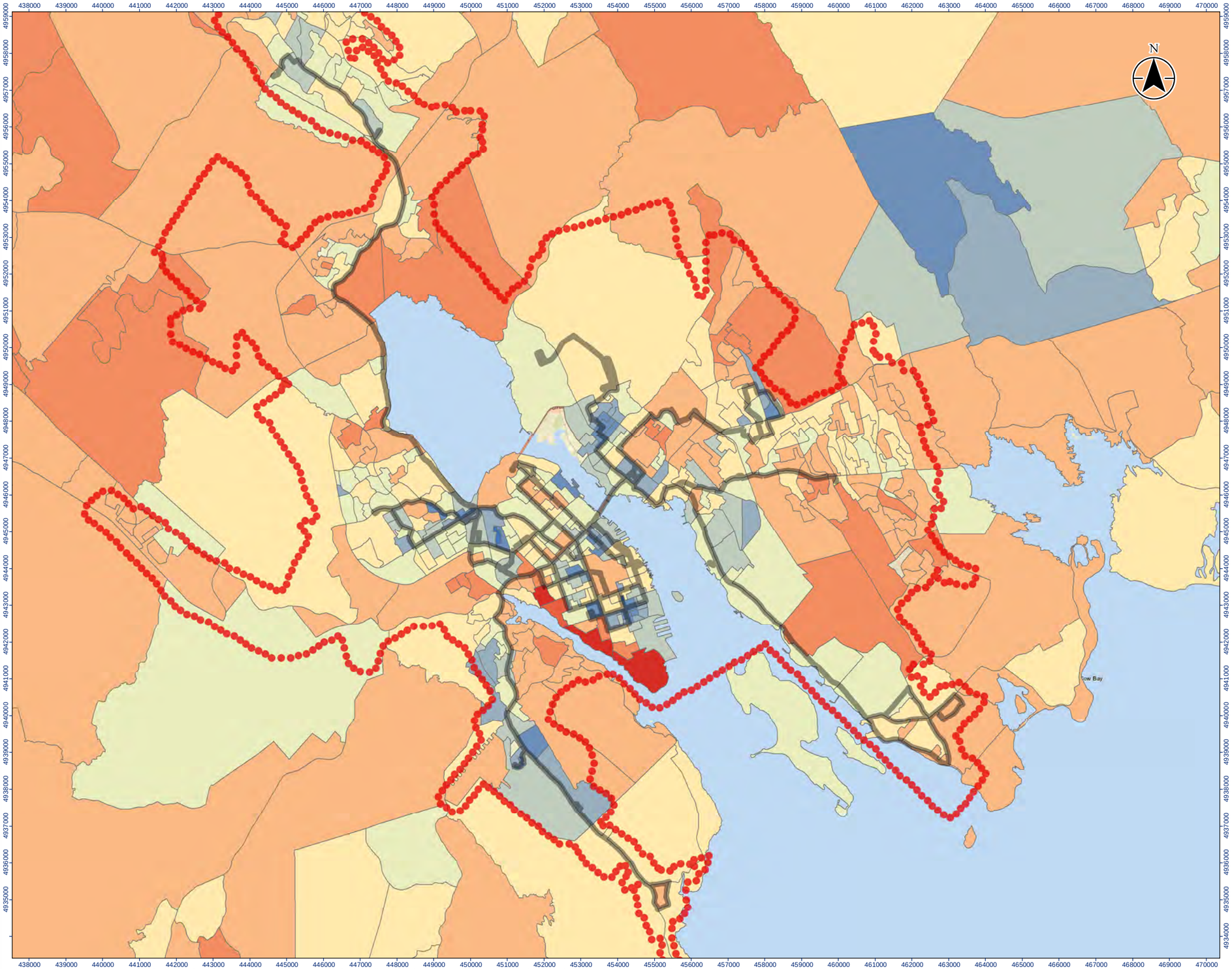
HRM Population Density REVA
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
1

Title
Population density around the MFTP Corridor Routes

C:\GIS\halifax\Revised Report Figures\Figure 1 - HRM Population Density.mxd Revised 2018-12-19 By aaxter



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HALIFAX TRANSIT

Legend

Urban Transit Service Boundary

MFTP Corridor Route Network

Median Income

- < 15,000
- 15,001 - 20,000
- 20,001 - 25,000
- 25,001 - 30,000
- 30,001 - 35,000
- 35,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- > 70,000

0 1 2 Kilometers

1:106,052 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Median Income Data from Statistics Canada 2016 Census
3. Urban Transit Service Boundary is approximate

Project Location
Municipality of

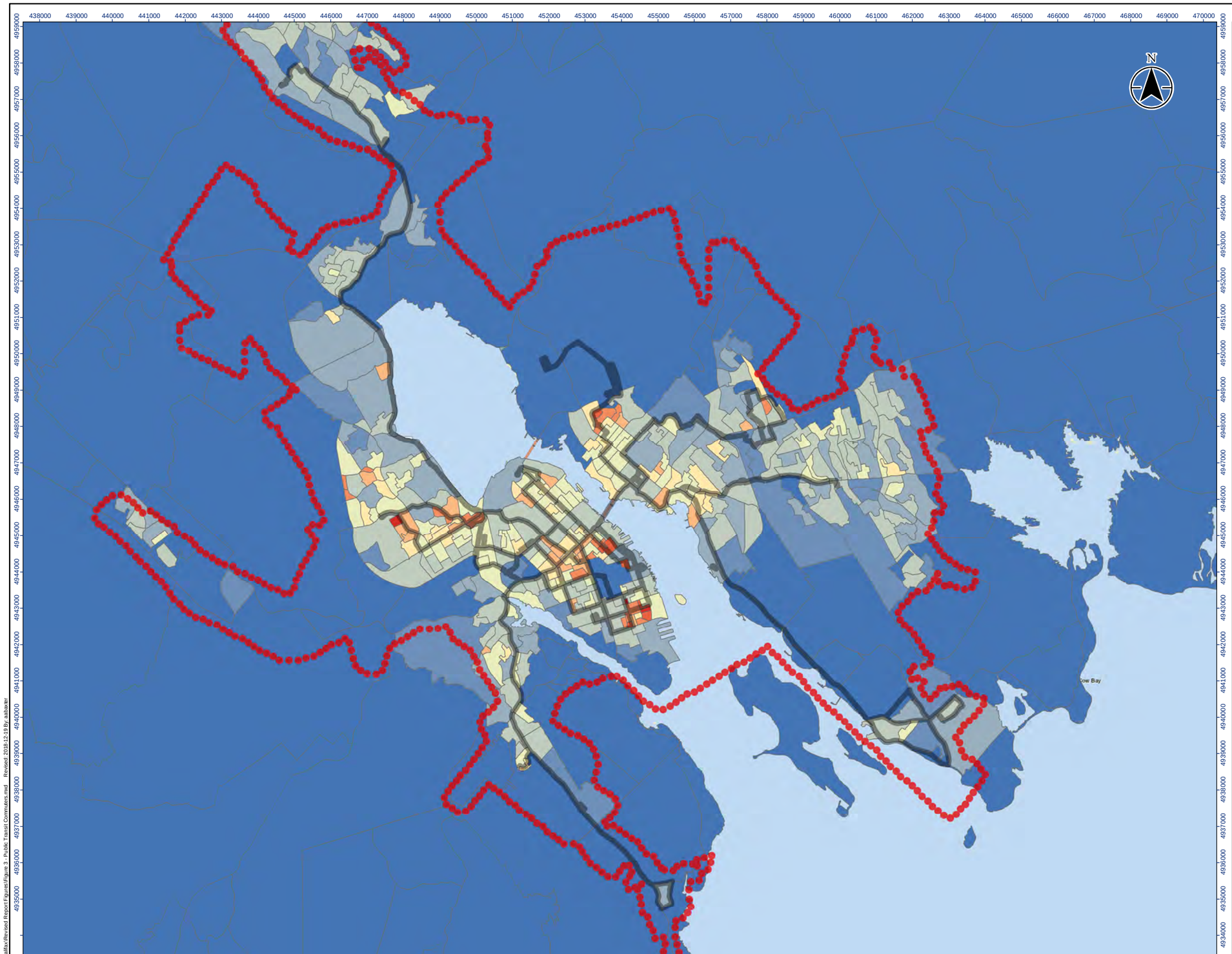
HRM Median Income REVA
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
2

Title
Median Income around the MFTP Corridor Routes

C:\GIS\halifax\Revised Report Figures\Figure 2 - HRM Median Income.mxd Revised: 2018-12-19 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Urban Transit Service Boundary

MFTP Corridor Route Network

Median Income

Commuters / Sq.Km

- 0 - 30
- 31 - 50
- 51 - 100
- 101 - 250
- 251 - 500
- 501 - 750
- 751 - 1,000
- 1,001 - 1,500
- 1,501 - 2,500
- > 2,500

0 1 2 Kilometers

1:106,052 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Transit Commuter Data from Statistics Canada 2016 Census
3. Urban Transit Service Boundary is approximate

Project Location
Municipality of

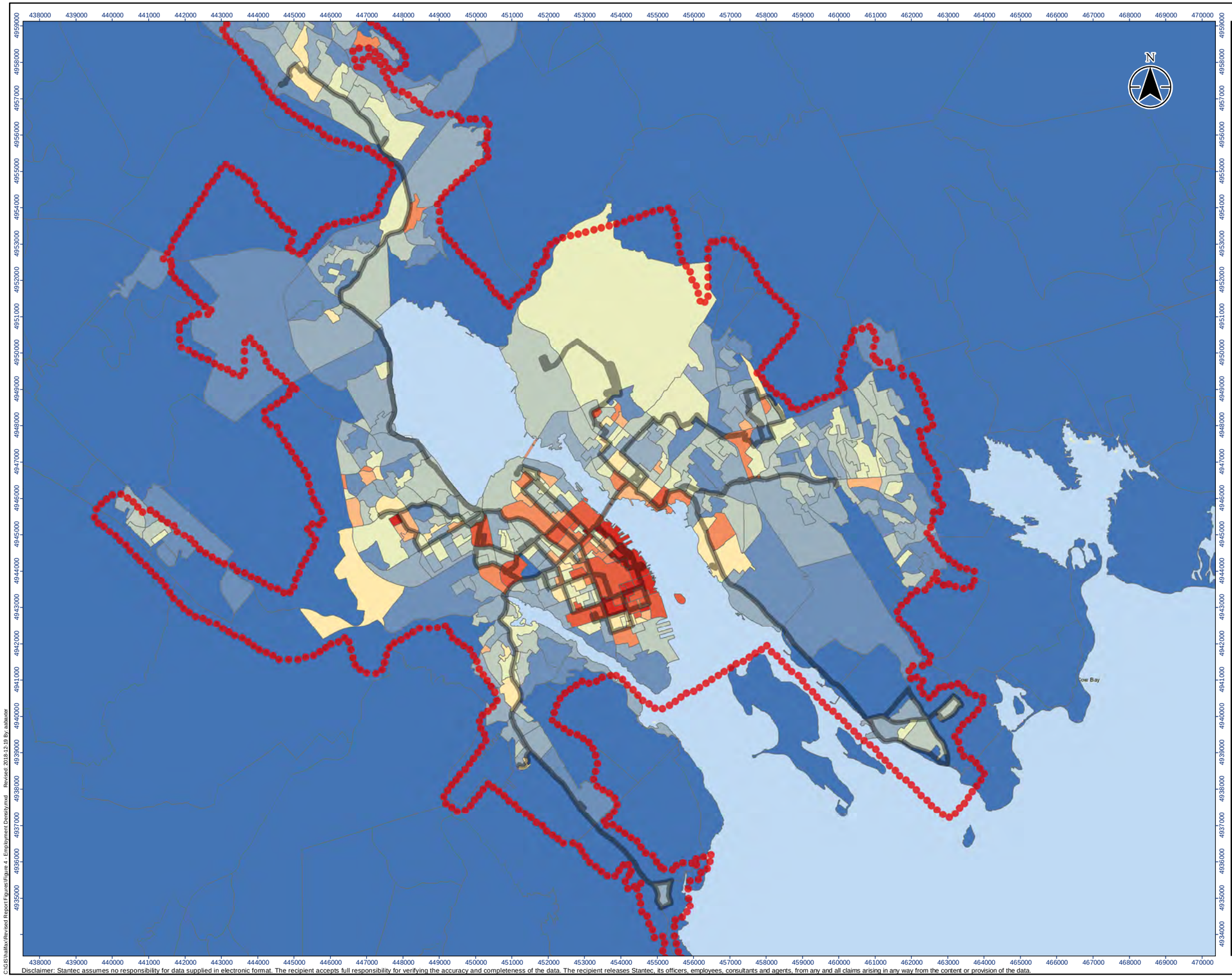
HRM Transit Commuters REVA
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
3

Title
Density of Transit Commuters around the MFTP Corridor Routes

C:\GIS\Halifax\Revised Report Figures\Figure 3 - Public Transit Commuters.mxd Revised: 2018-12-19 By: aabaxter



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HALIFAX TRANSIT

Legend

Urban Transit Service Boundary

MFTP Corridor Route Network

Job Density

Jobs / Sq.Km

- 0 - 100
- 101 - 250
- 251 - 500
- 501 - 1,000
- 1,001 - 1,500
- 1,501 - 2,000
- 2,001 - 3,000
- 3,001 - 5,000
- 5,001 - 10,000
- > 10,000

0 1 2 Kilometers

1:106,052 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Employment Data from Statistics Canada 2016 Census
3. Urban Transit Service Boundary is approximate

Project Location
Municipality of

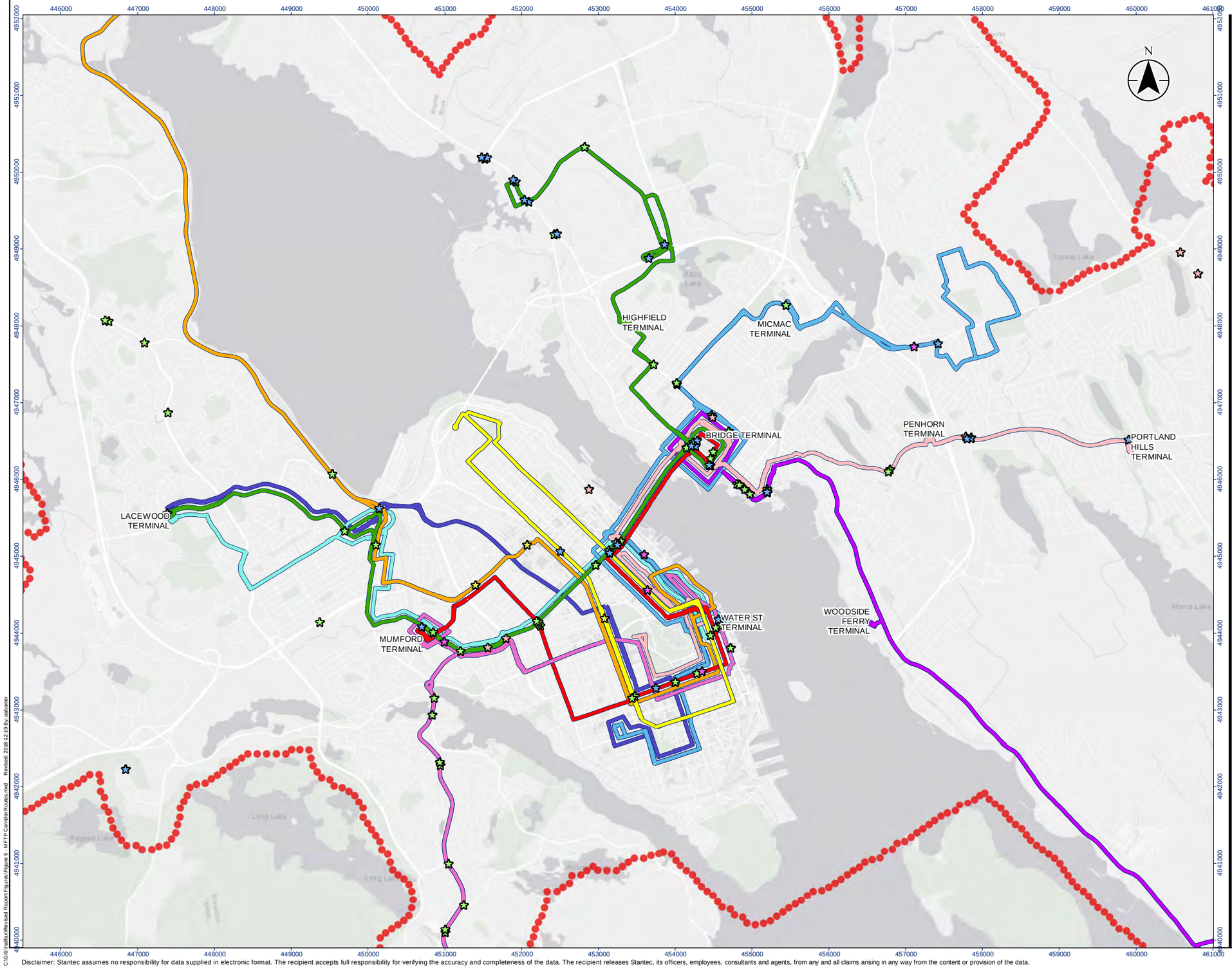
HRM Employment Density REVA
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
4

Title
Employment Density around the MFTP Corridor Routes

C:\GIS\halifax\Revised Report Figures\Figure 4 - Employment Density.mxd Revised: 2018-12-19 By: aabaxter



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HALIFAX TRANSIT

Legend

Route Number

1 2 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Transit Priority Measures

- Conceptual Development Phase
- Implementation 2018
- Implementation 2019
- Implementation 2020+
- Operational

0 1 2 Kilometers

1:50,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit

Project Location
Halifax Regional Municipality

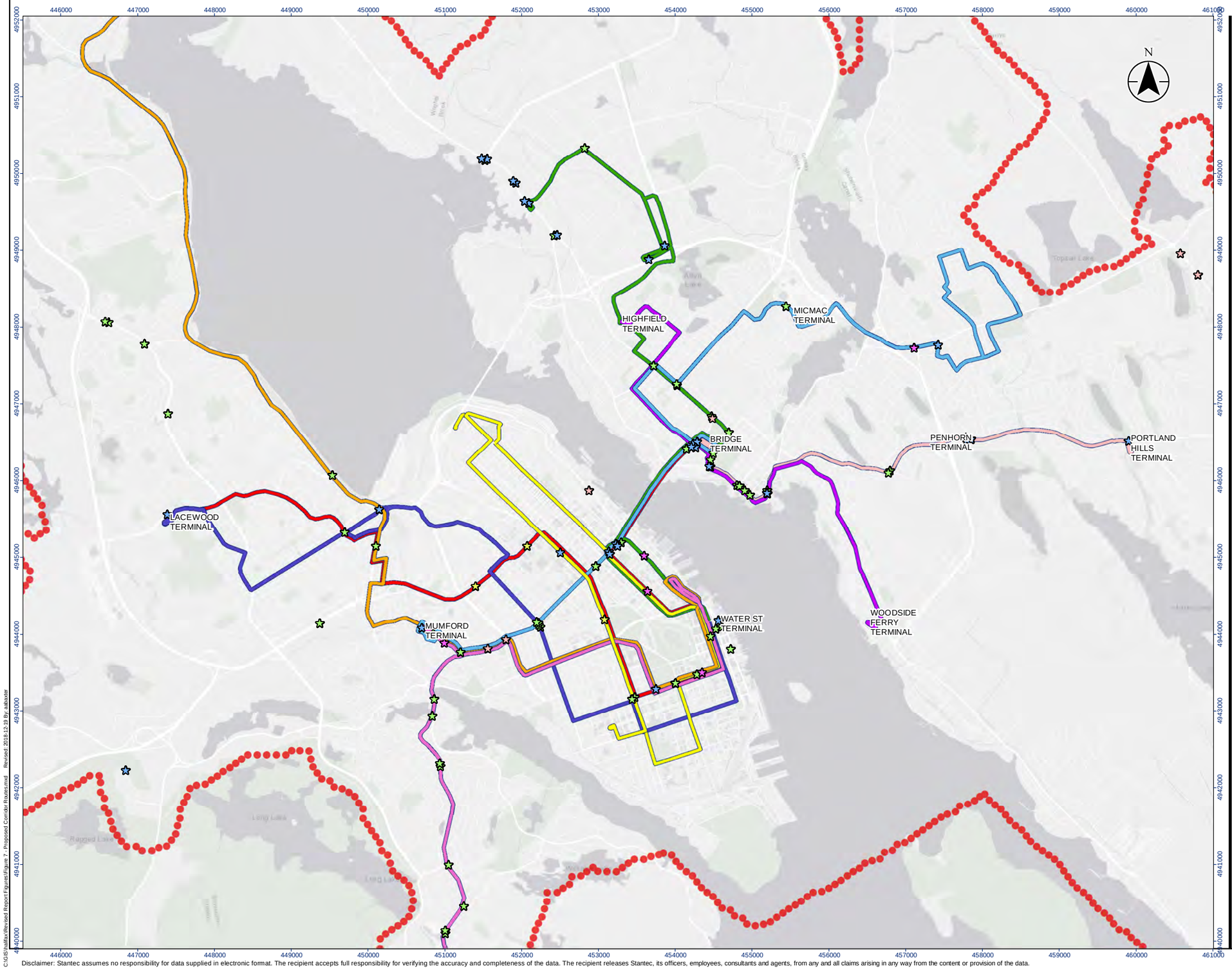
MFTP Corridor Route Network REVB
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
6

Title
MFTP Corridor Route Network - All Routes

C:\GIS\halifax\Revised Report Figures\Figure 6 - MFTP Corridor Routes.mxd Revised 2018-12-19 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Route Number

1 2 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Transit Priority Measures

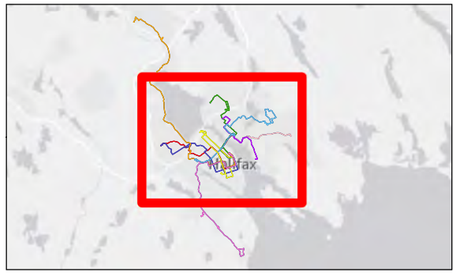
- Conceptual Development Phase
- Implementation 2018
- Implementation 2019
- Implementation 2020+
- Operational

0 1 2 Kilometers

1:50,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit



Project Location
Halifax Regional Municipality

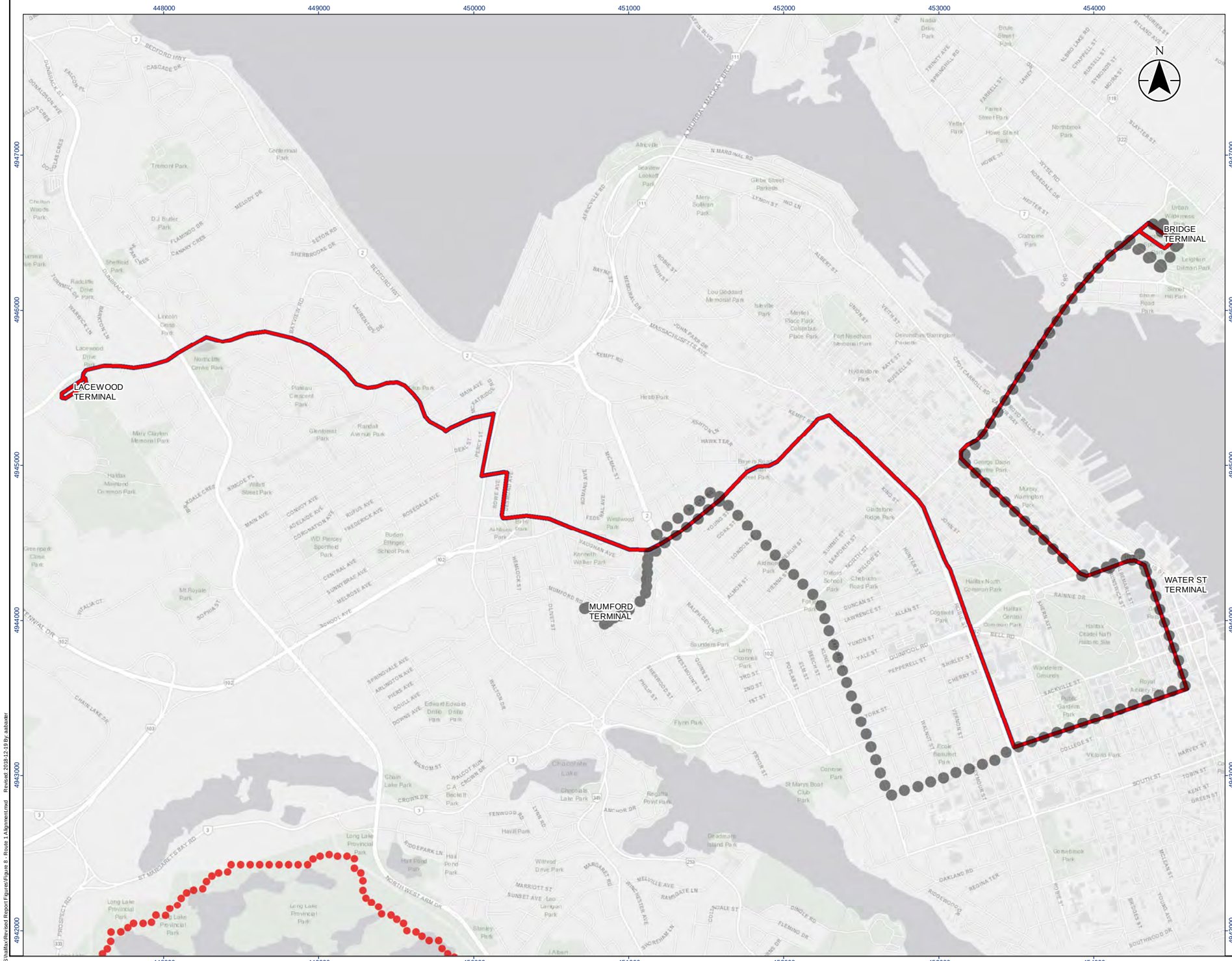
Proposed Corridor Route Network REVB
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT / MFTP CORRIDOR ROUTE REVIEW

Figure No.
7

Title
Proposed Corridor Route Network - All Routes

C:\GIS\halifax\Revised Report Figures\Figure 7 - Proposed Corridor Routes.mxd Revised: 2018-12-19 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignments

1 2 3 4 5 6 7 8 9 10

MFTP Corridor Route Alignment

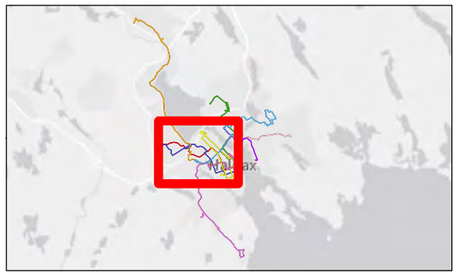
Urban Transit Service Boundary

0 500 1,000 Meters

1:25,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit



Project Location Halifax Regional Municipality	Proposed Corridor Route Network REVB Prepared by Aaron Baxter on 2018-12-19 Technical Review by BP on 2018-12-20 Independent Review by SP on 2018-12-20

Client/Project

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.

8

Title

Proposed Corridor Route Network (Route 1)

C:\GIS\halifax\Revised Report\Figures\Figure 8 - Route 1 Alignment.mxd Revised: 2018-12-19 By: jabaxter

Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignments

1 2 3 4 5 6 7 8 9 10

MFTP Corridor Route Alignment

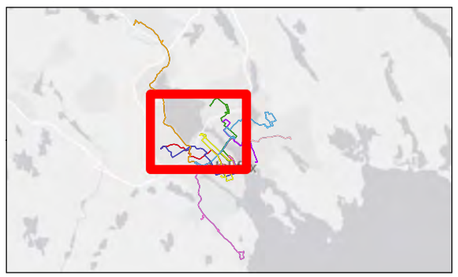
Urban Transit Service Boundary

0 500 1,000 Meters

1:30,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit



Project Location
Halifax Regional Municipality

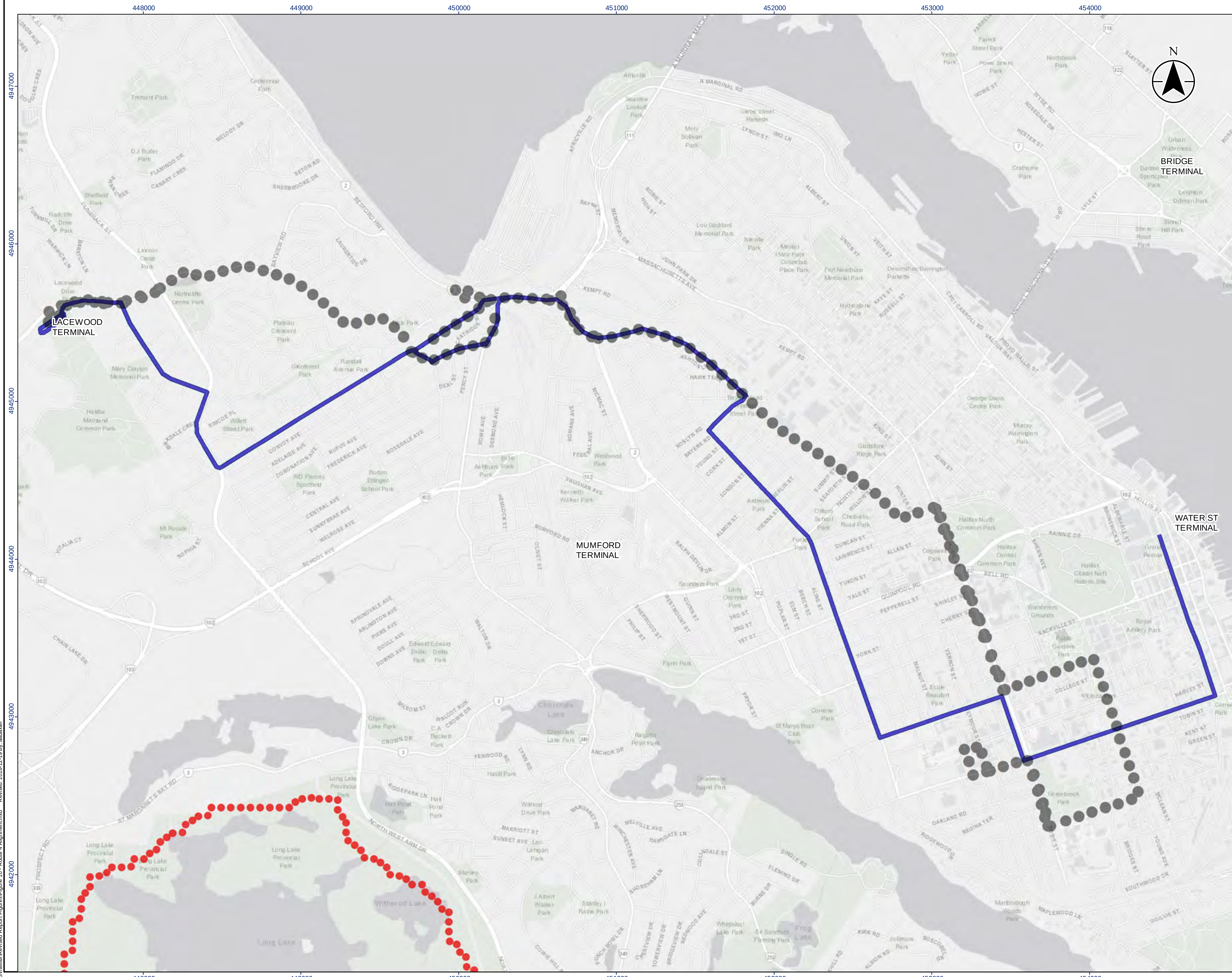
Proposed Corridor Route Network REVB
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
9

Title
Proposed Corridor Route Network (Route 3)

C:\GIS\halifax\Revised Report Figures\Figure 9 - Route 3 Alignment.mxd Revised: 2018-12-21 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignments

1 2 3 4 5 6 7 8 9 10

MFTP Corridor Route Alignment

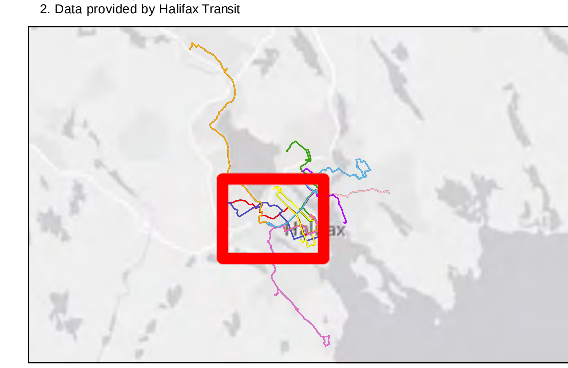
Urban Transit Service Boundary

0 500 1,000 Meters

1:25,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit



Project Location
Halifax Regional Municipality

Proposed Corridor Route Network REVB
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
10

Title
Proposed Corridor Route Network (Route 4)

C:\GIS\halifax\Revised Report Figures\Figure 10 - Route 4 Alignment.mxd Revised: 2018-12-19 By: aabaxter

HIGHFIELD TERMINAL

MICMAC TERMINAL

BRIDGE TERMINAL

RENHORN TERMINAL

PORTLAND HILLS TERMINAL

WATER ST TERMINAL

WOODSIDE FERRY TERMINAL

N

Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignments

1 2 3 4 5 6 7 8 9 10

MFTP Corridor Route Alignment

Urban Transit Service Boundary

0 500 1,000 Meters

1:24,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit

Project Location Halifax Regional Municipality	Proposed Corridor Route Network REVB Prepared by Aaron Baxter on 2018-12-19 Technical Review by BP on 2018-12-20 Independent Review by SP on 2018-12-20

Client/Project

HALIFAX TRANSIT / MFTP CORRIDOR ROUTE REVIEW

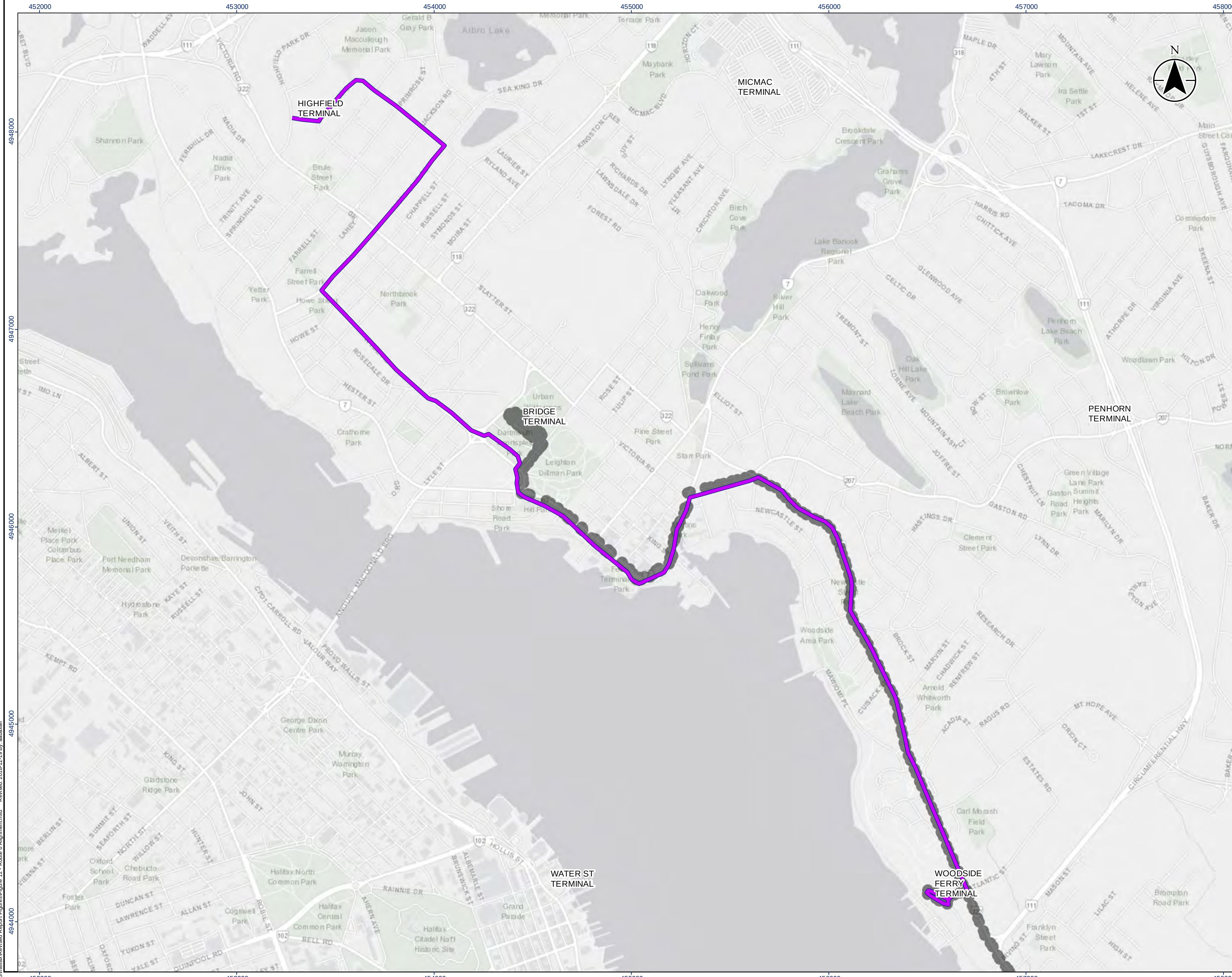
Figure No.

11

Title

Proposed Corridor Route Network (Route 5)

C:\GIS\halifax\Revised Report\Figures\Figure 11 - Route 5 Alignment.mxd Revised: 2018-12-19 By: aabaxter



Legend

Proposed Corridor Route Alignments

1 2 3 4 5 6 7 8 9 10

MFTP Corridor Route Alignment

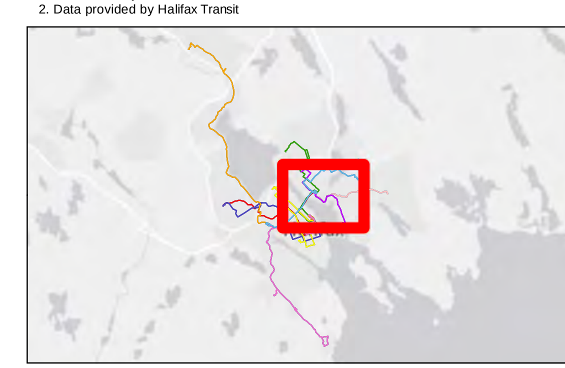
Urban Transit Service Boundary

0 500 1,000 Meters

1:20,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit



Project Location
Halifax Regional Municipality

Proposed Corridor Route Network REVB
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.

12

Title

Proposed Corridor Route Network (Route 6)

C:\GIS\halifax\Revised Report Figures\Figure 12 - Route 6 Alignment.mxd Revised: 2018-12-19 By: aabaxter

Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignments

1 2 3 4 5 6 7 8 9 10

MFTP Corridor Route Alignment

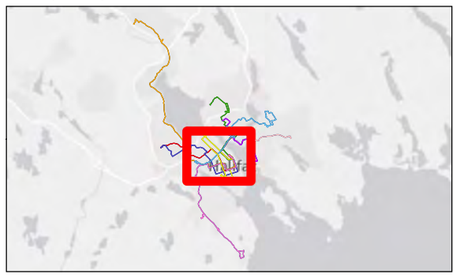
Urban Transit Service Boundary

0 500 1,000 Meters

1:20,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit



Project Location	Proposed Corridor Route Network REVB
Halifax Regional Municipality	Prepared by Aaron Baxter on 2018-12-19
	Technical Review by BP on 2018-12-20
	Independent Review by SP on 2018-12-20

Client/Project

HALIFAX TRANSIT / MFTP CORRIDOR ROUTE REVIEW

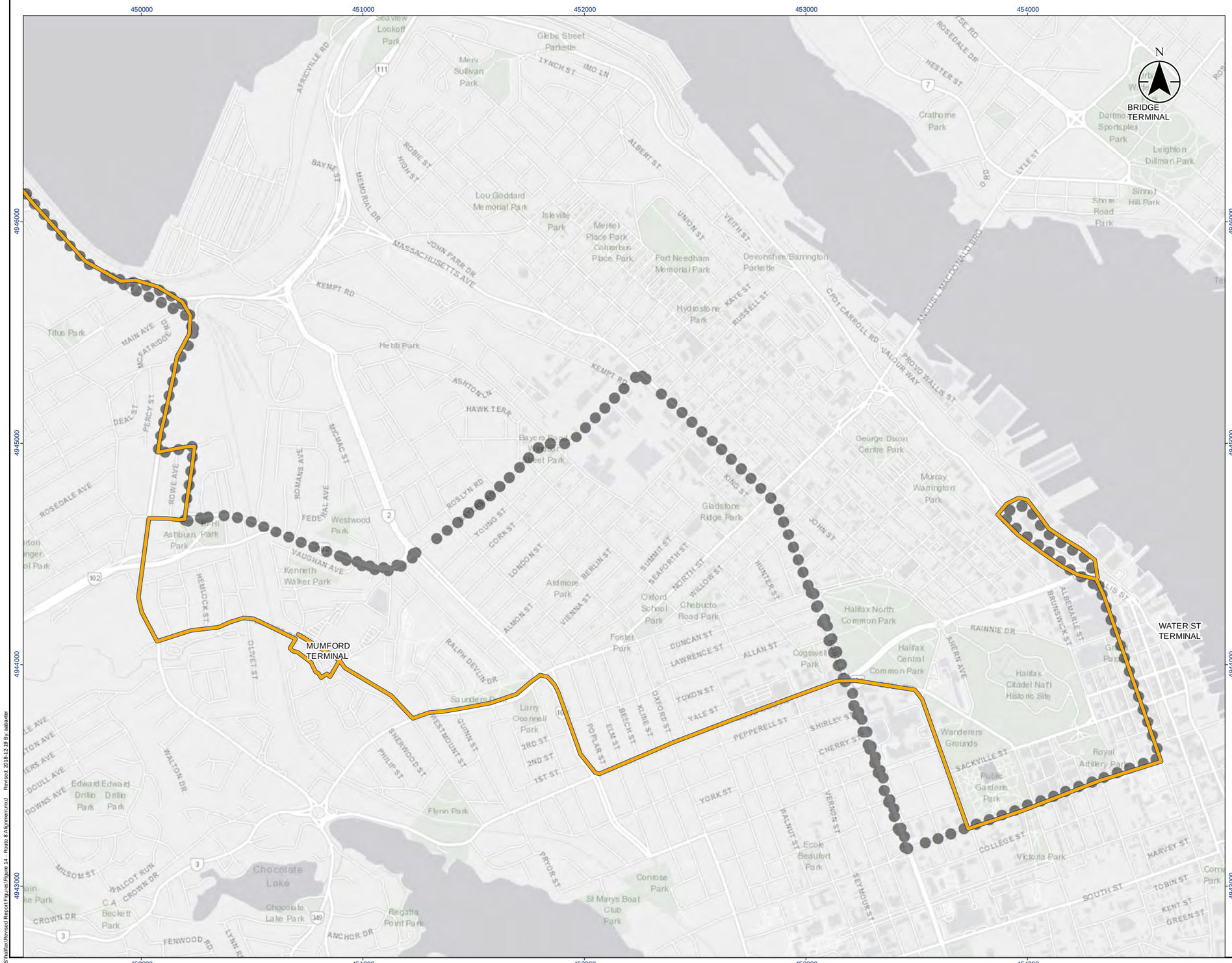
Figure No.

13

Title

Proposed Corridor Route Network (Route 7)

C:\GIS\halifax\Revised Report\Figure\Figure 13 - Route 7 Alignment.mxd Revised: 2018-12-19 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignments

1 2 3 4 5 6 7 8 9 10

MFTP Corridor Route Alignment

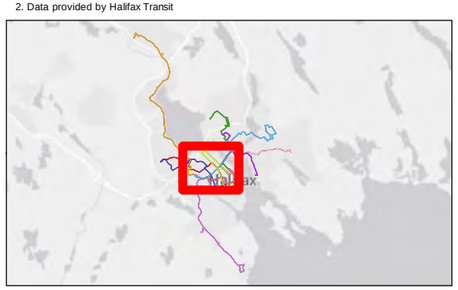
Urban Transit Service Boundary

0 500 1,000 Meters

1:17,500 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit



Project Location
Halifax Regional Municipality

Proposed Corridor Route Network REVB
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
14

Title
Proposed Corridor Route Network (Route 8)

C:\GIS\Halifax\Revised Report Figures\Figure 14 - Route 8 Alignment.mxd Revised: 2018-12-19 By: aabaxter

MUMFORD TERMINAL

WATER ST TERMINAL

WOODSIDE FERRY TERMINAL

N

Legend

Proposed Corridor Route Alignments

1 2 3 4 5 6 7 8 9 10

MFTP Corridor Route Alignment

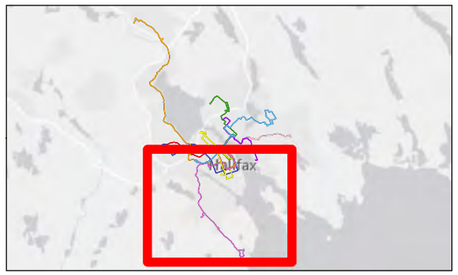
Urban Transit Service Boundary

0 500 1,000 Meters

1:45,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit



Project Location
Halifax Regional Municipality

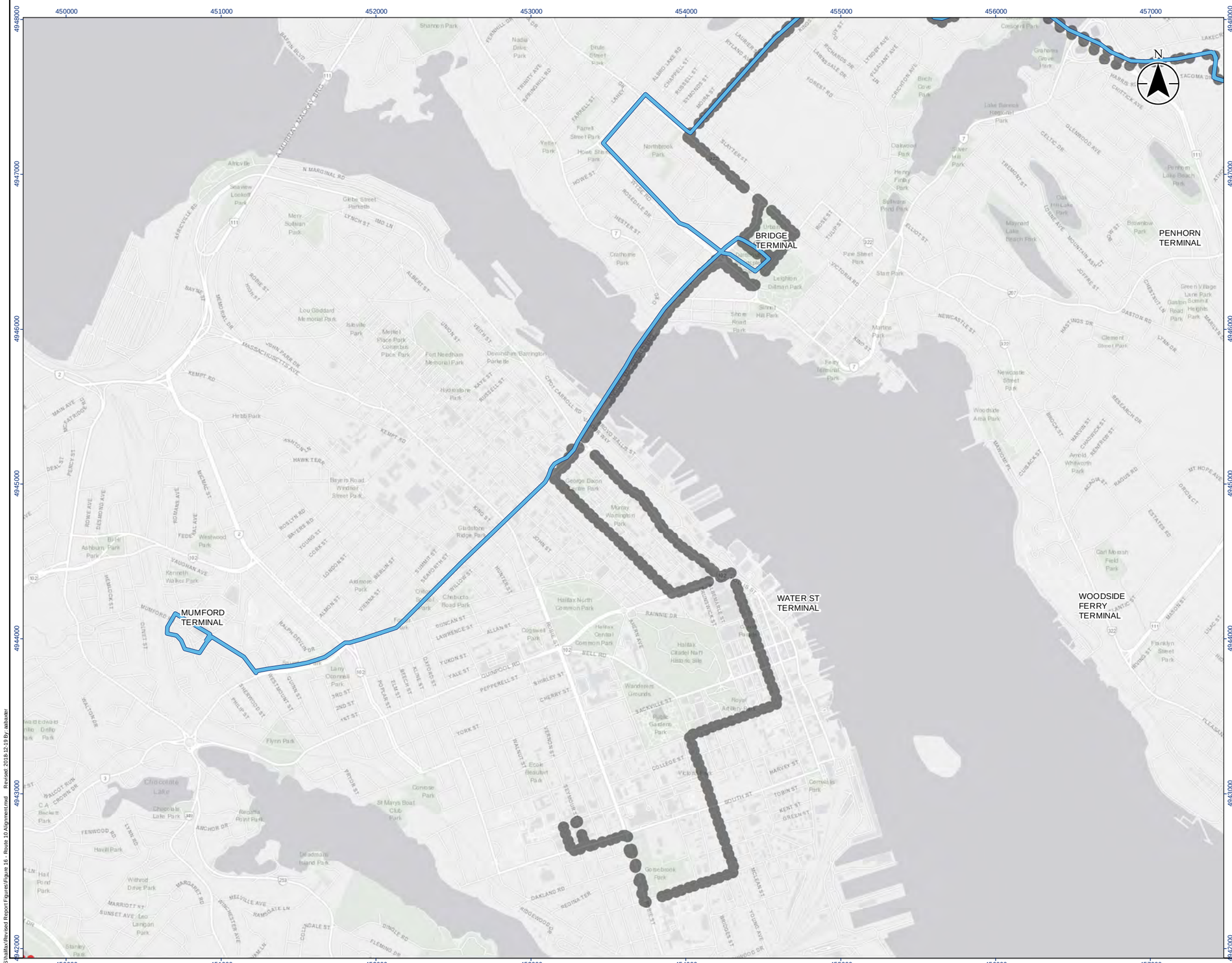
Proposed Corridor Route Network REVB
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
15

Title
Proposed Corridor Route Network (Route 9)

C:\GIS\Halifax\Revised Report Figures\Figure 15 - Route 9 Alignment.mxd Revised: 2018-12-19 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignments

1 2 3 4 5 6 7 8 9 10

MFTP Corridor Route Alignment

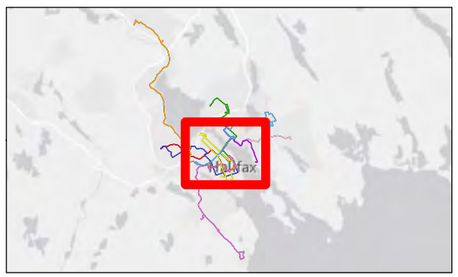
Urban Transit Service Boundary

0 500 1,000 Meters

1:25,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit



Project Location
Halifax Regional Municipality

Proposed Corridor Route Network REVB
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
16

Title
Proposed Corridor Route Network (Route 10)

C:\GIS\halifax\Revised Report Figures\Figure 16 - Route 10 Alignment.mxd Revised: 2018-12-19 By: aabaxter

SACKVILLE TERMINAL

COBEQUID TERMINAL

HIGHFIELD TERMINAL

MICMAC TERMINAL

BRIDGE TERMINAL

PENHORN TERMINAL

PORTLAND HILLS TERMINAL

LACEWOOD TERMINAL

MUMFORD TERMINAL

WATER ST TERMINAL

WOODSIDE FERRY TERMINAL

N

Stantec

HALIFAX TRANSIT

Legend

Urban Transit Service Boundary

Average Daily Ridership

Sum of boardings and alightings

- 0 - 25
- 26 - 50
- 51 - 100
- 101 - 150
- 151 - 250
- 251 - 500
- 501 - 750
- 751 - 1,000
- 1,001 - 1,500
- > 1,500

0 1 2 Kilometers

1:110,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit

Project Location
Halifax Regional Municipality

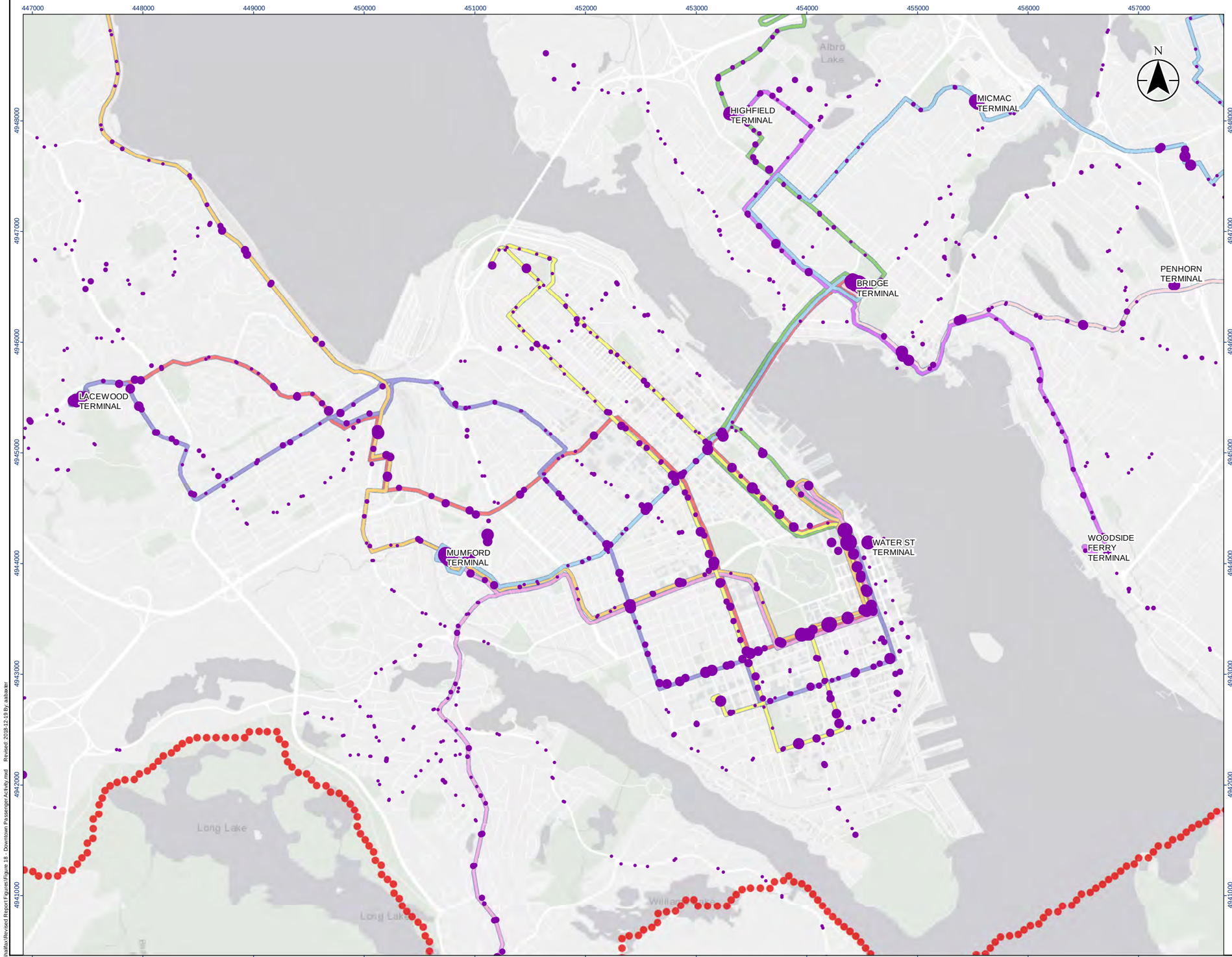
Halifax Transit Ridership Activity REVB
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
17

Title
Average daily number of boardings and alightings per stop

C:\GIS\Halifax\Revised Report Figures\Figure 17 - Passenger activity by Halifax Transit bus stop.mxd Revised: 2018-12-19 By: abaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Average Daily Ridership

Sum of boardings and alightings

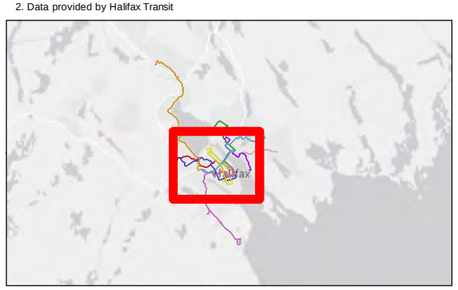
- 0 - 25
- 26 - 50
- 51 - 100
- 101 - 150
- 151 - 250
- 251 - 500
- 501 - 750
- 751 - 1,000
- 1,001 - 1,500
- > 1,500

0 500 1,000 Meters

1:35,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit



Project Location
Halifax Regional Municipality

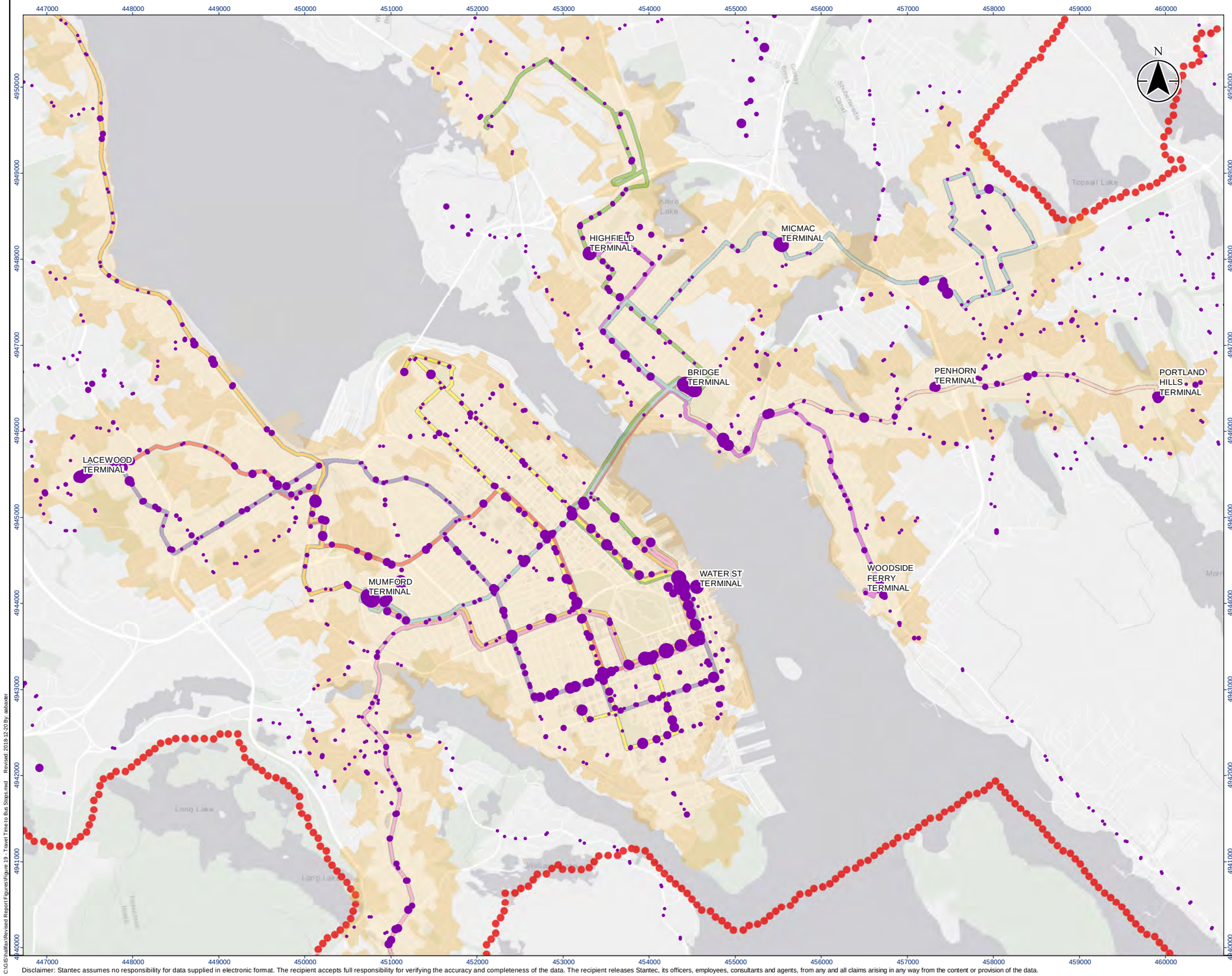
Rideship along Proposed Corridor Routes REVA
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
18

Title
Average daily ridership per stop along proposed corridor routes

C:\GIS\Halifax\Revised Report Figures\Figure 18 - Downtown Passenger Activity.mxd Revised: 2018-12-19 By: abaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Sum of boardings and alightings

- 0 - 25
- 26 - 50
- 51 - 100
- 101 - 150
- 151 - 250
- 251 - 500
- 501 - 750
- 751 - 1,000
- 1,001 - 1,500
- > 1,500

Walking Time to Bus Stop

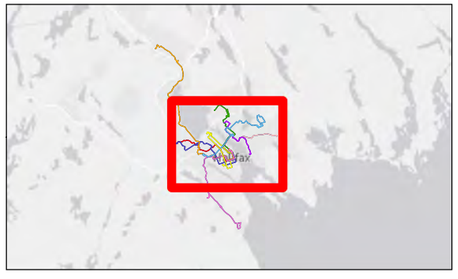
- 5 minutes
- 10 minutes

0 500 1,000 Meters

1:45,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps



Project Location
Halifax Regional Municipality

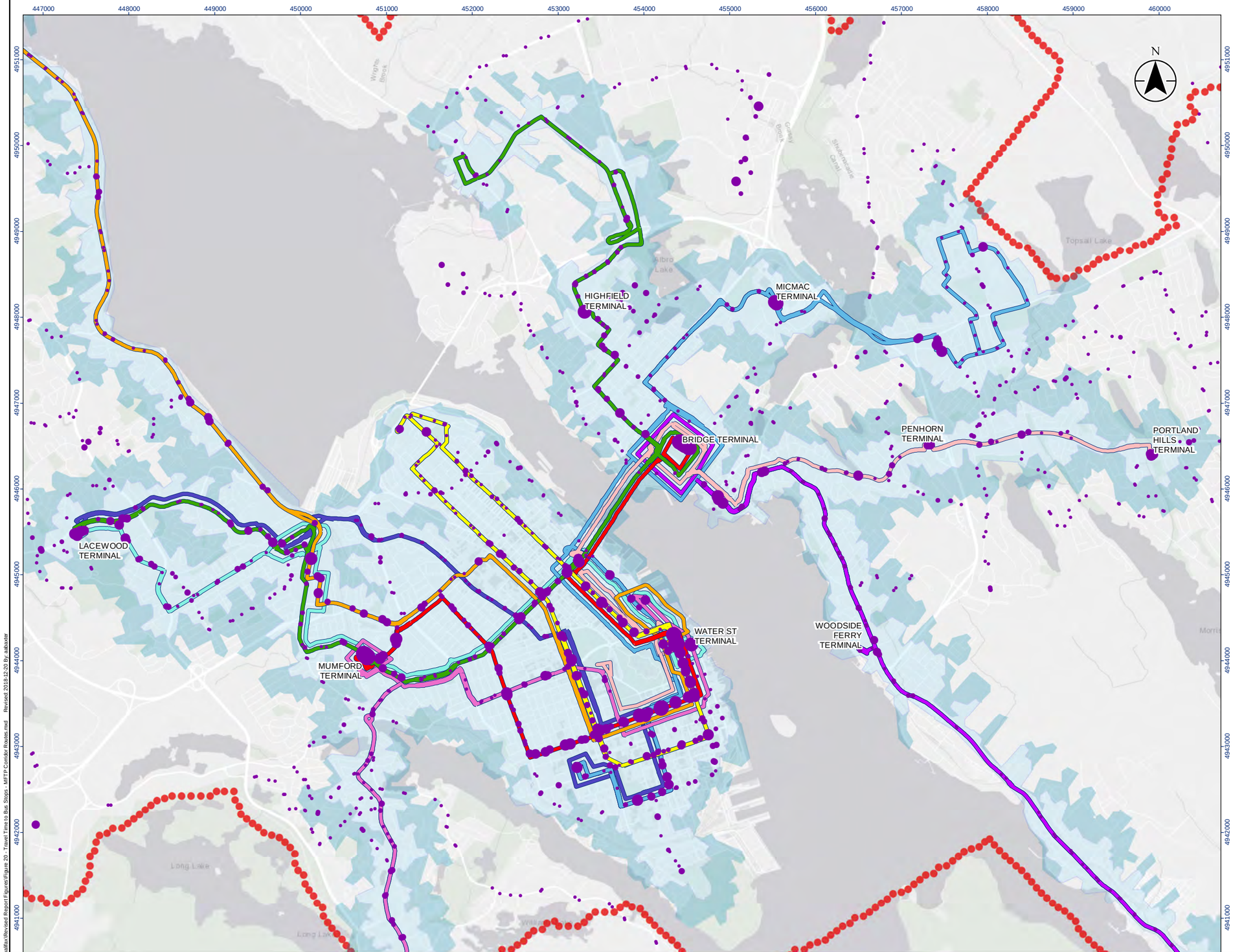
Walking Time to Bus Stops REVA
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
19

Title
Walking Time to Bus Stops Along Proposed Corridor Routes

C:\GIS\halifax\Revised Report Figures\Figure 19 - Travel Time to Bus Stops.mxd Revised 2018-12-20 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Sum of boardings and alightings

- 0 - 25
- 26 - 50
- 51 - 100
- 101 - 150
- 151 - 250
- 251 - 500
- 501 - 750
- 751 - 1,000
- 1,001 - 1,500
- > 1,500

Walking Time to Bus Stop

- 5 minutes
- 10 minutes

0 500 1,000 Meters

1:45,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

Walking Time to Bus Stops REVA
Prepared by Aaron Baxter on 2018-12-19
Technical Review by BP on 2018-12-20
Independent Review by SP on 2018-12-20

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
20

Title
Walking Time to Bus Stops Along MFTP Corridor Routes

C:\GIS\Halifax\Revised Report Figures\Figure 20 - Travel Time to Bus Stops - MFTP Corridor Routes.mxd Revised 2018-12-20 By: jabaxter

Sackville Terminal
Lacewood Terminal
Highfield Terminal
Micmac Terminal
Bridge Terminal
Penhorn Terminal
Mumford Terminal
Scotia Square
Robie at Spring Garden
Woodside Ferry Terminal

N

Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

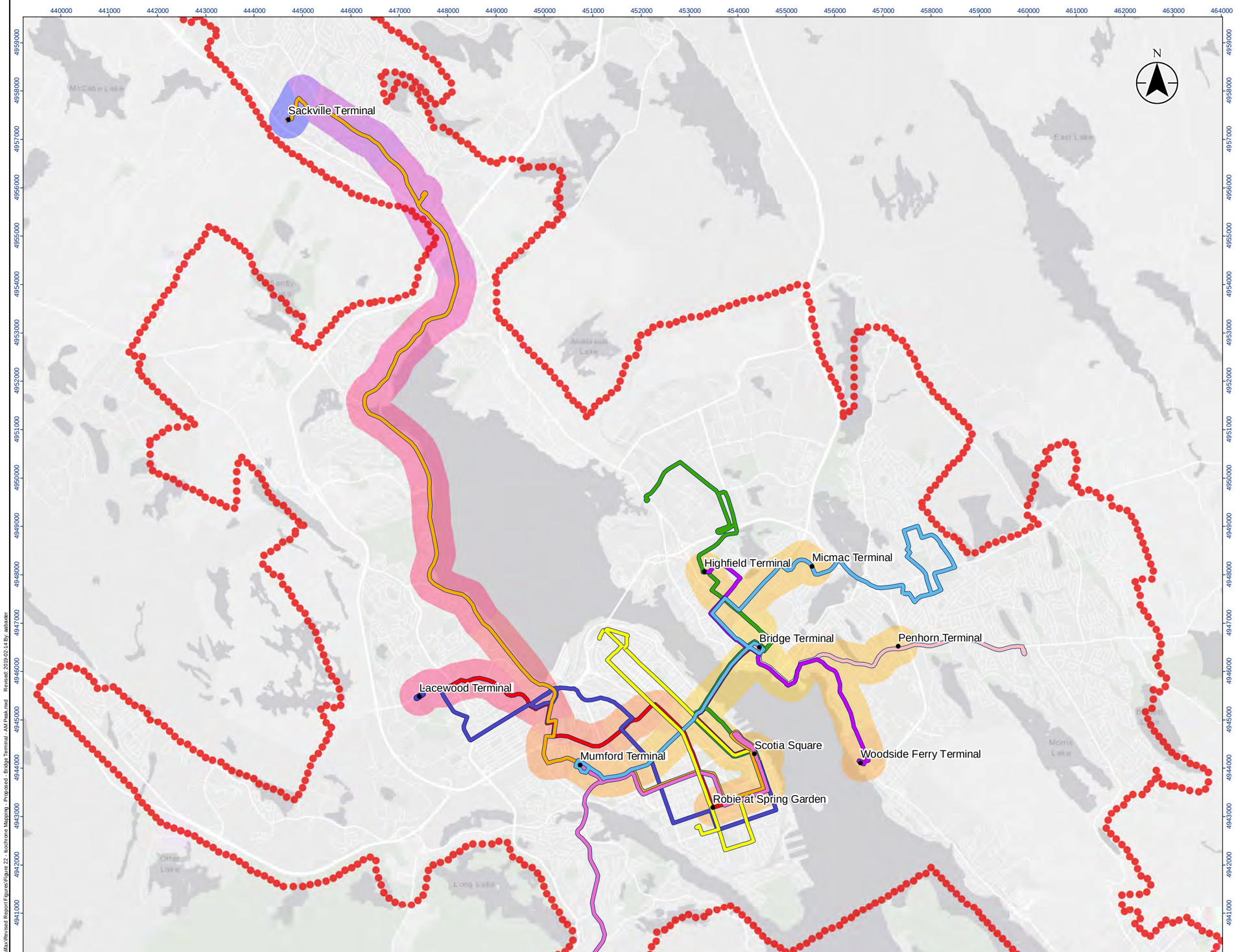
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
21

Title
Origin: Bridge Terminal | Time Period: AM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 21 - Isochrone Mapping - MFTP - Bridge Terminal - AM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

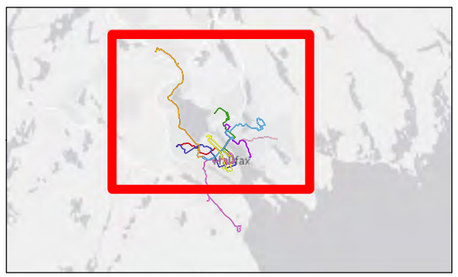
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps



Project Location
Halifax Regional Municipality

Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
22

Title
Origin: Bridge Terminal | Time Period: AM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 22 - Isochrone Mapping - Proposed - Bridge Terminal - AM Peak.mxd Revised: 2019-02-14 By: abbaxter

Sackville Terminal
Highfield Terminal
Micmac Terminal
Bridge Terminal
Penhorn Terminal
Lacewood Terminal
Scotia Square
Mumford Terminal
Woodside Ferry Terminal
Robie at Spring Garden

N

Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

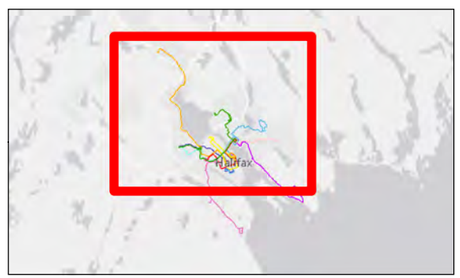
Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000
Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps



Project Location
Halifax Regional Municipality

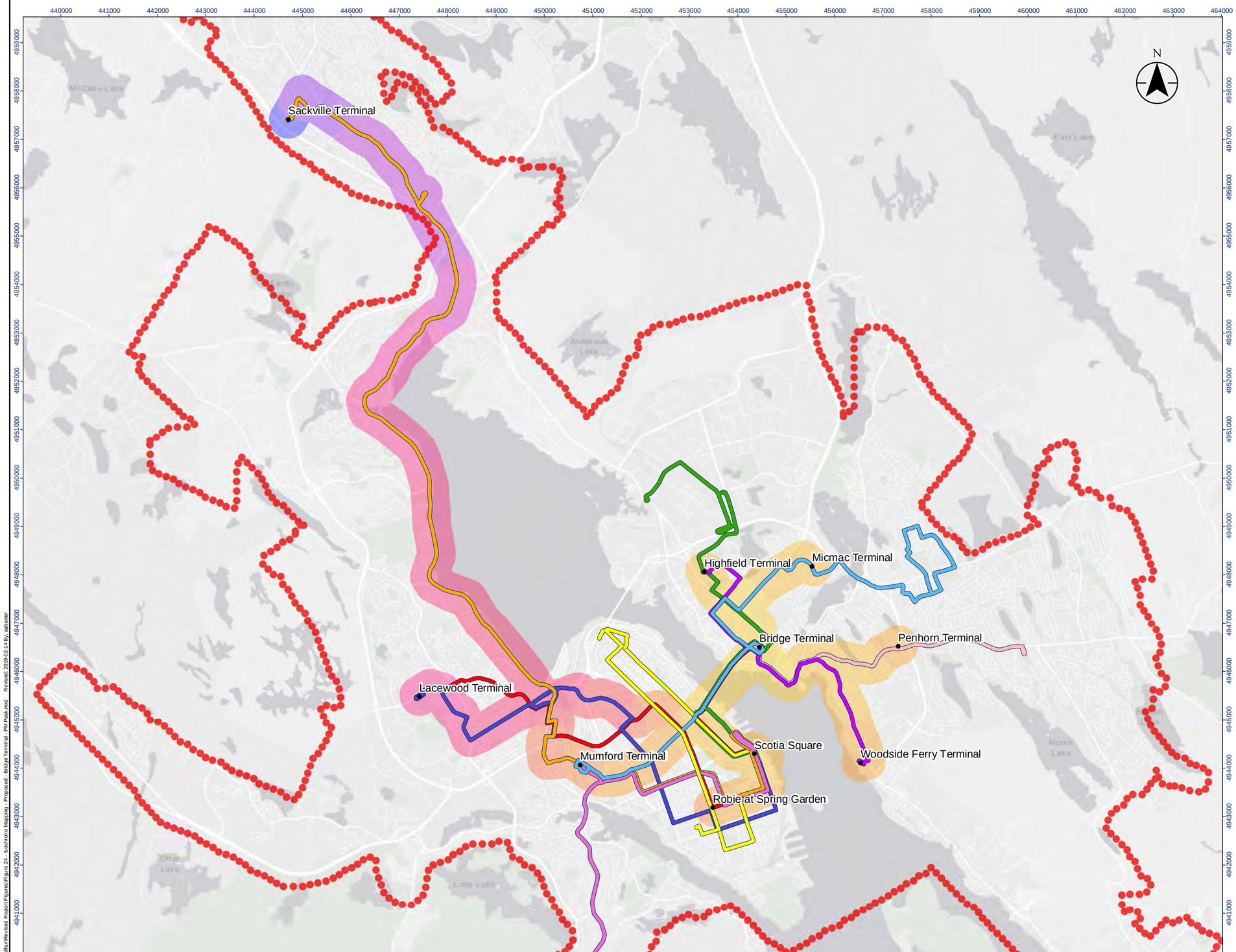
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
23

Title
Origin: Bridge Terminal | Time Period: PM Peak | Network: MFTP

C:\GIS\staff\x\Revised Report Figures\Figure 23 - Isochrone Mapping - MFTP - Bridge Terminal - PM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

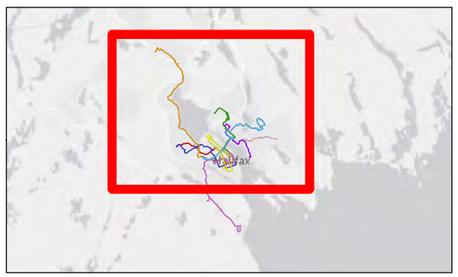
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps



Project Location
Halifax Regional Municipality

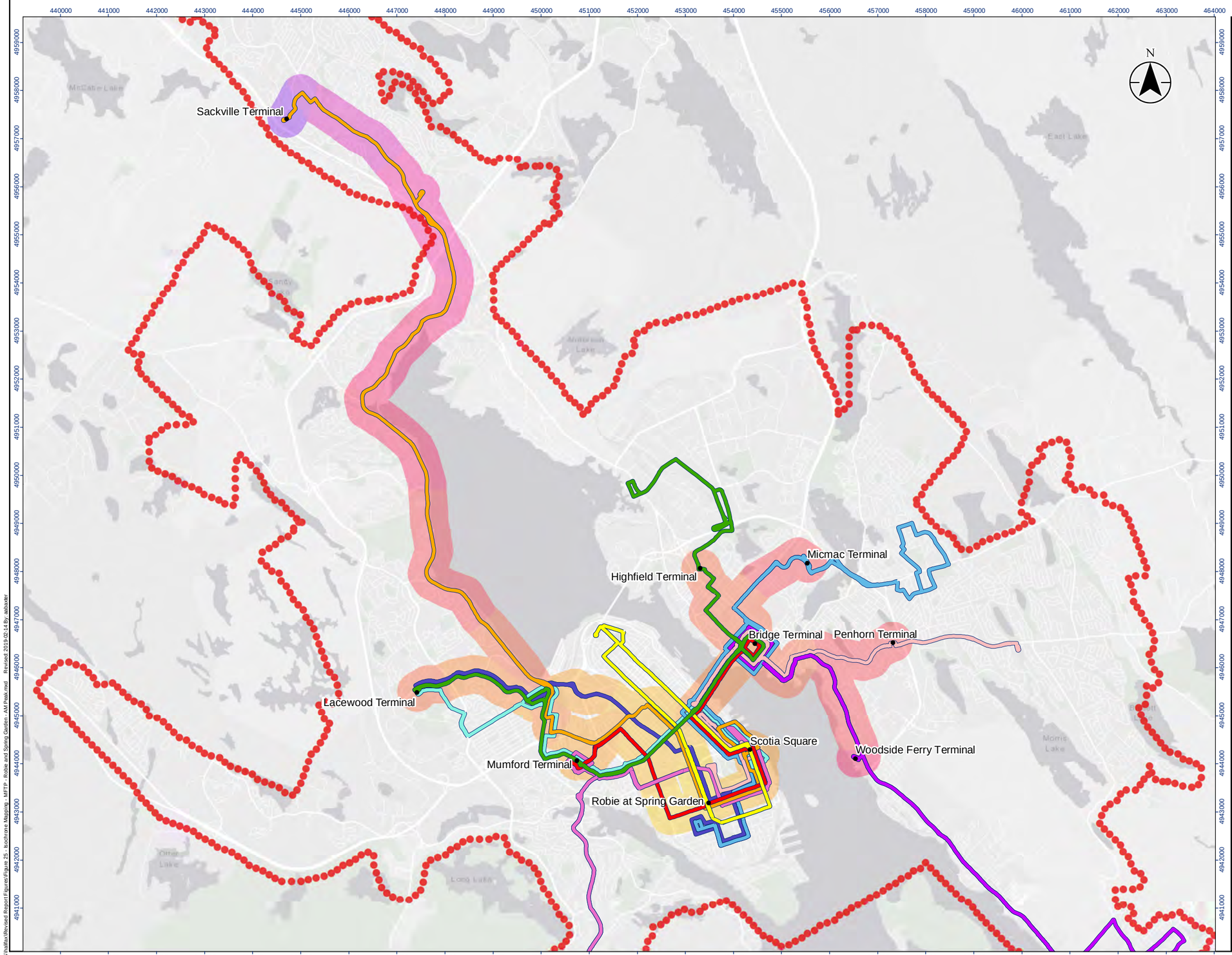
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
24

Title
Origin: Bridge Terminal | Time Period: PM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 24 - Isochrone Mapping - Proposed - Bridge Terminal - PM Peak.mxd Revised: 2019-02-14 By: abbaxter



Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

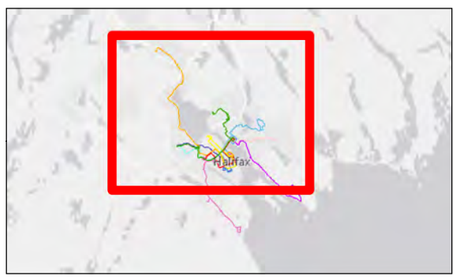
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps



Project Location
Halifax Regional Municipality

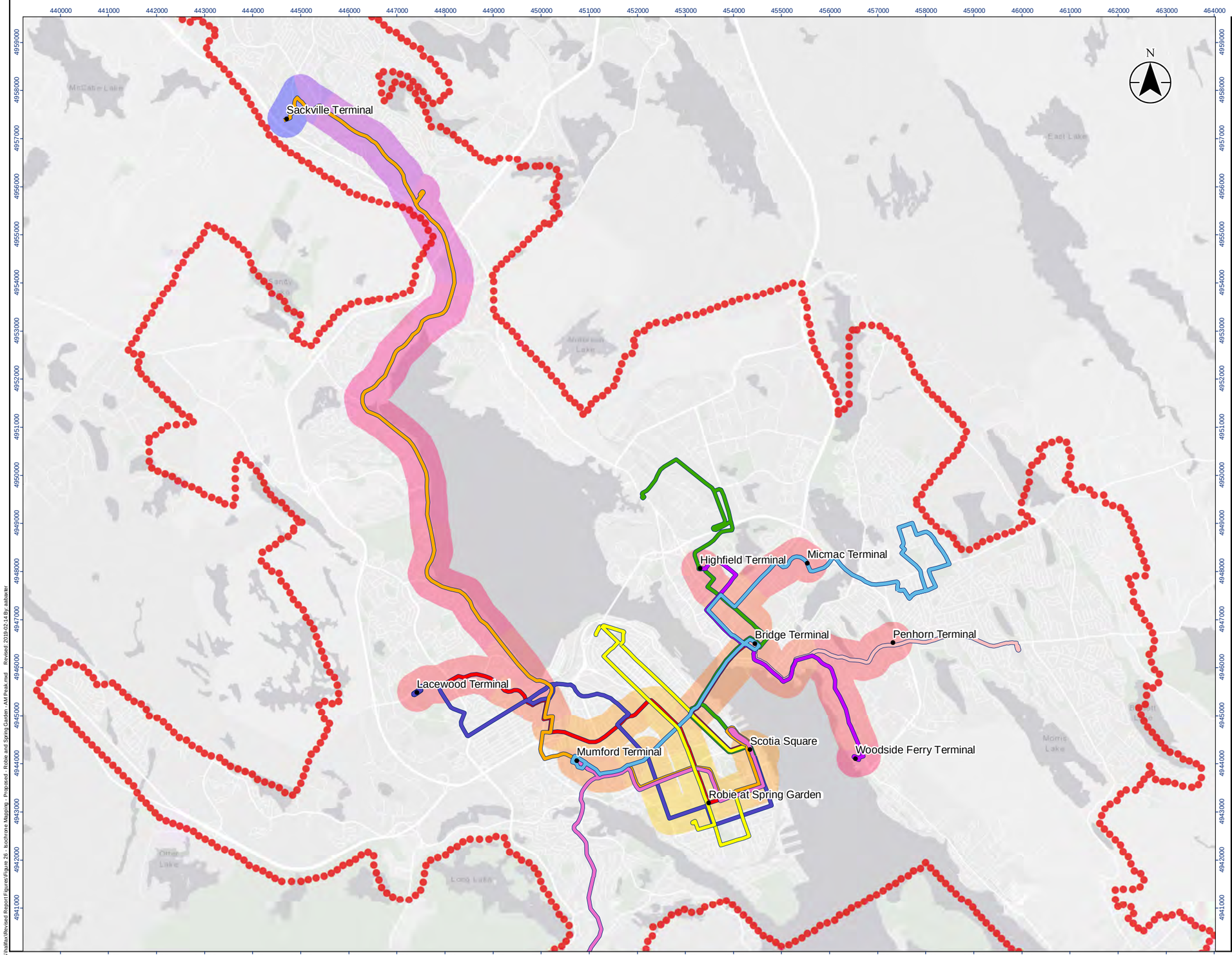
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
25

Title
Origin: Robie and Spring Garden | Time Period: AM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 25 - Isochrone Mapping - MFTP - Robie and Spring Garden - AM Peak.mxd Revised 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

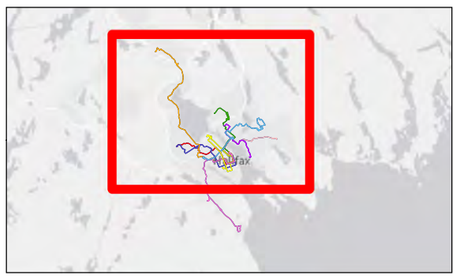
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps



Project Location
Halifax Regional Municipality

Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
6

Title
Origin: Robie and Spring Garden | Time Period: AM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 26 - Isochrone Mapping - Proposed - Robie and Spring Garden - AM Peak.mxd Revised 2019-02-14 By: aabaxter

Sackville Terminal
Highfield Terminal
Micmac Terminal
Bridge Terminal
Penhorn Terminal
Lacewood Terminal
Mumford Terminal
Scotia Square
Woodside Ferry Terminal
Robie at Spring Garden

N

Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

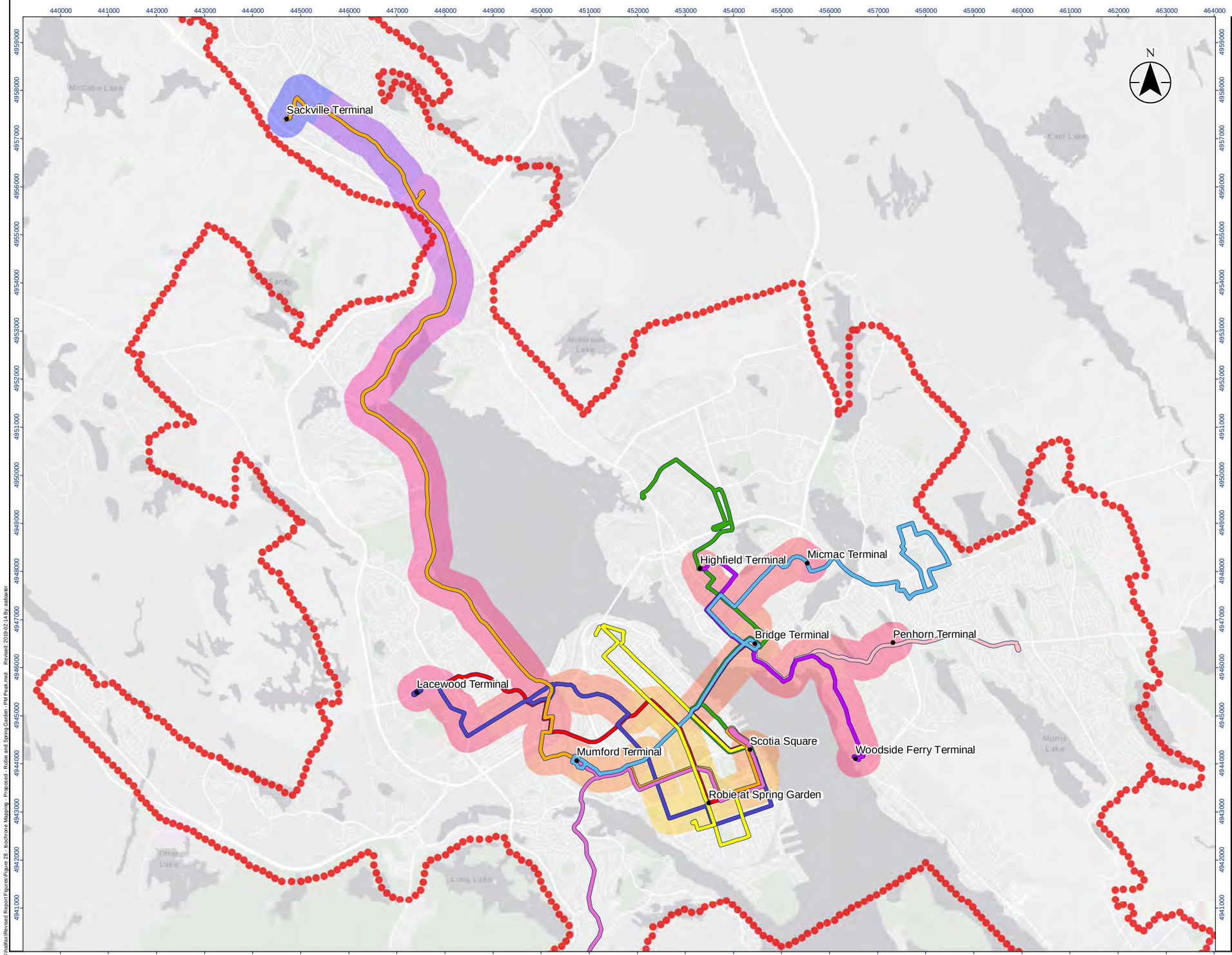
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
27

Title
Origin: Robie and Spring Garden | Time Period: PM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 27 - Isochrone Mapping - MFTP - Robie and Spring Garden - PM Peak.mxd Revised 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

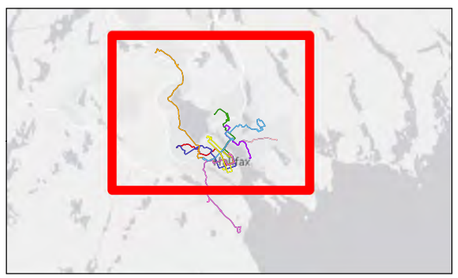
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps



Project Location
Halifax Regional Municipality

Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
28

Title
Origin: Robie and Spring Garden | Time Period: PM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 28 - Isochrone Mapping - Proposed - Robie and Spring Garden - PM Peak.mxd Revised 2019-02-14 By: aabaxter

Sackville Terminal
Highfield Terminal
Micmac Terminal
Bridge Terminal
Penhorn Terminal
Lacewood Terminal
Mumford Terminal
Scotia Square
Woodside Ferry Terminal
Robie at Spring Garden

N

Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes from Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000
Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
29

Title
Origin: Scotia Square | Time Period: AM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 29 - Isochrone Mapping - MFTP - Scotia Square - AM Peak.mxd Revised: 2019-02-14 By: aabaxter

Sackville Terminal
Highfield Terminal
Micmac Terminal
Bridge Terminal
Penhorn Terminal
Lacewood Terminal
Mumford Terminal
Scotia Square
Woodside Ferry Terminal
Robie at Spring Garden

N

Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000
Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

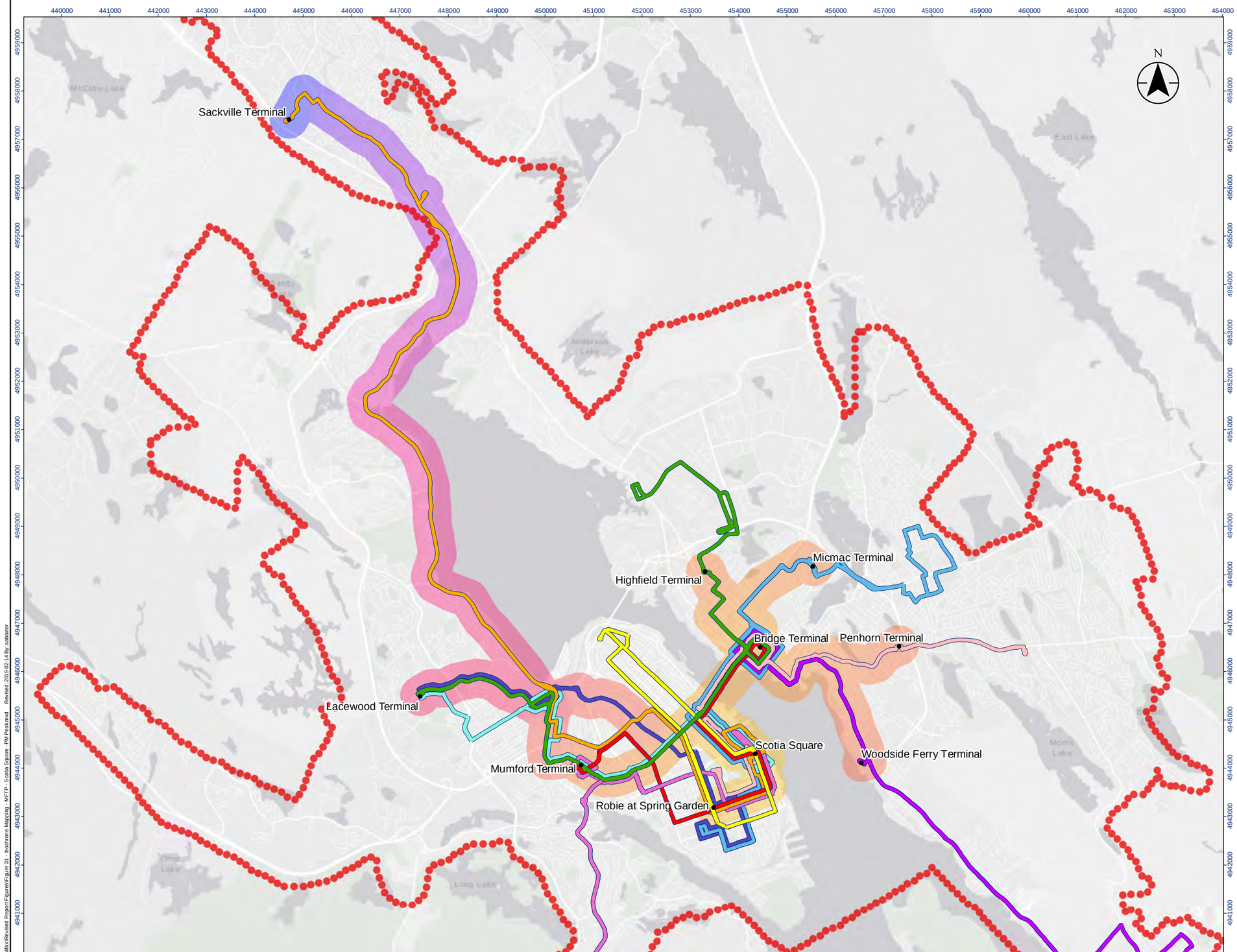
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
30

Title
Origin: Scotia Square | Time Period: AM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure30 - Isochrone Mapping - Proposed - Scotia Square - AM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes from Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

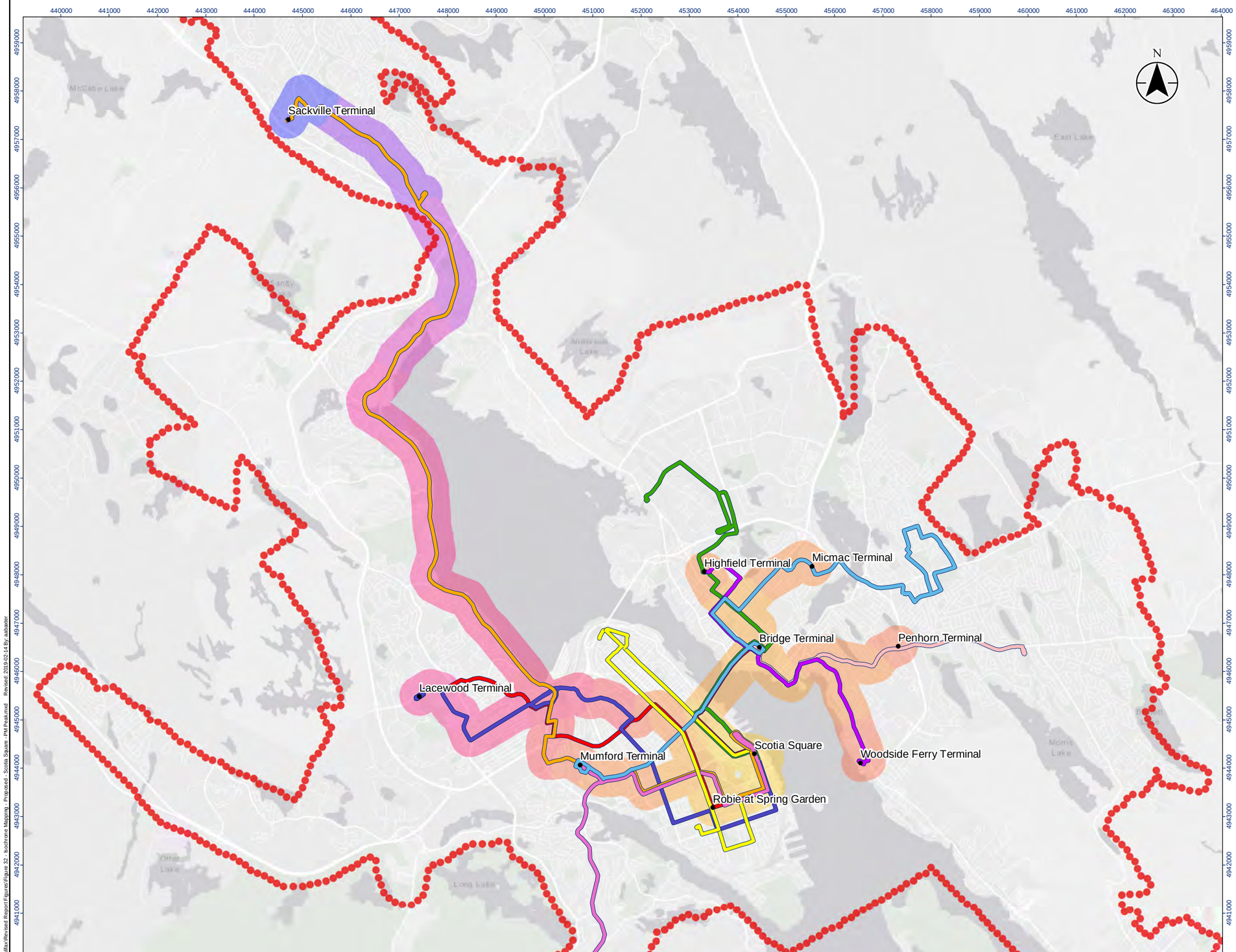
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
31

Title
Origin: Scotia Square | Time Period: PM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 31 - Isochrone Mapping - MFTP - Scotia Square - PM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

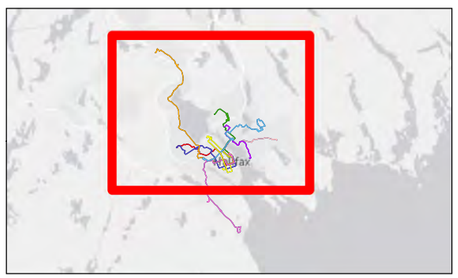
Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps



Project Location
Halifax Regional Municipality

Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
32

Title
Origin: Scotia Square | Time Period: PM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 32 - Isochrone Mapping - Proposed - Scotia Square - PM Peak.mxd Revised 2019-02-14 By aabaxter

Sackville Terminal
Lacewood Terminal
Highfield Terminal
Micmac Terminal
Bridge Terminal
Penhorn Terminal
Mumford Terminal
Scotia Square
Robie at Spring Garden
Woodside Ferry Terminal
N

Stantec
HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

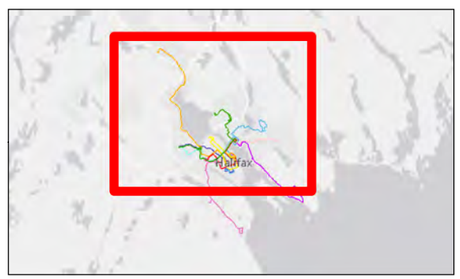
Travel Minutes from Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps



Project Location
Halifax Regional Municipality

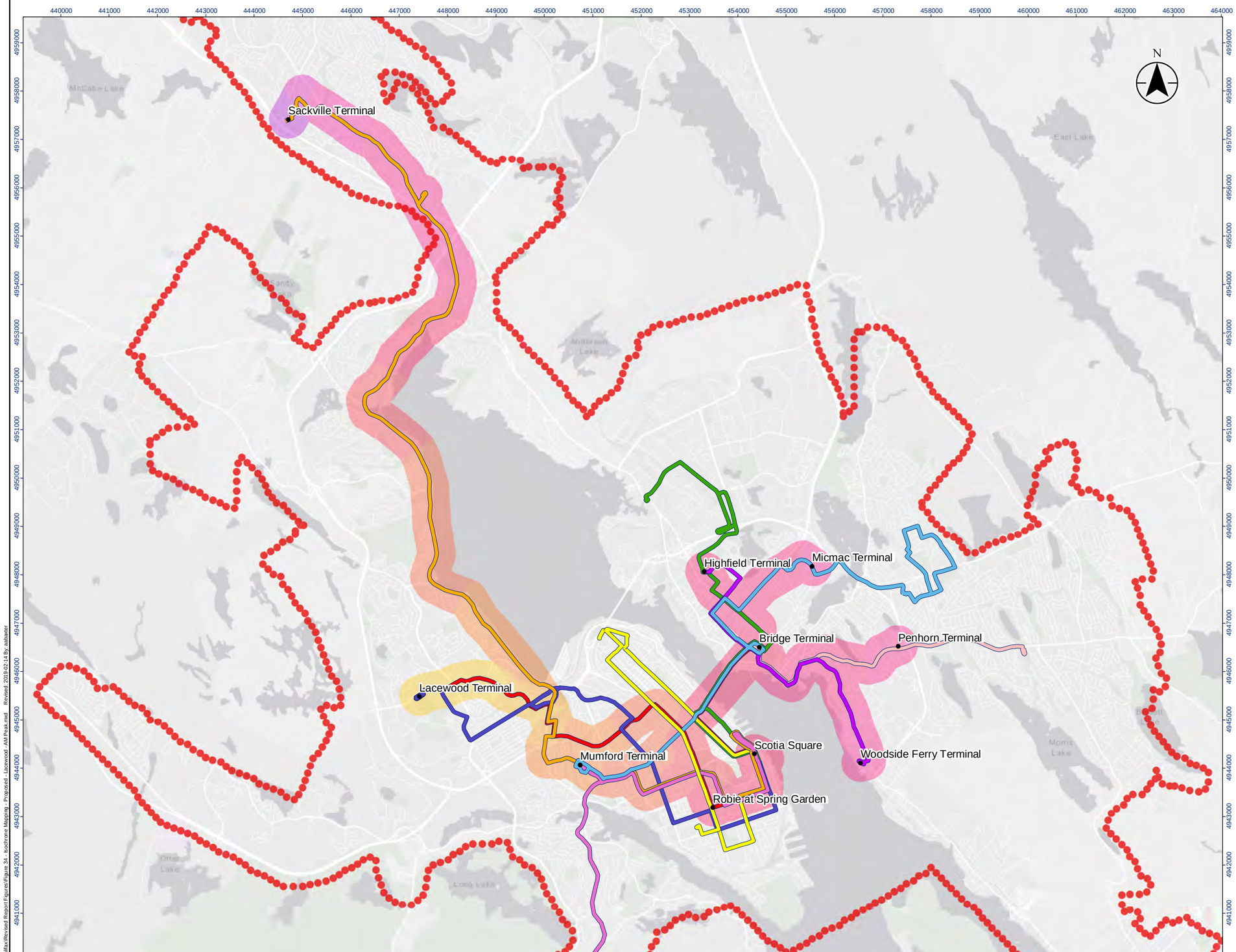
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
33

Title
Origin: Lacewood | Time Period: AM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 33 - Isochrone Mapping - MFTP - Lacewood - AM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

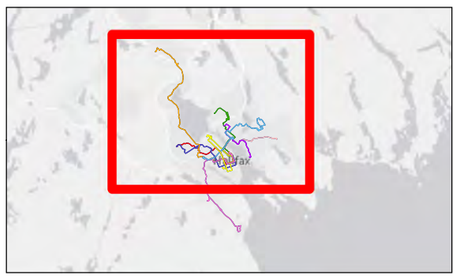
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps



Project Location
Halifax Regional Municipality

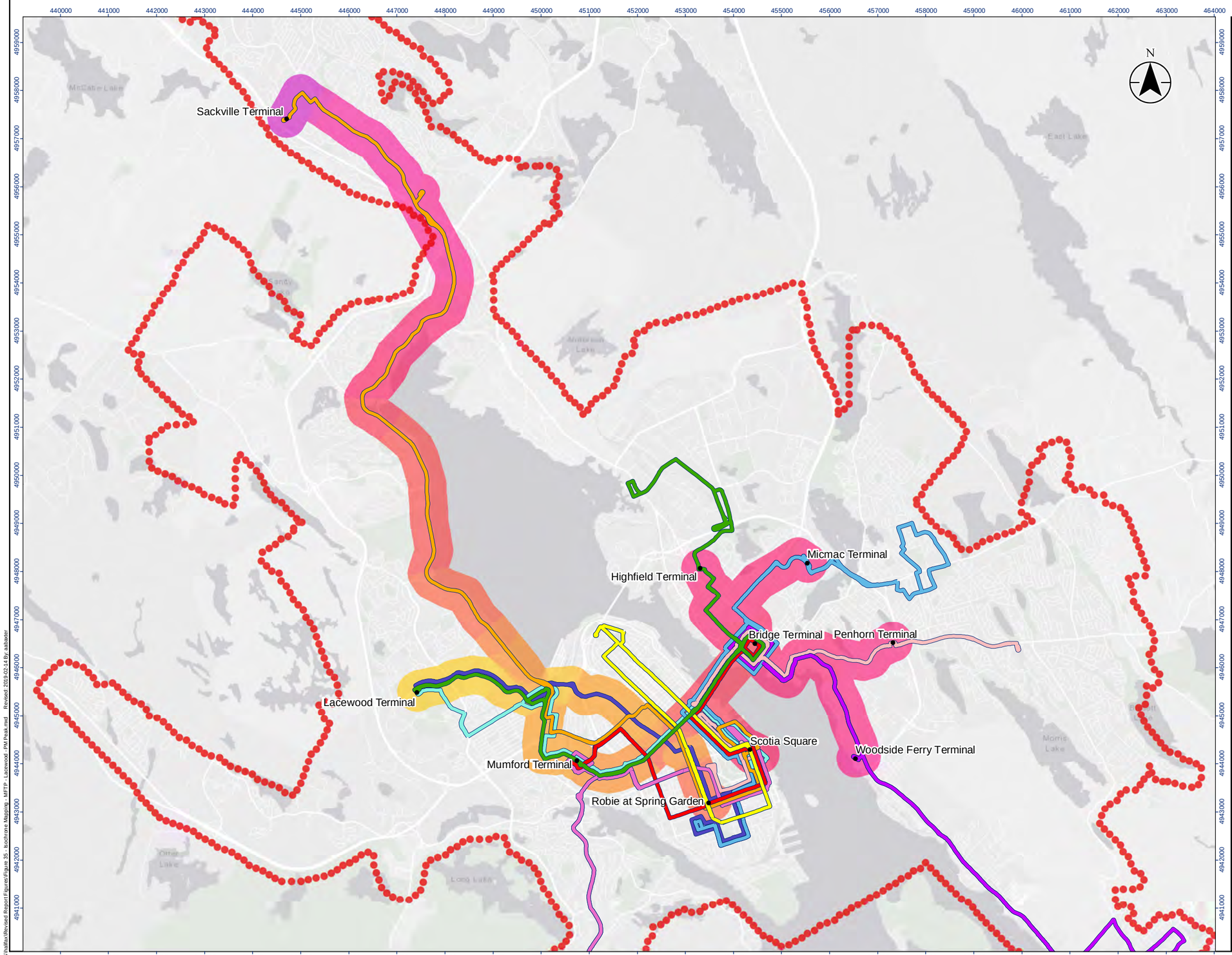
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
34

Title
Origin: Lacewood | Time Period: AM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 34 - Isochrone Mapping - Proposed - Lacewood - AM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

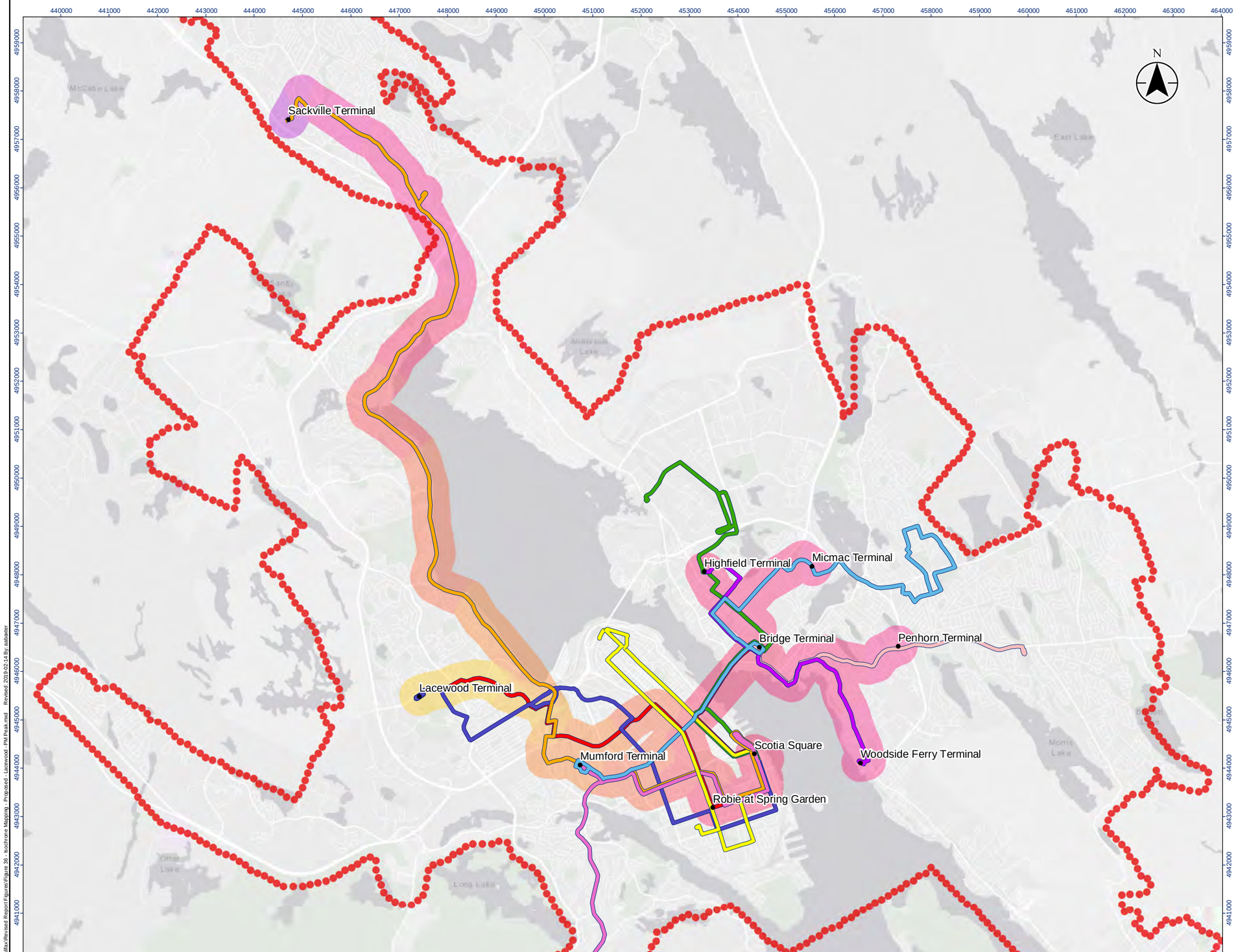
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
35

Title
Origin: Lacewood | Time Period: PM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 35 - Isochrone Mapping - MFTP - Lacewood - PM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

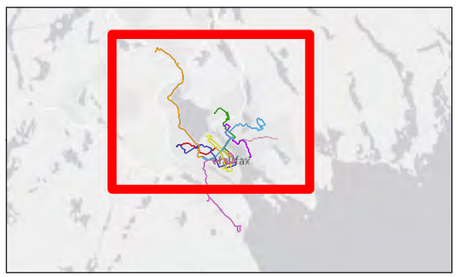
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps



Project Location
Halifax Regional Municipality

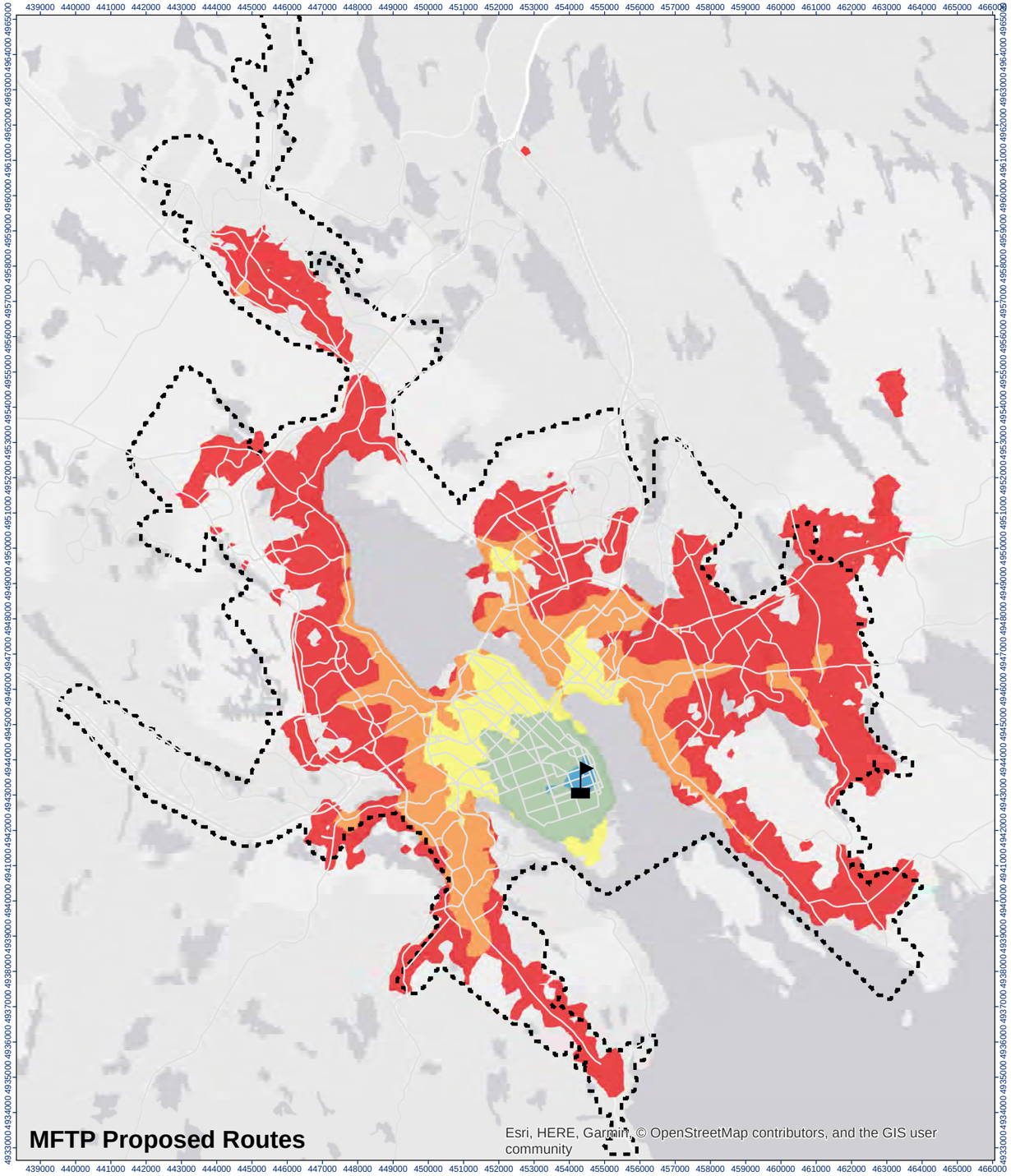
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

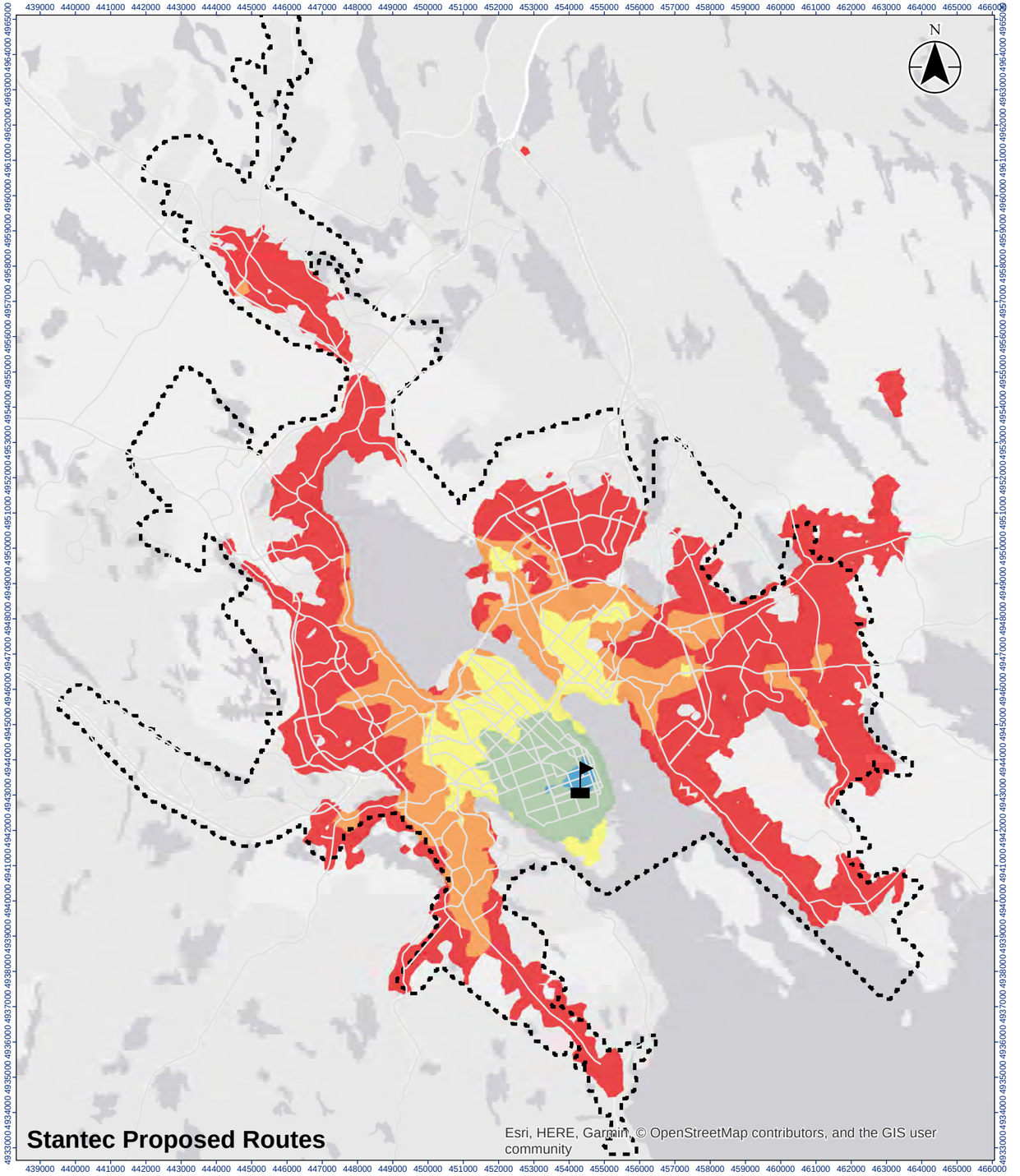
Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
36

Title
Origin: Lacewood | Time Period: PM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 36 - Isochrone Mapping - Proposed - Lacewood - PM Peak.mxd Revised 2019-02-14 By: aabaxter





Legend

Name

Halifax Central Library

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

37

Figure No.

Origin: Halifax Central Library| Time Period: Weekday AM Peak (8:30:00 - 9:30:00)

Title

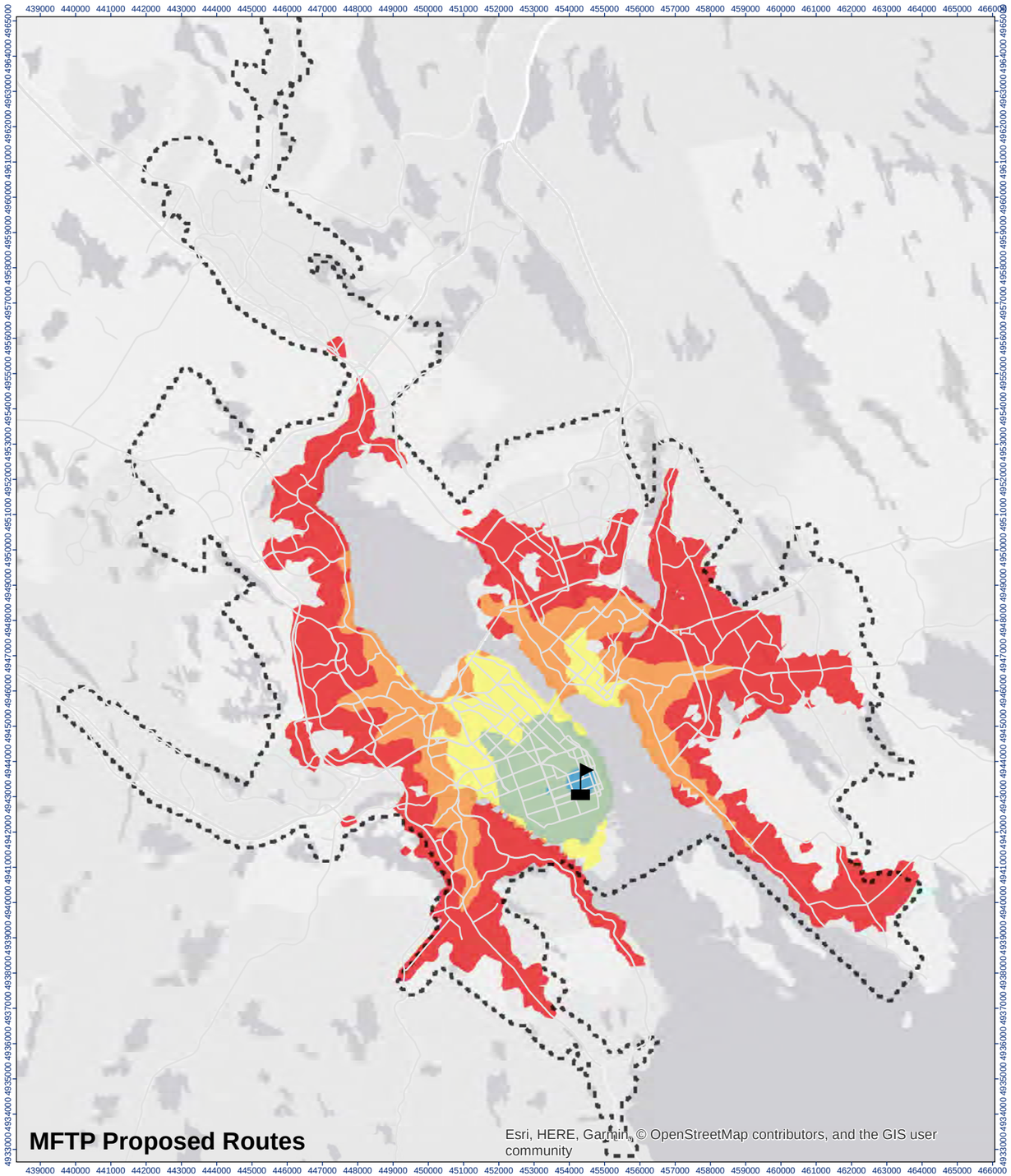
Notes

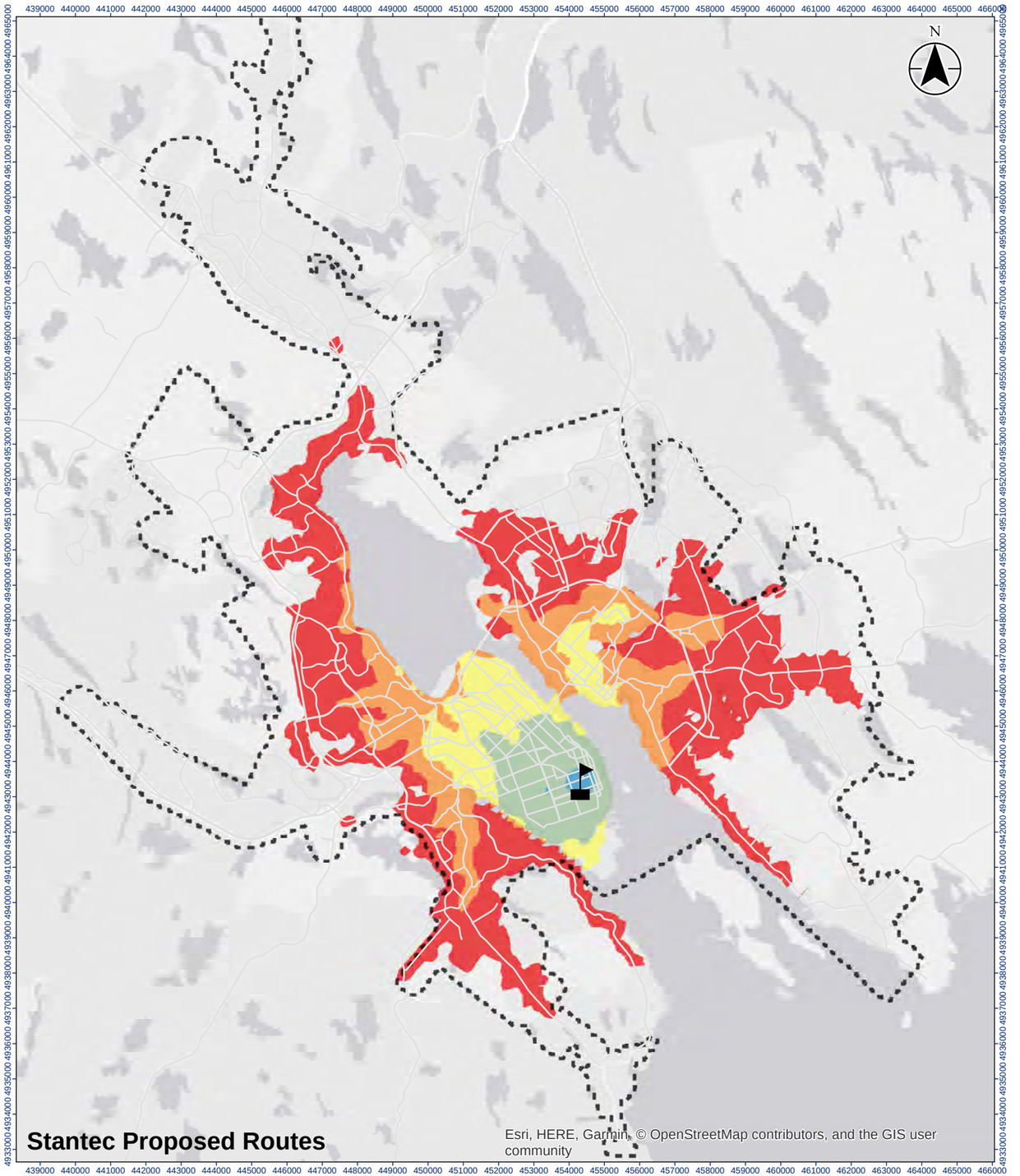
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Legend

Name

Halifax Central Library

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

38

Figure No.

Origin: Halifax Central Library| Time Period: Weekday Midday (12:30:00 - 13:30:00)

Title

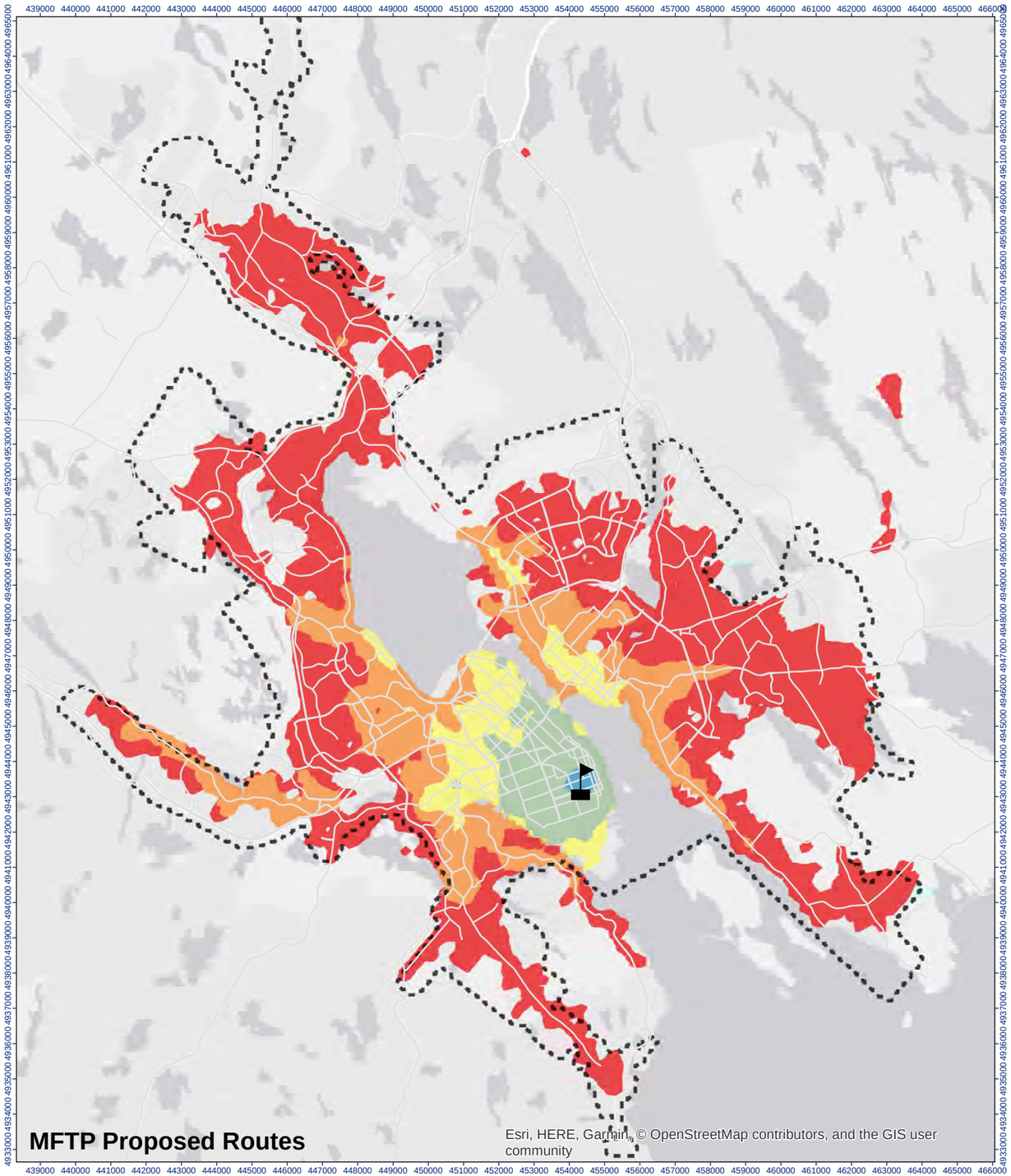
Notes

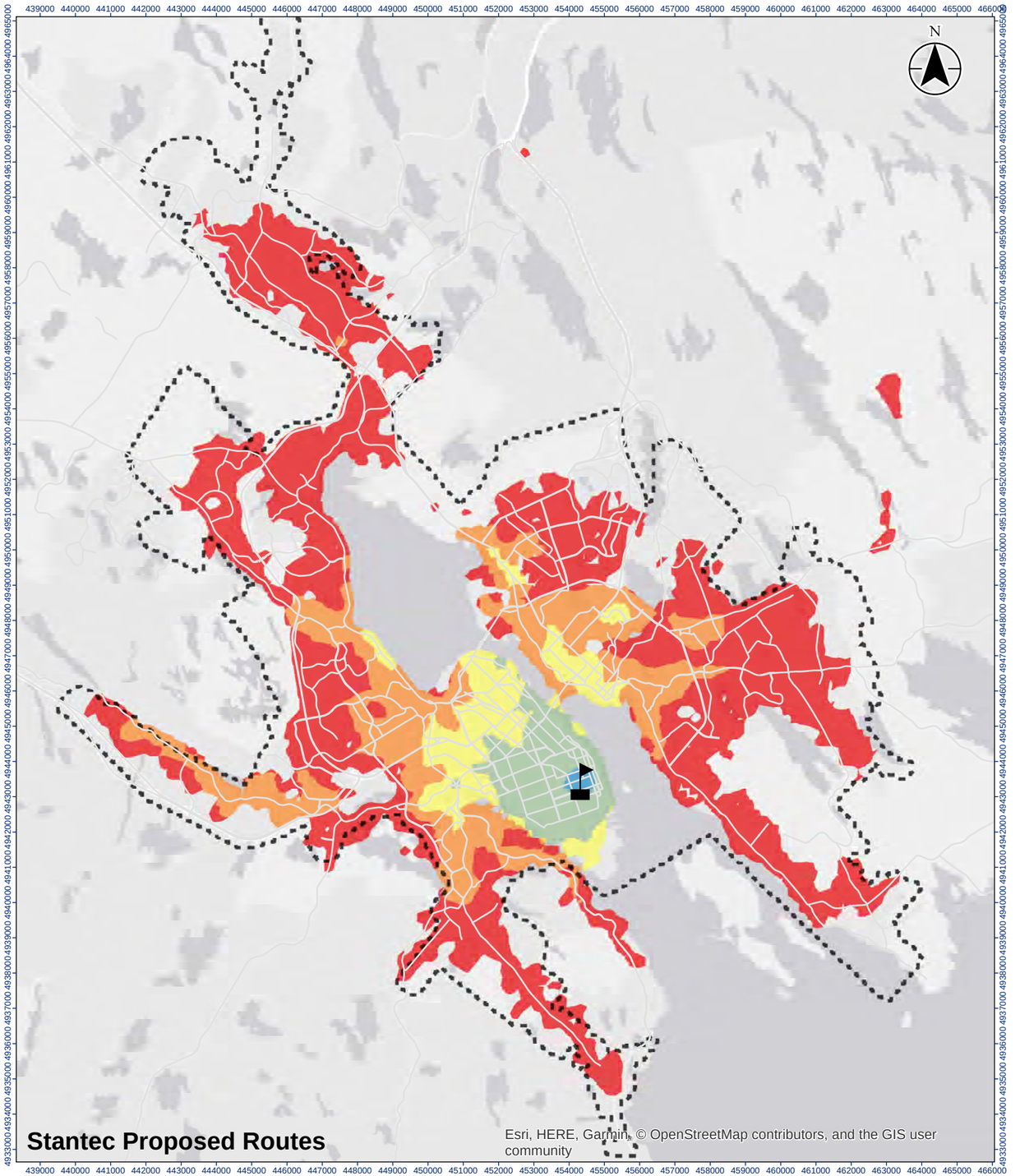
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Legend

Name

- Halifax Central Library
- Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

39

Figure No.

Origin: Halifax Central Library| Time Period: Weekday PM Peak (17:00:00 - 18:00:00)

Title

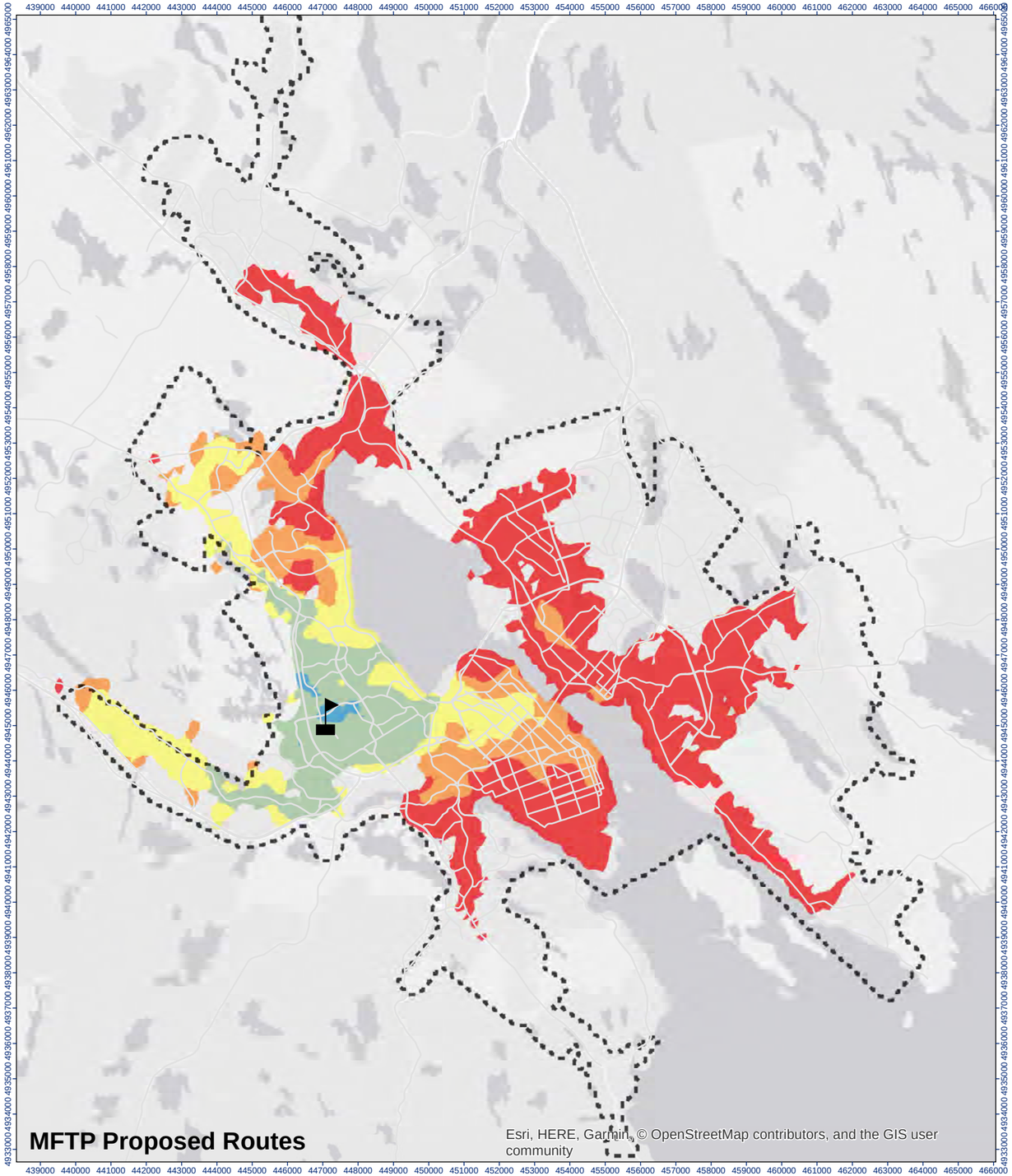
Notes

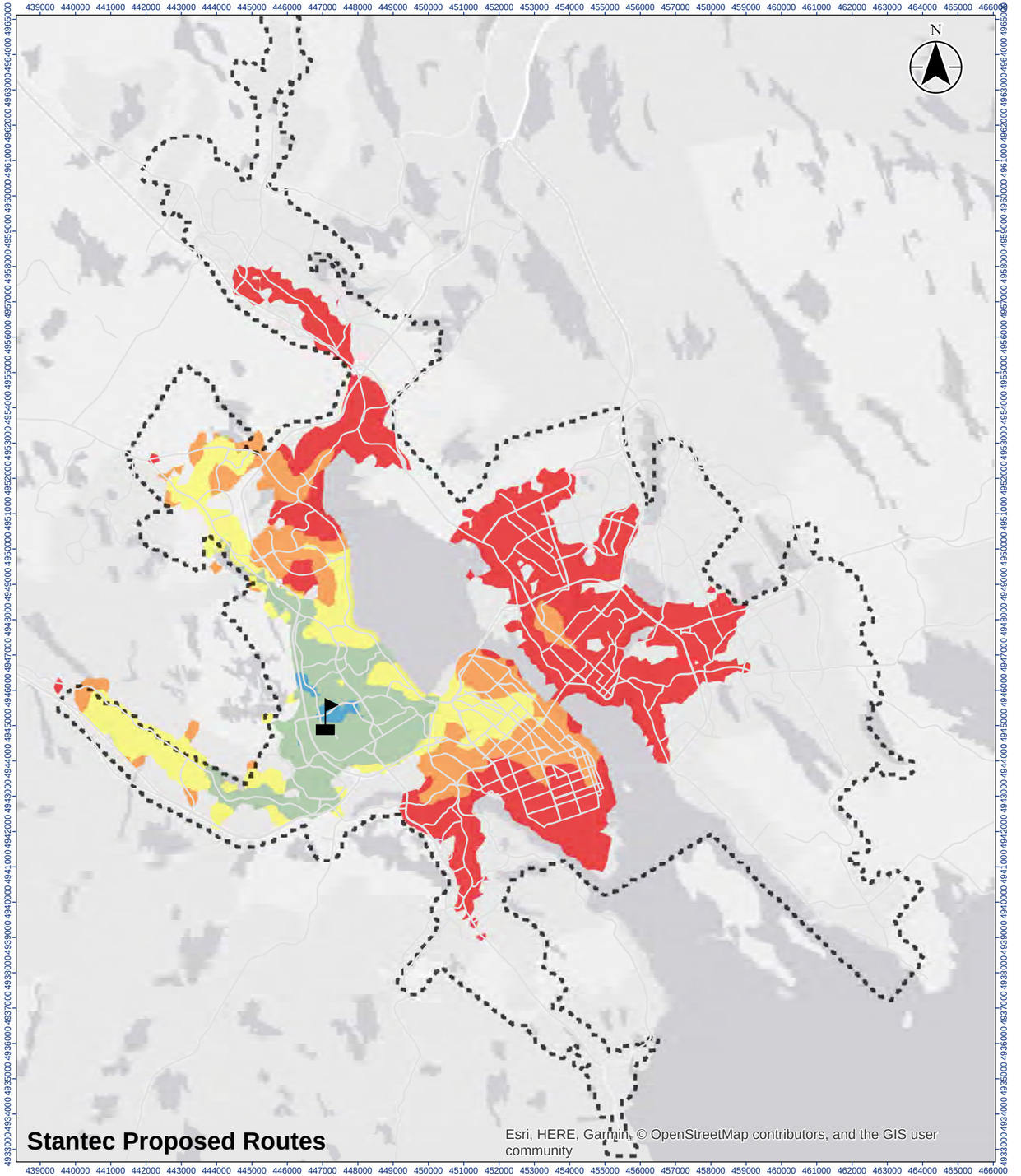
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Legend

Name

Keshen Goodman Public Library

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

40

Figure No.

Origin: Keshen Goodman Public Library| Time Period: Weekday AM Peak (8:30:00 - 9:30:00)

Title

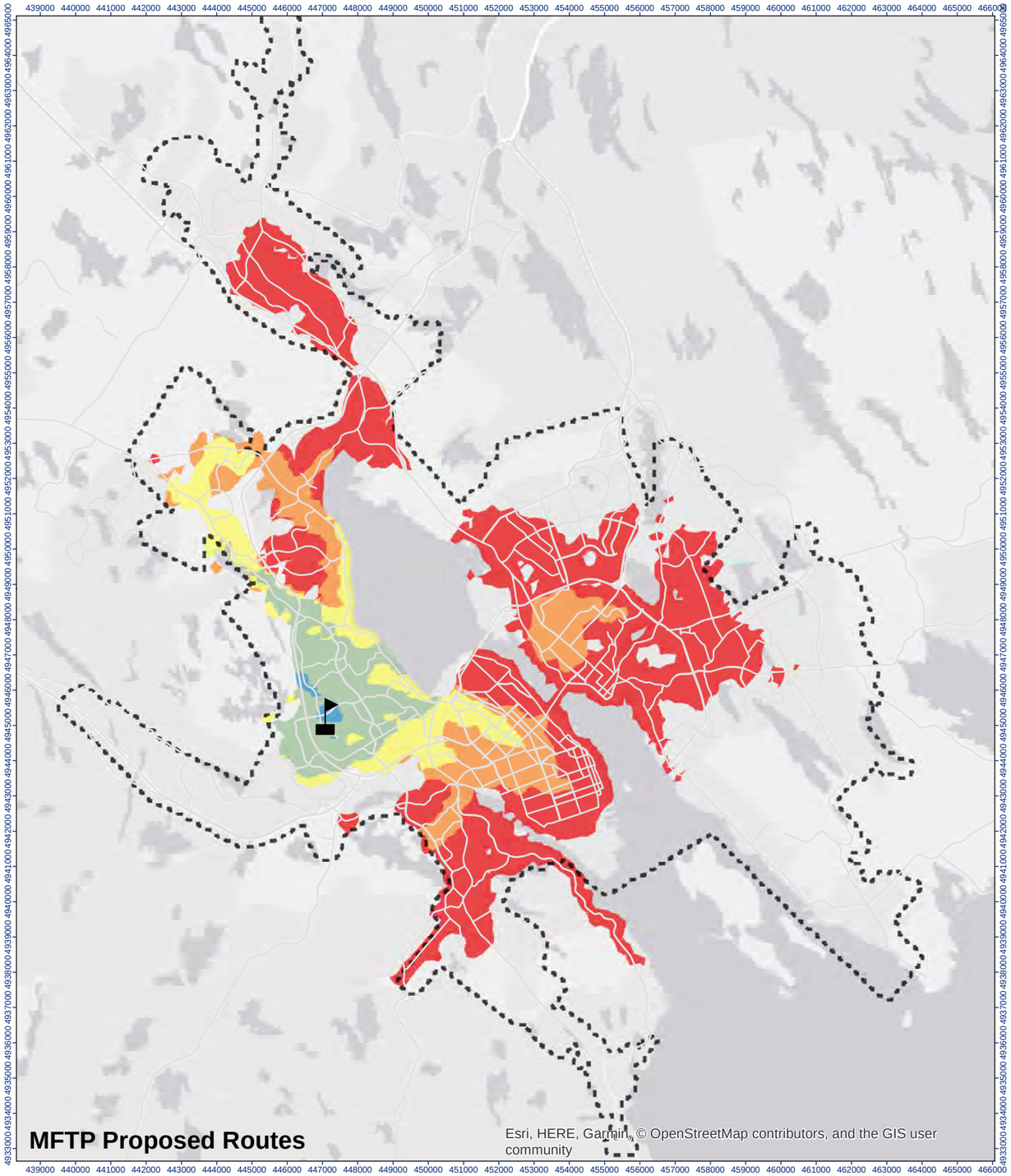
Notes

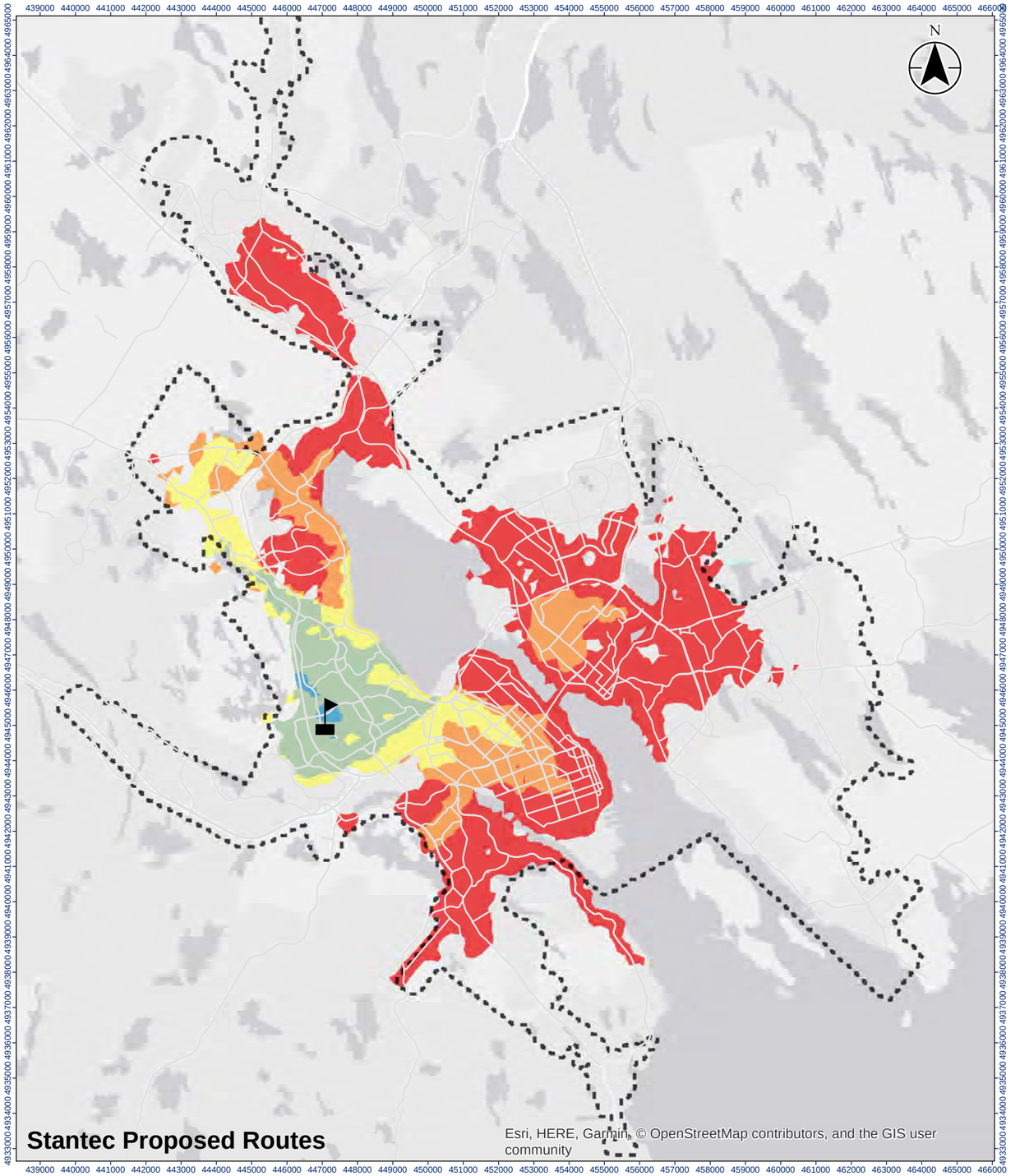
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

41

Figure No.

Origin: Keshen Goodman Public Library| Time Period: Weekday Midday (12:30:00 - 13:30:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Keshen Goodman Public Library

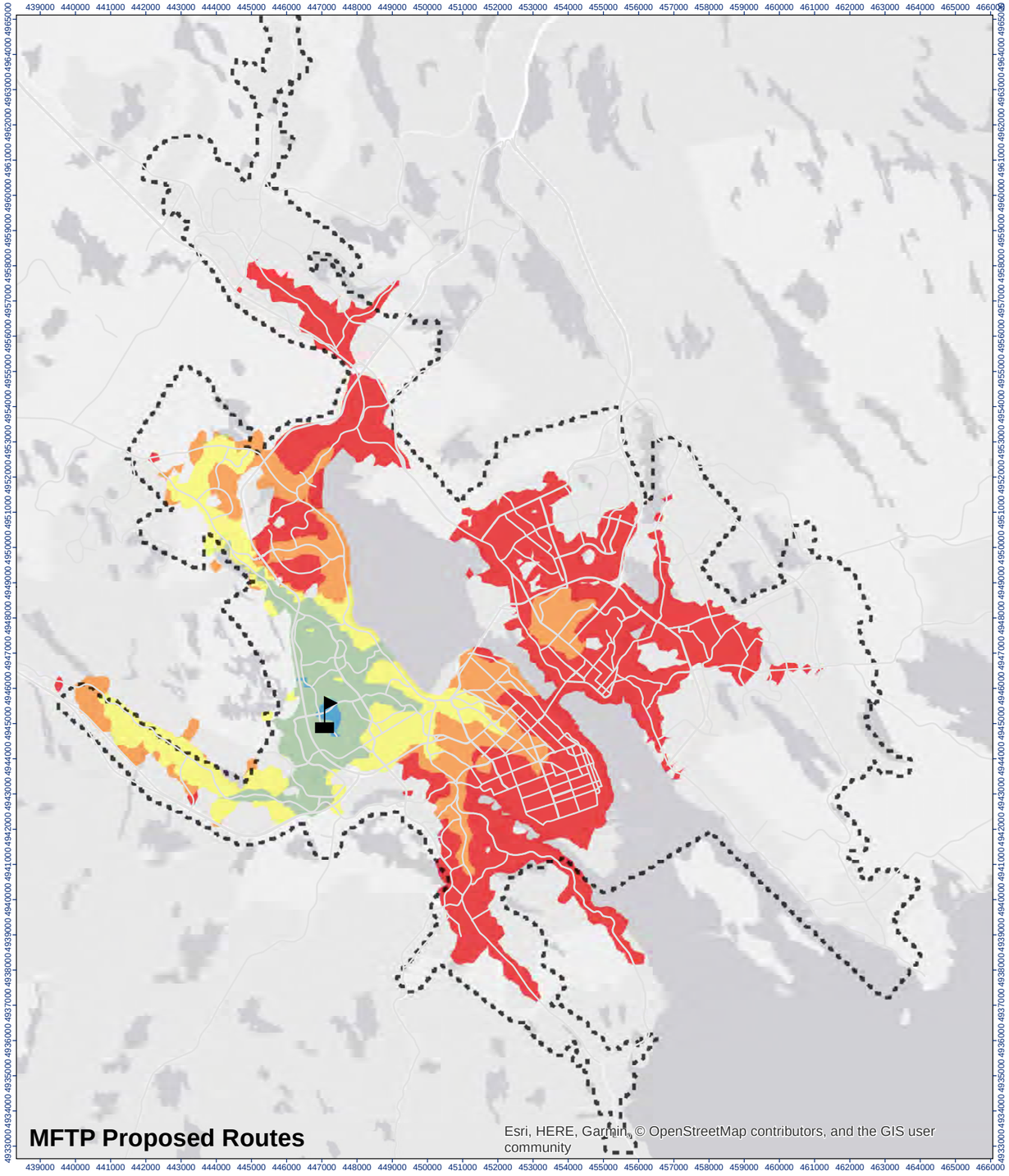
Urban Transit Service Boundary

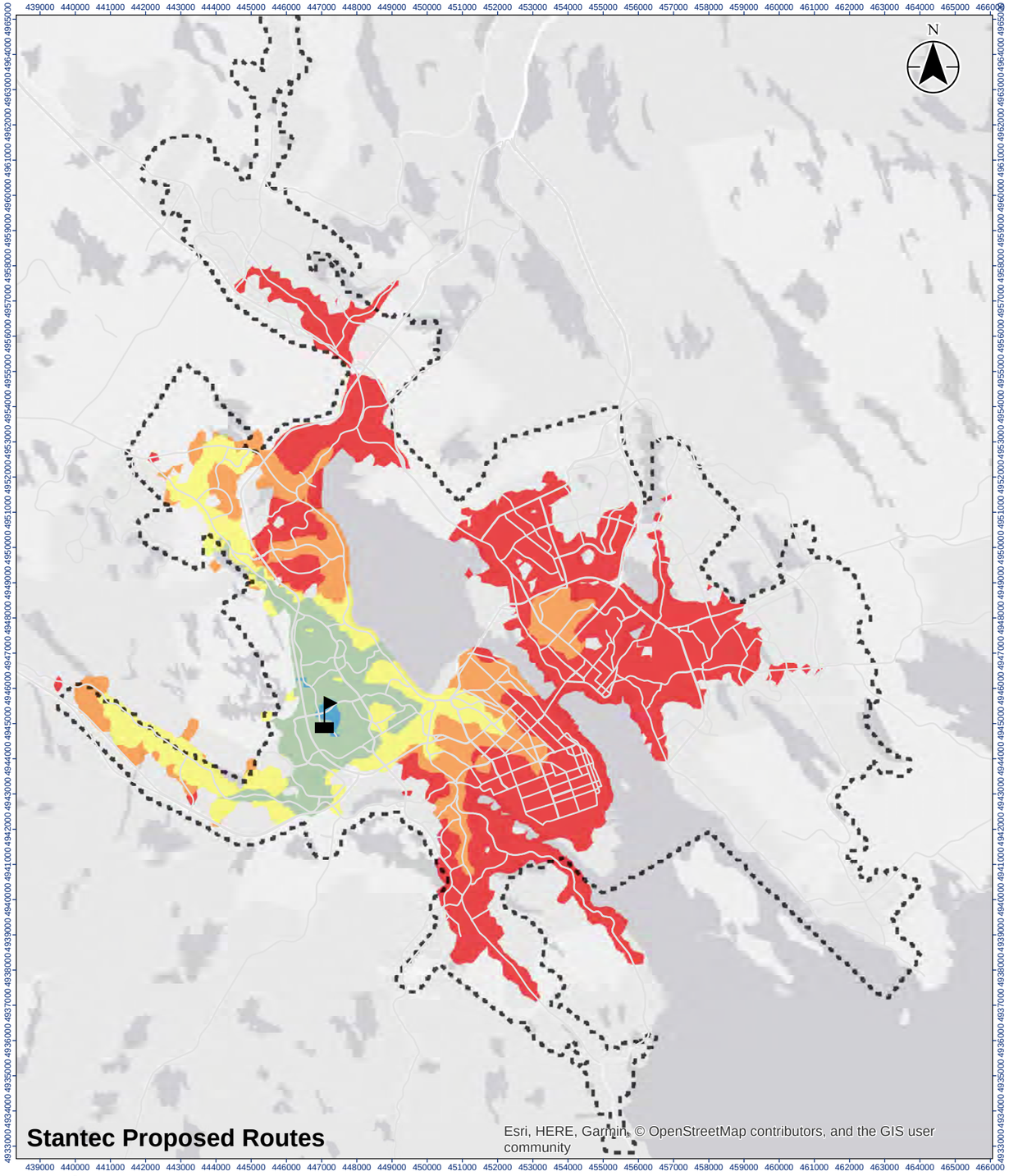
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Legend

Name

Keshen Goodman Public Library

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

42

Figure No.

Origin: Keshen Goodman Public Library| Time Period: Weekday PM Peak (17:00:00 - 18:00:00)

Title

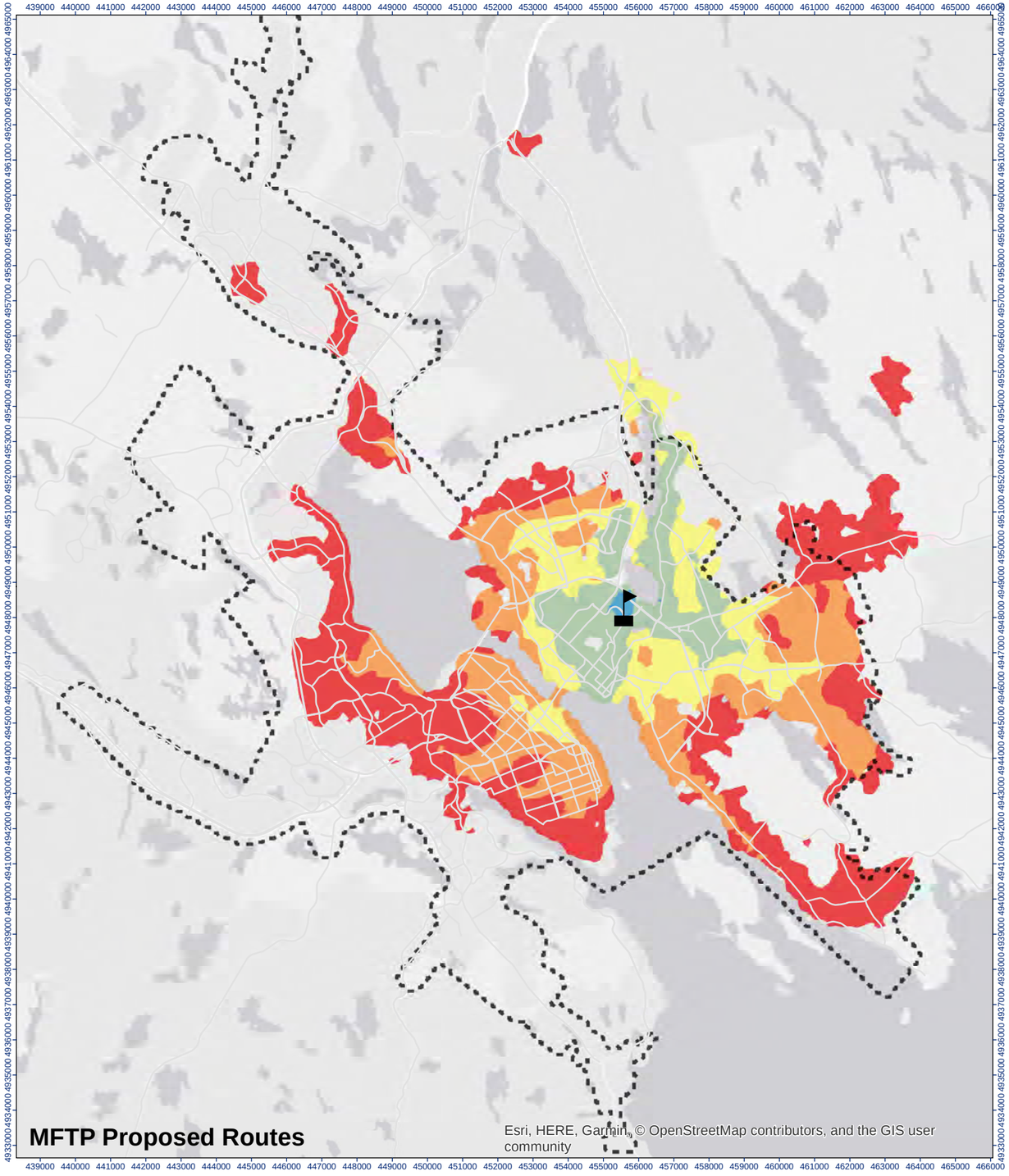
Notes

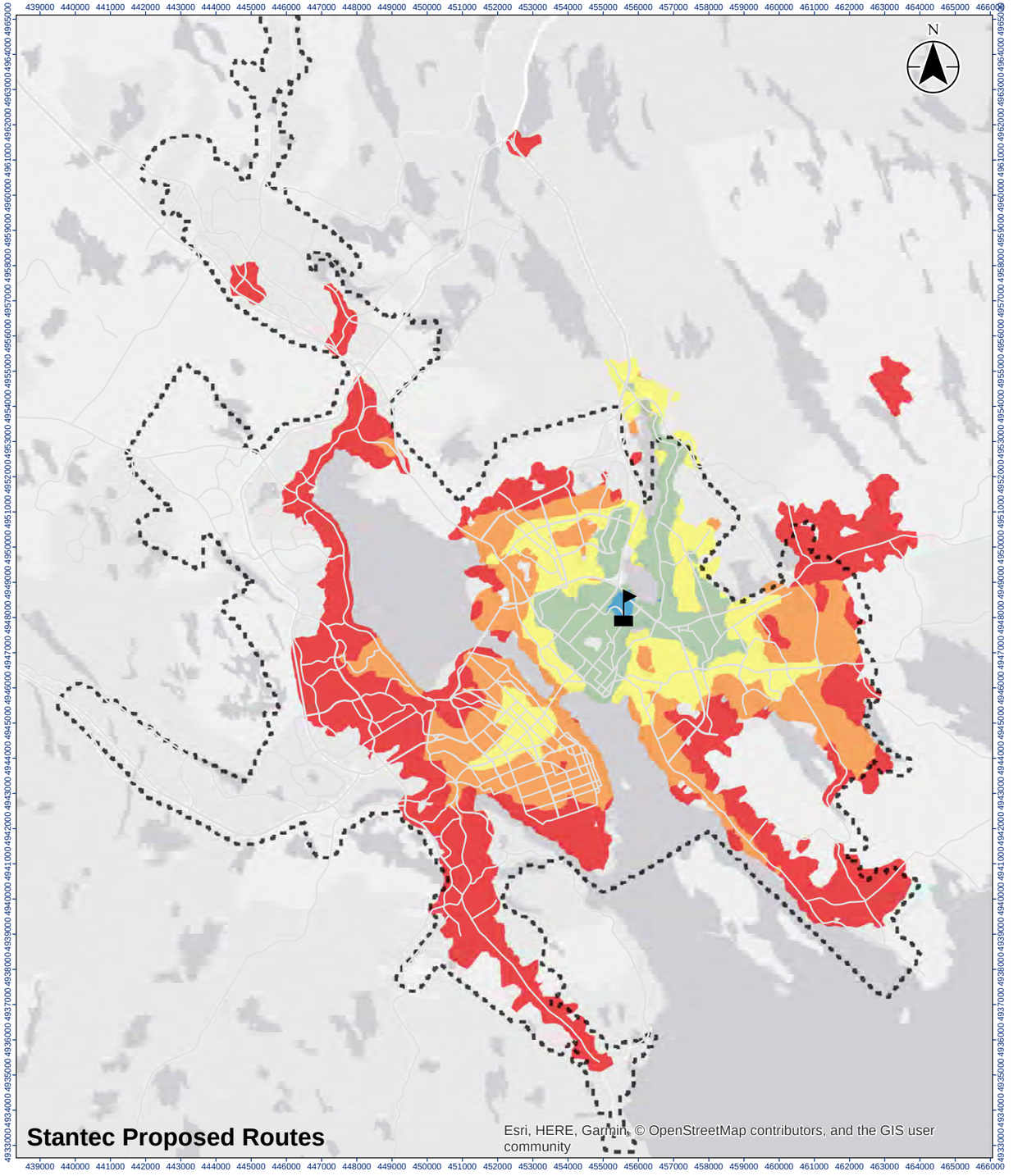
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Legend

Name

Mic Mac Mall

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

43

Figure No.

Origin: Mic Mac Mall| Time Period: Weekday AM Peak (8:30:00 - 9:30:00)

Title

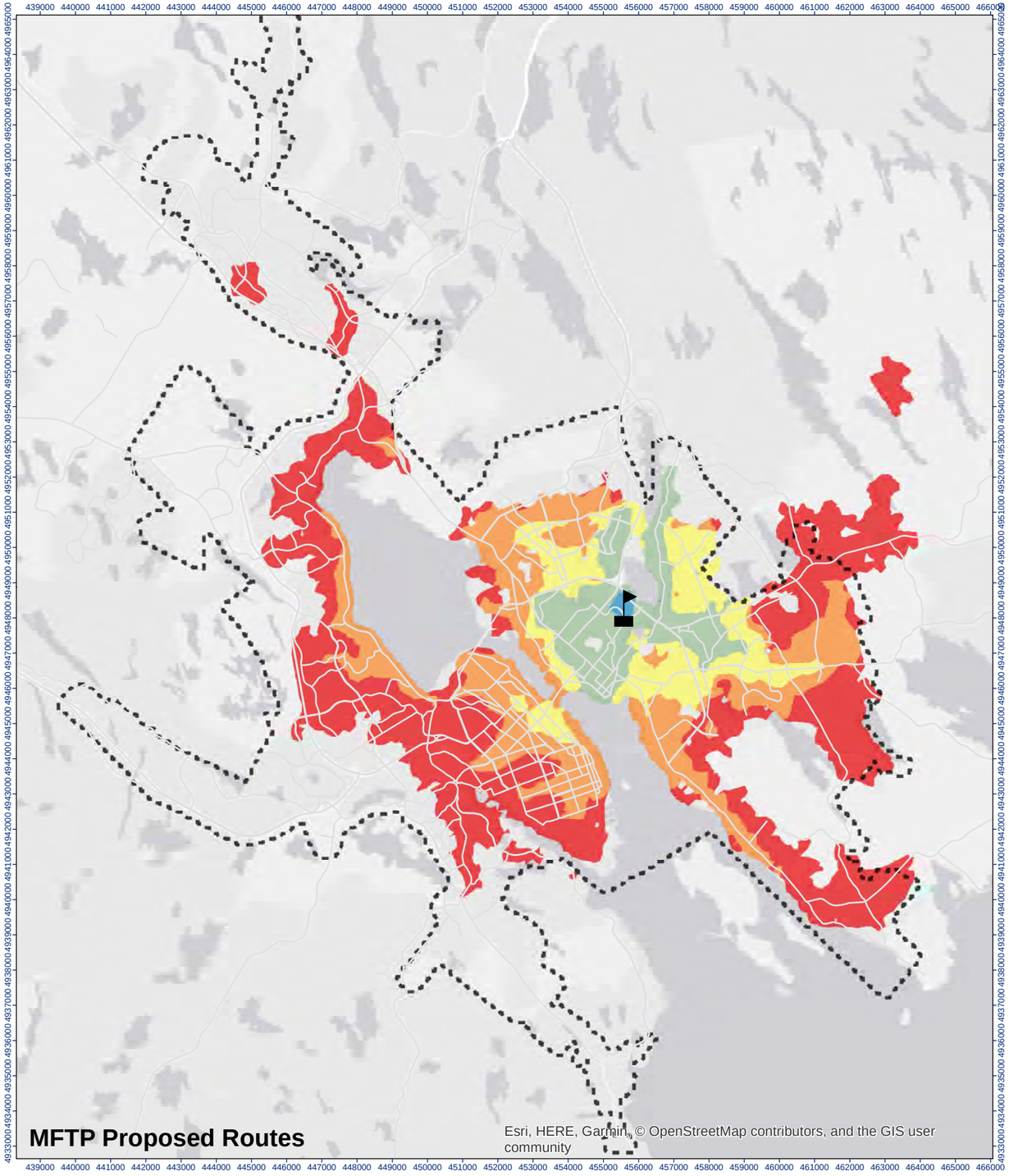
Notes

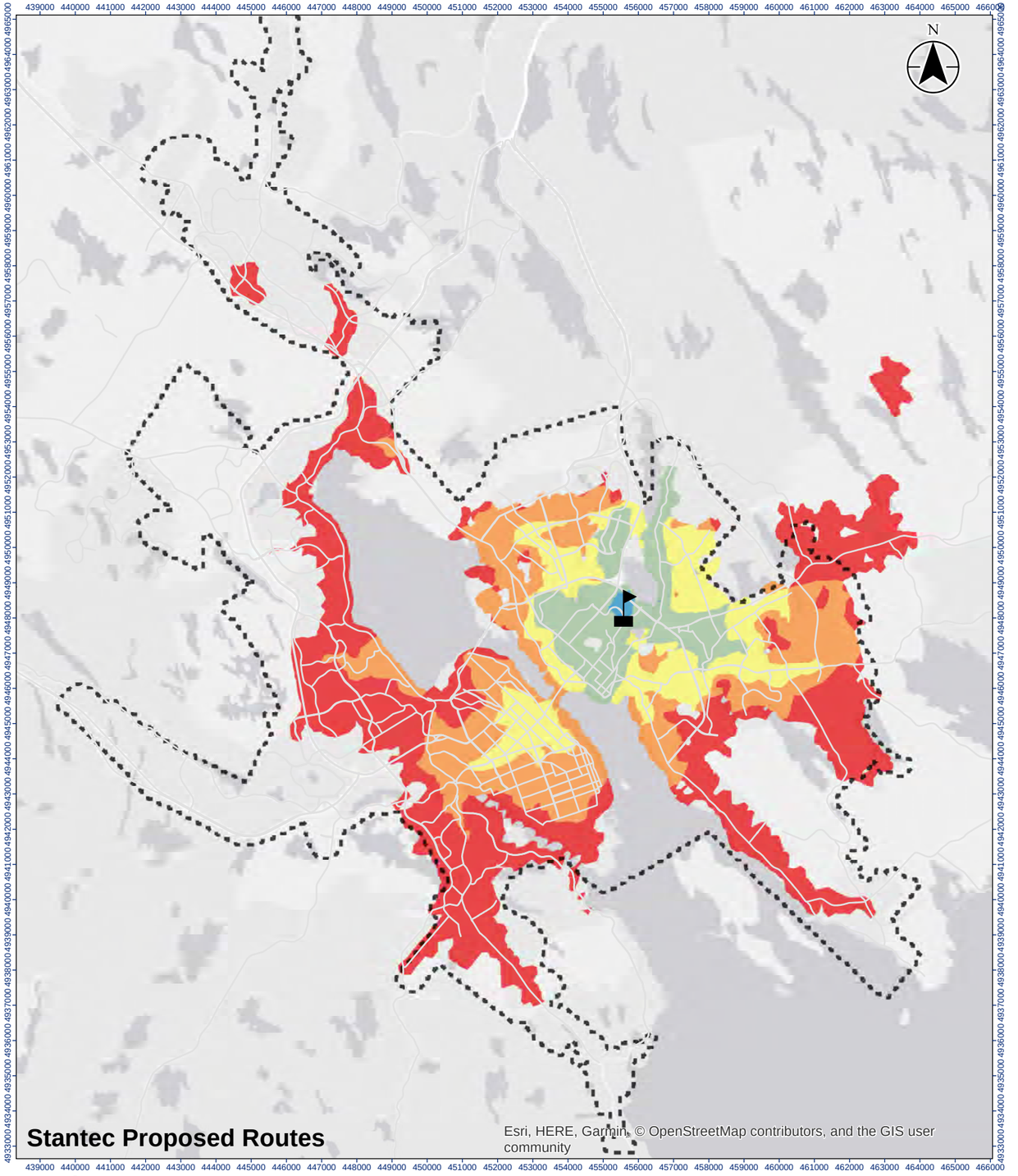
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Legend

Name

Mic Mac Mall

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

44

Figure No.

Origin: Mic Mac Mall | Time Period: Weekday Midday (12:30:00 - 13:30:00)

Title

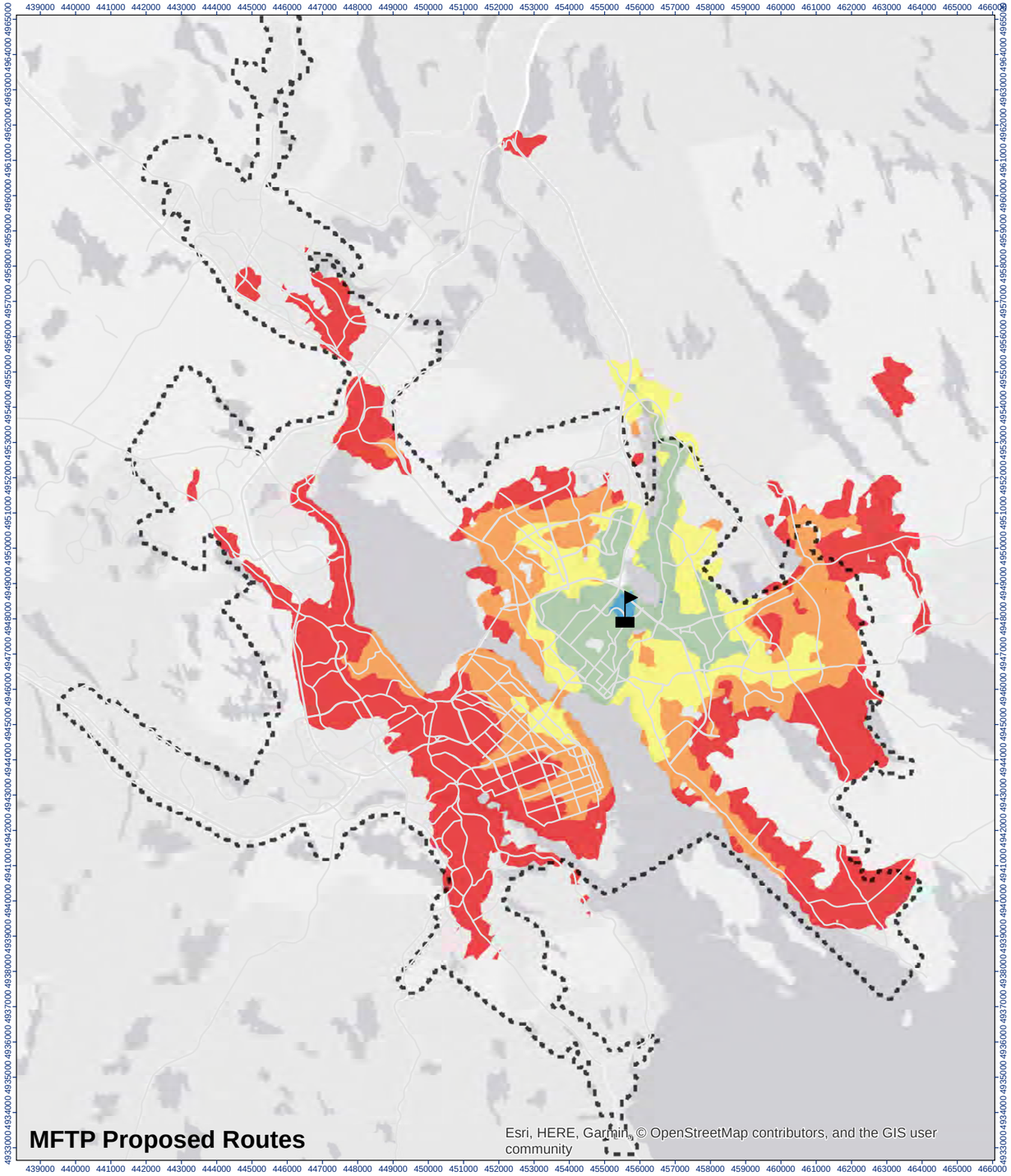
Notes

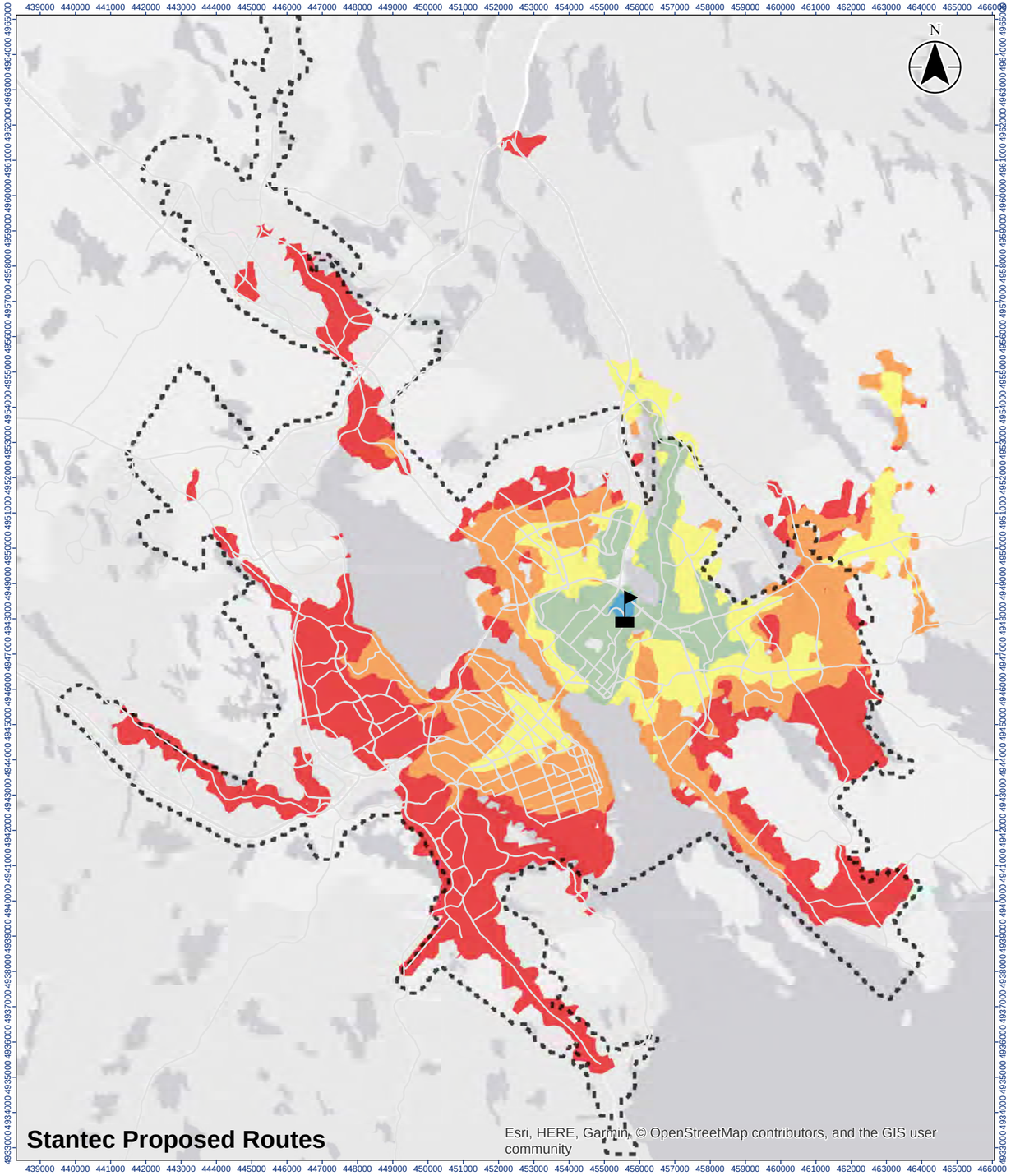
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Legend

Name

Mic Mac Mall

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

45

Figure No.

Origin: Mic Mac Mall| Time Period: Weekday PM Peak (17:00:00 - 18:00:00)

Title

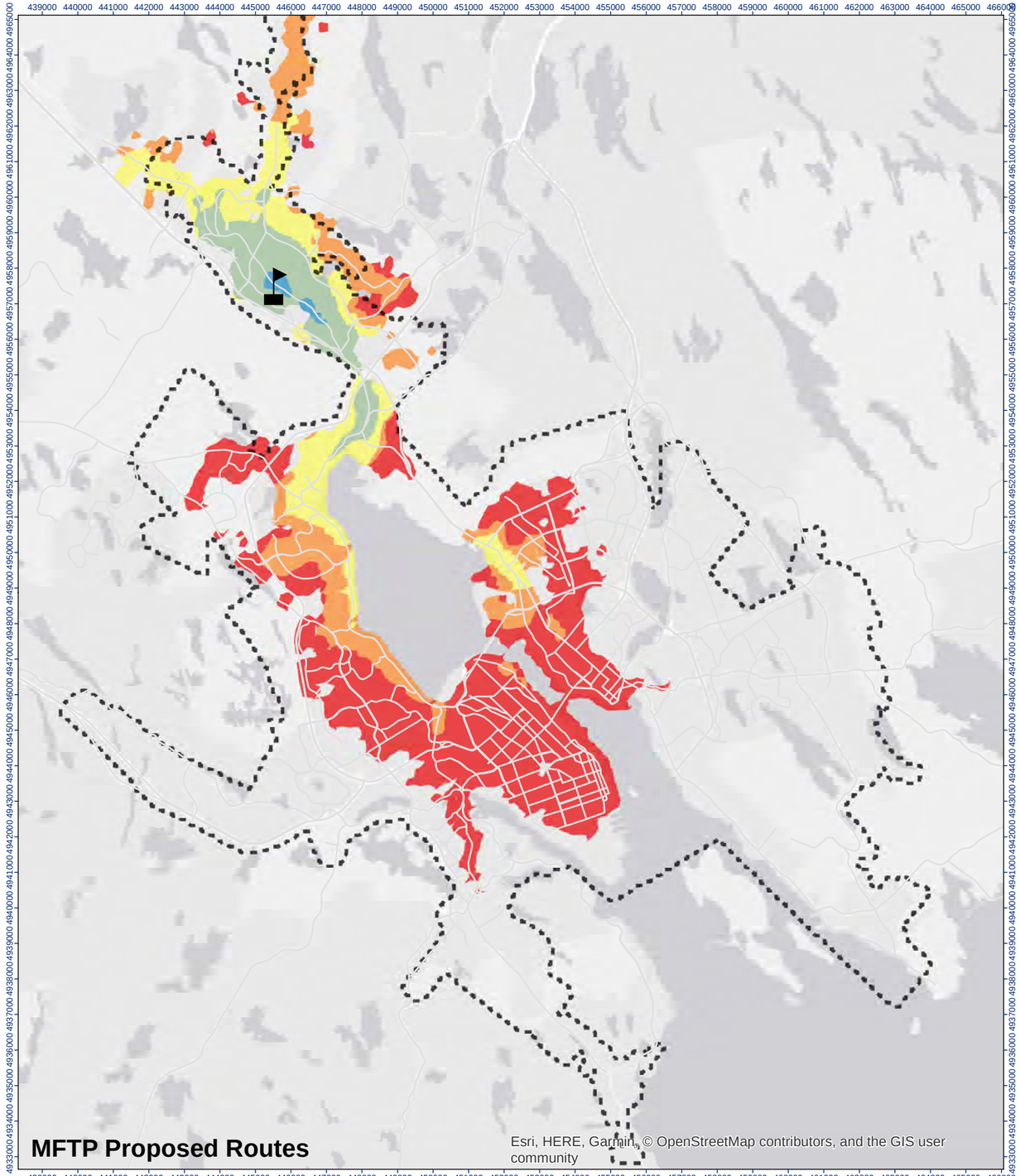
Notes

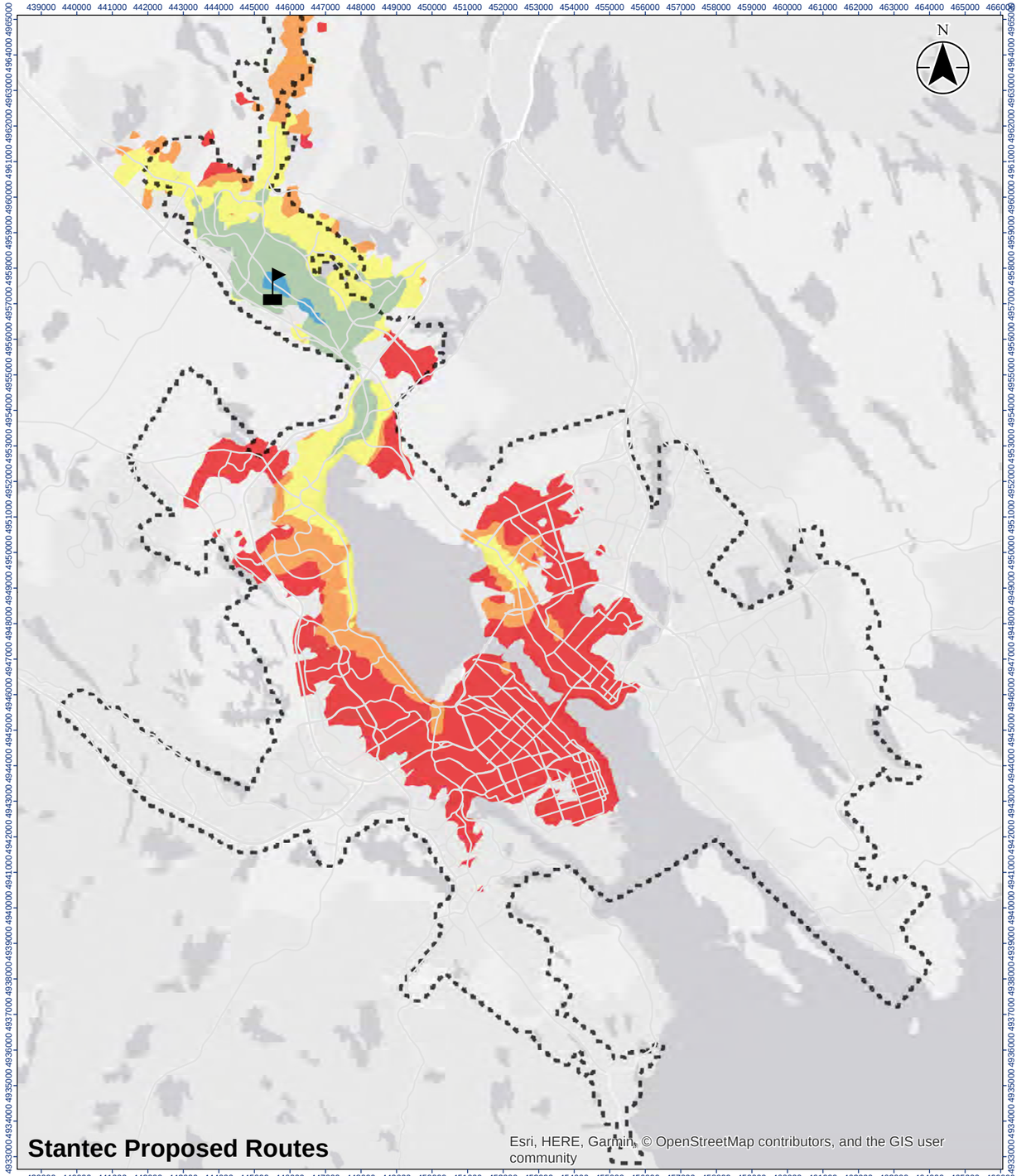
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

46

Figure No.

Origin: Sackville Public Library | Time Period: Weekday AM Peak (8:30:00 - 9:30:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Sackville Public Library

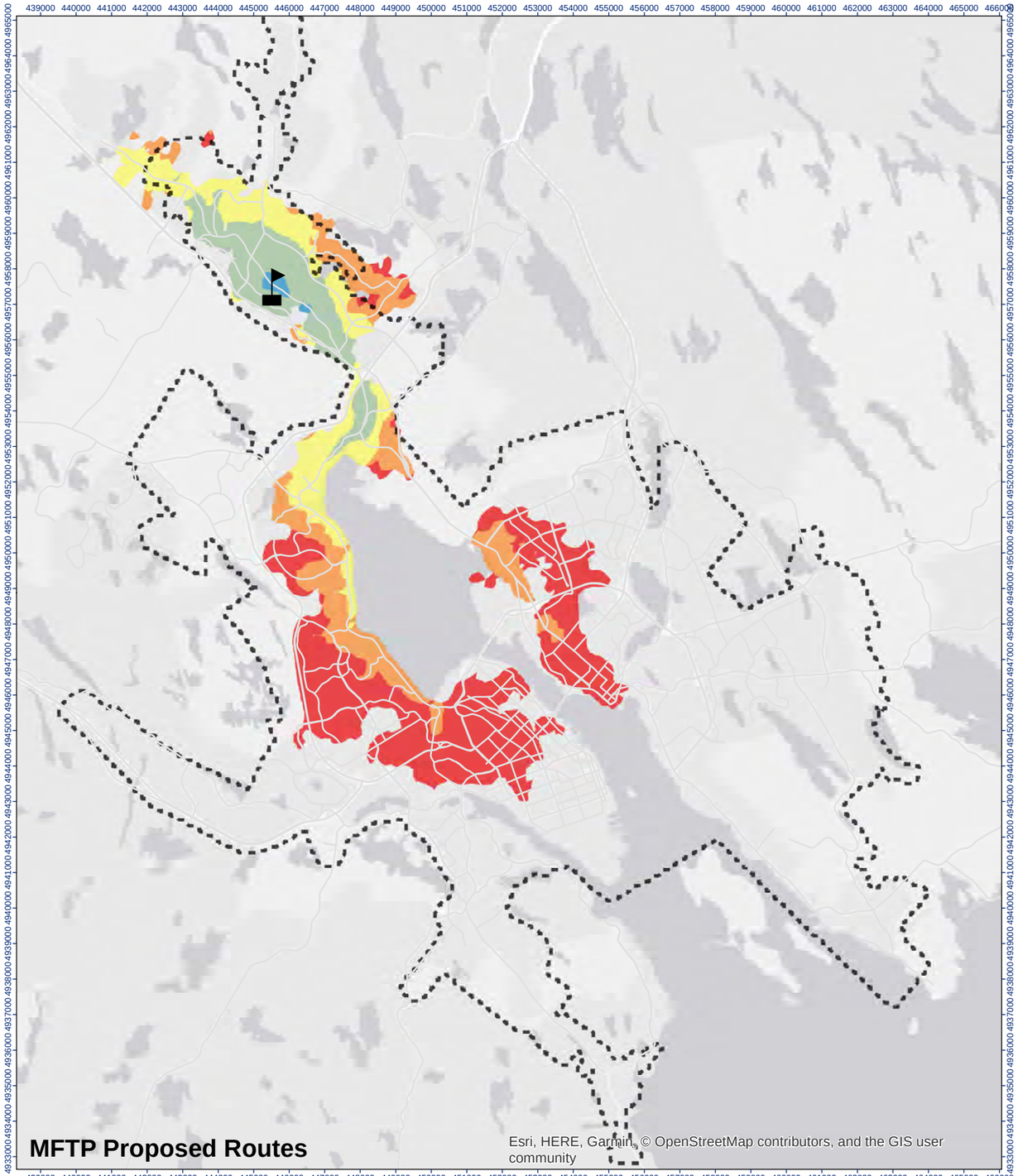
Urban Transit Service Boundary

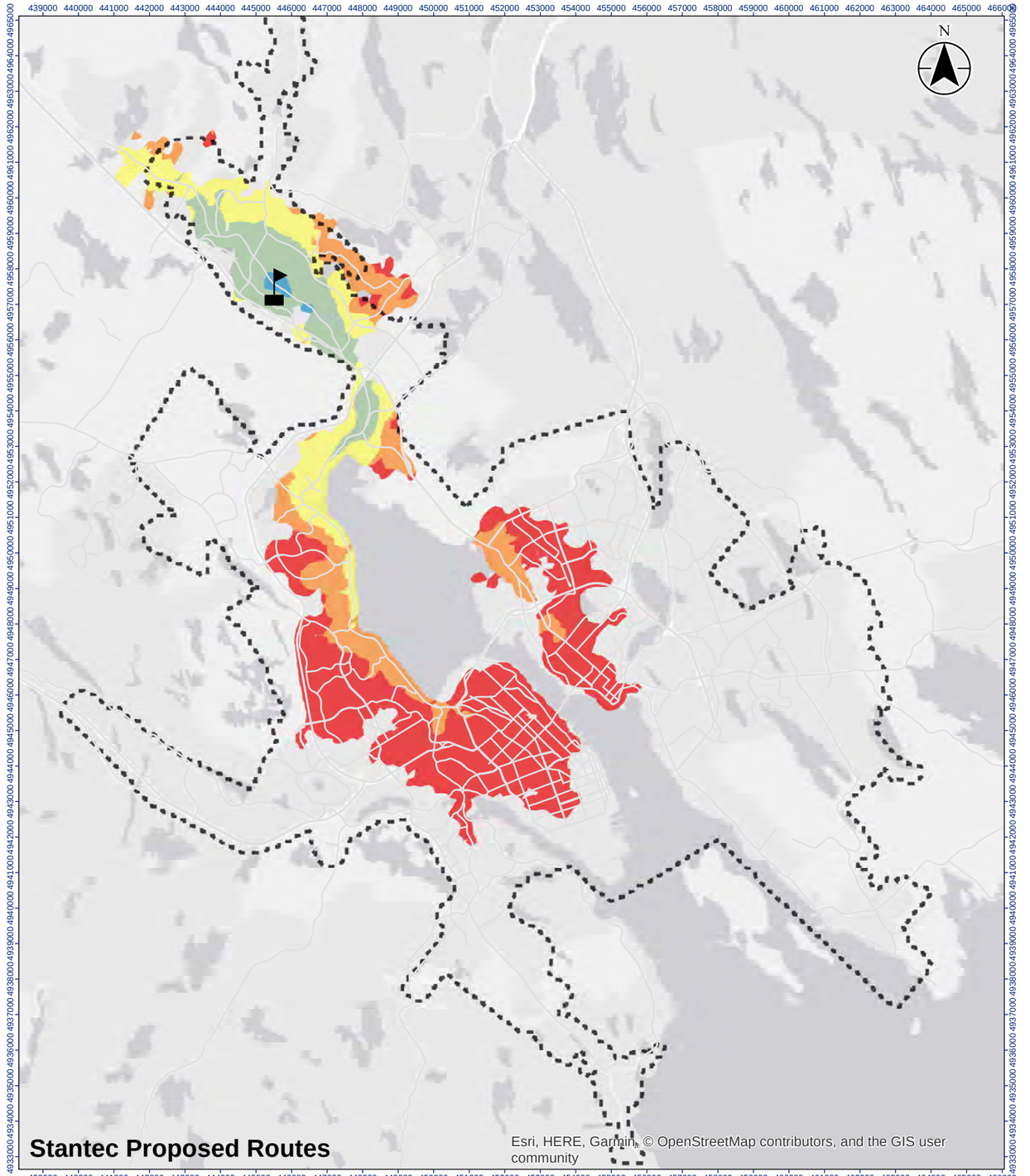
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Legend

Name

- Sackville Public Library
- Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

47

Figure No.

Origin: Sackville Public Library | Time Period: Weekday Midday (12:30:00 - 13:30:00)

Title

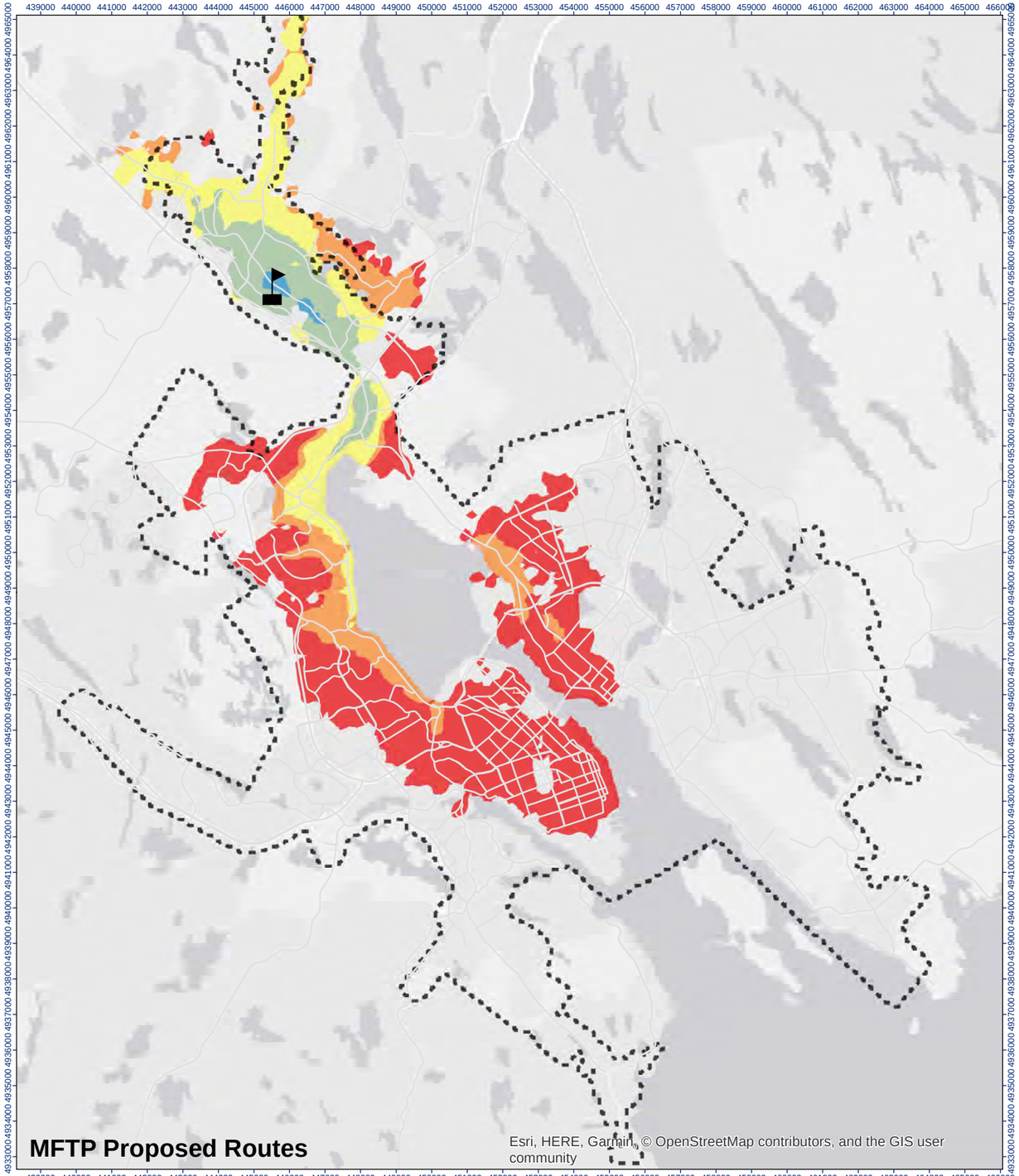
Notes

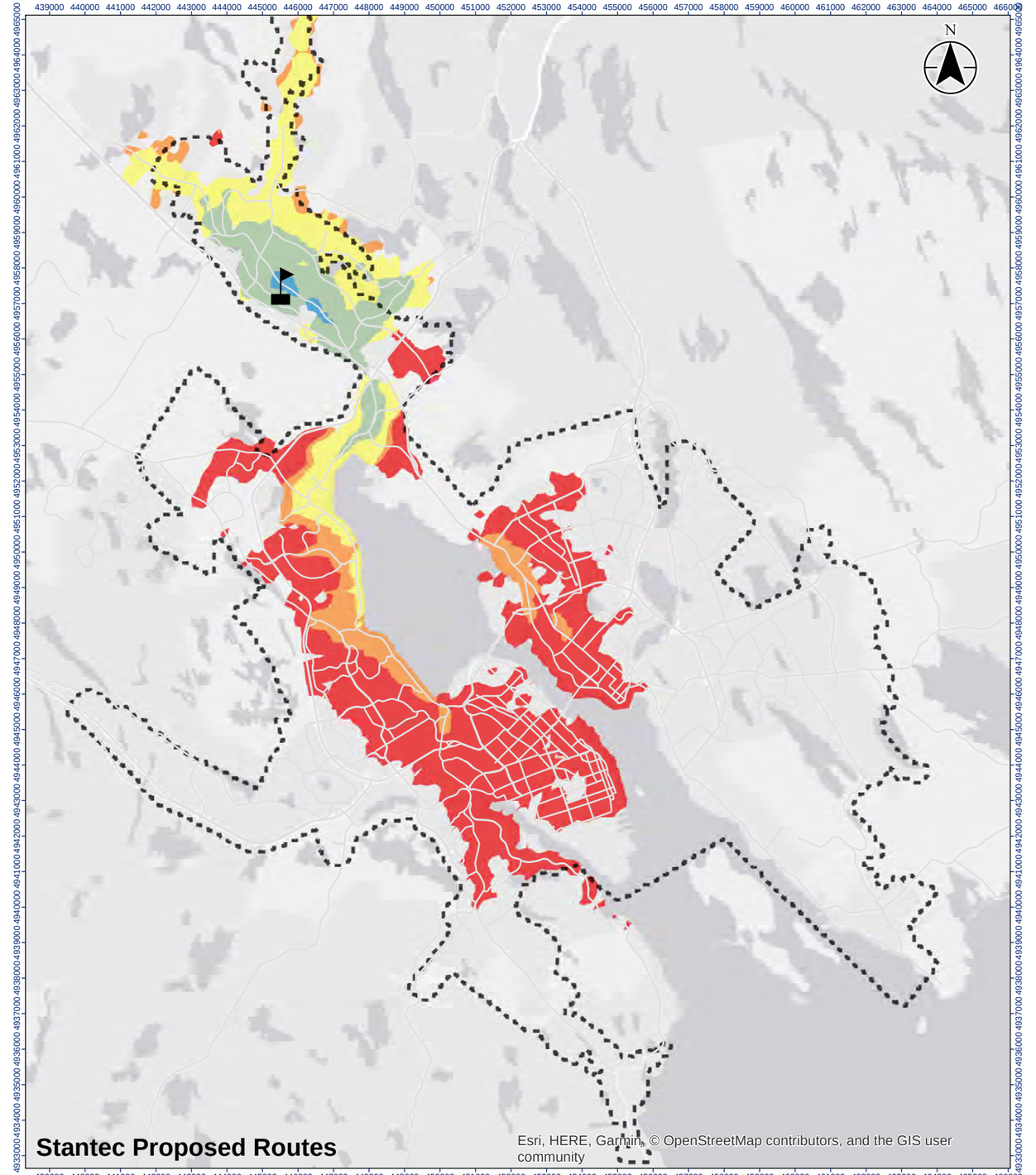
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Legend

Name

Sackville Public Library

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

48

Figure No.

Origin: Sackville Public Library | Time Period: Weekday PM Peak (17:00:00 - 18:00:00)

Title

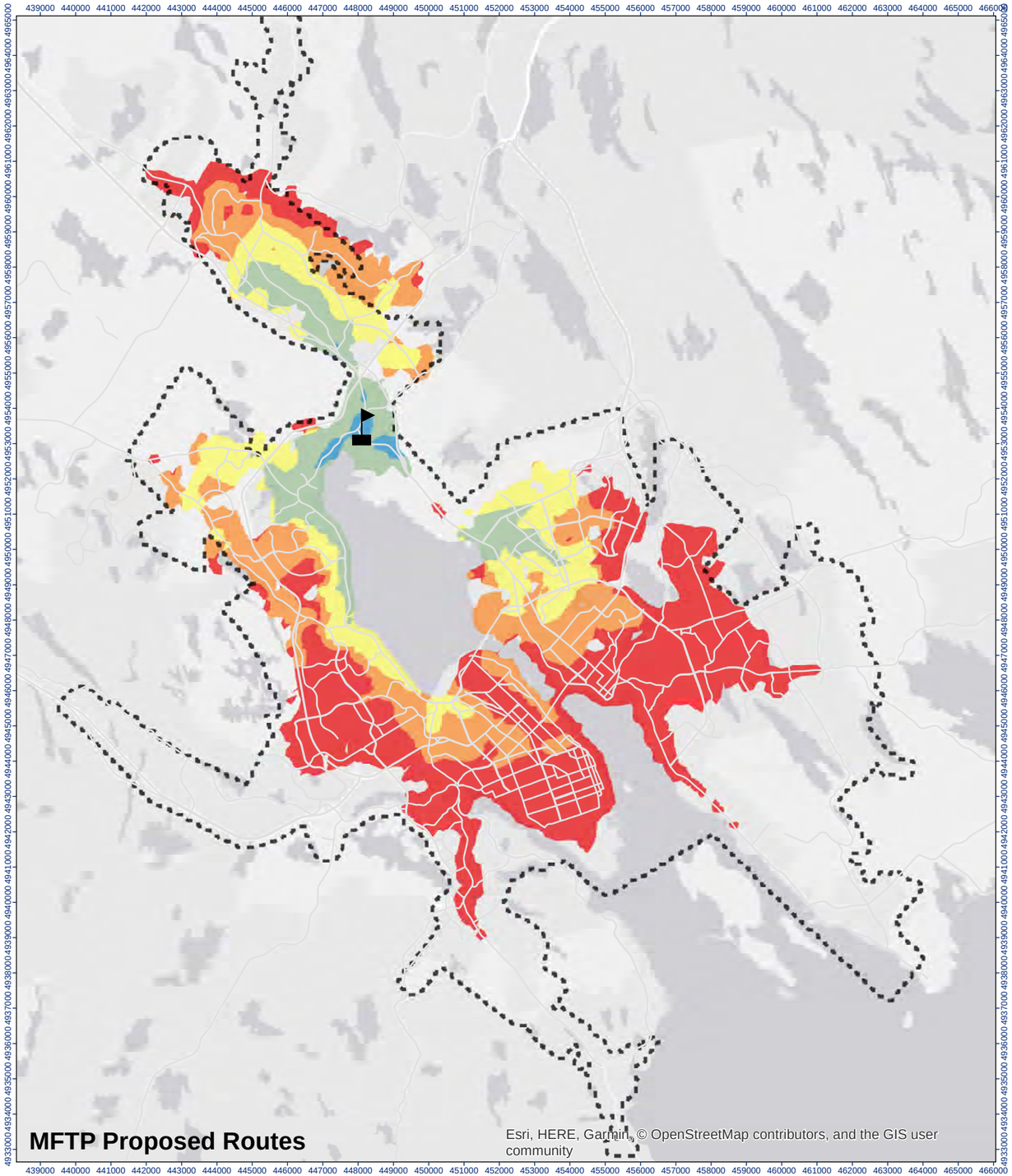
Notes

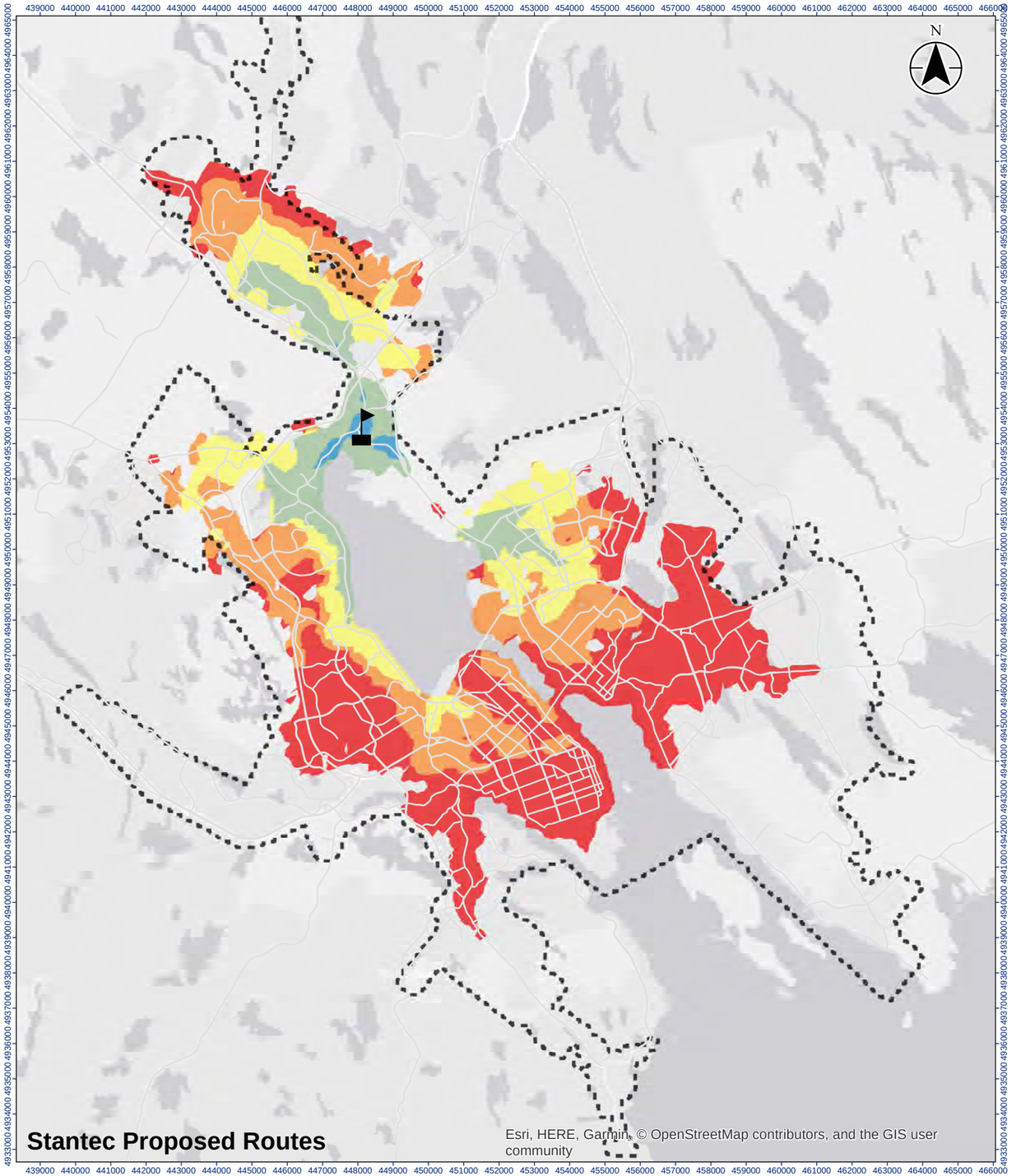
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Legend

Name

- Sunnyside Mall
- Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

49

Figure No.

Origin: Sunnyside Mall | Time Period: Weekday AM Peak (8:00:00 - 9:00:00)

Title

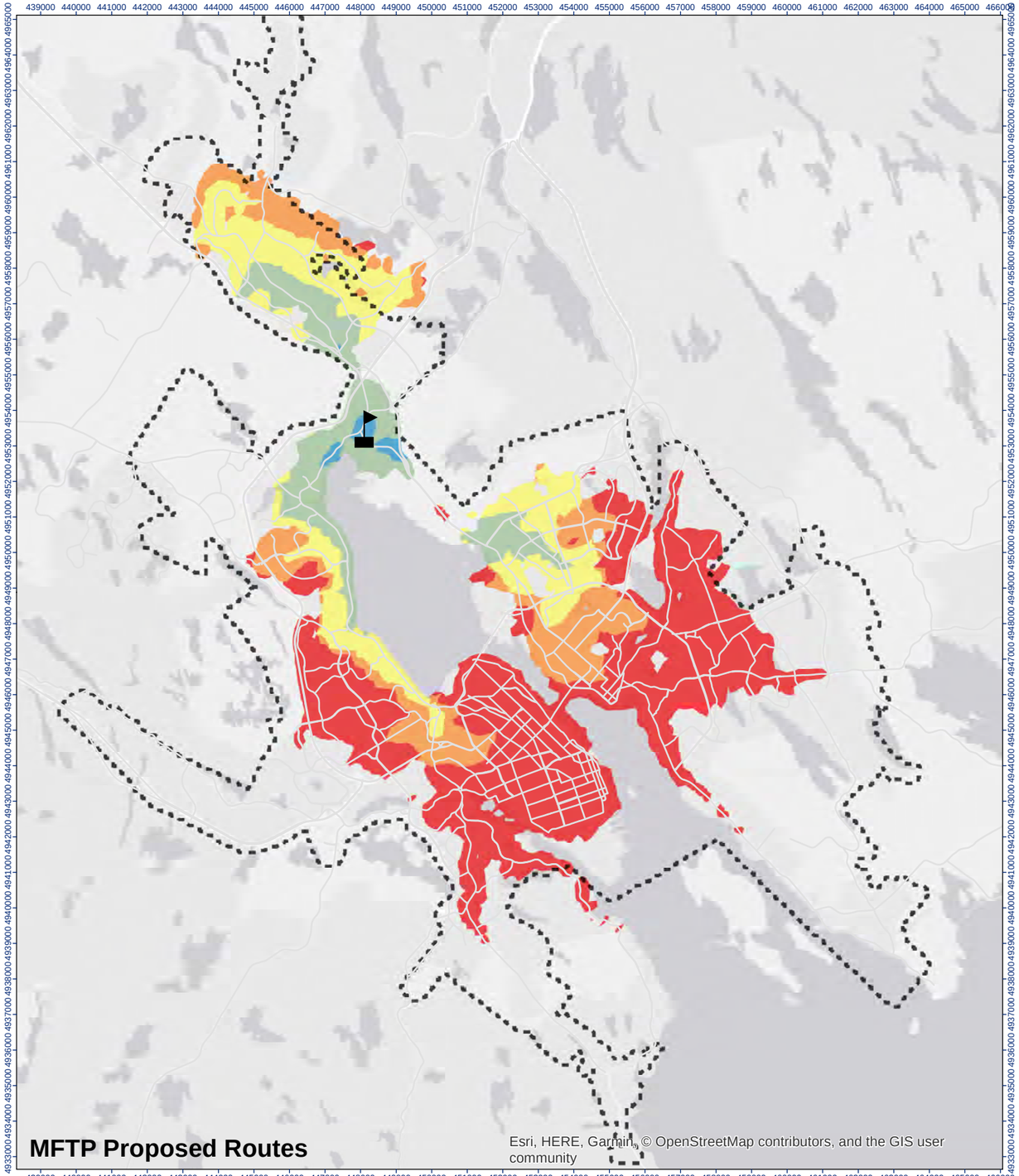
Notes

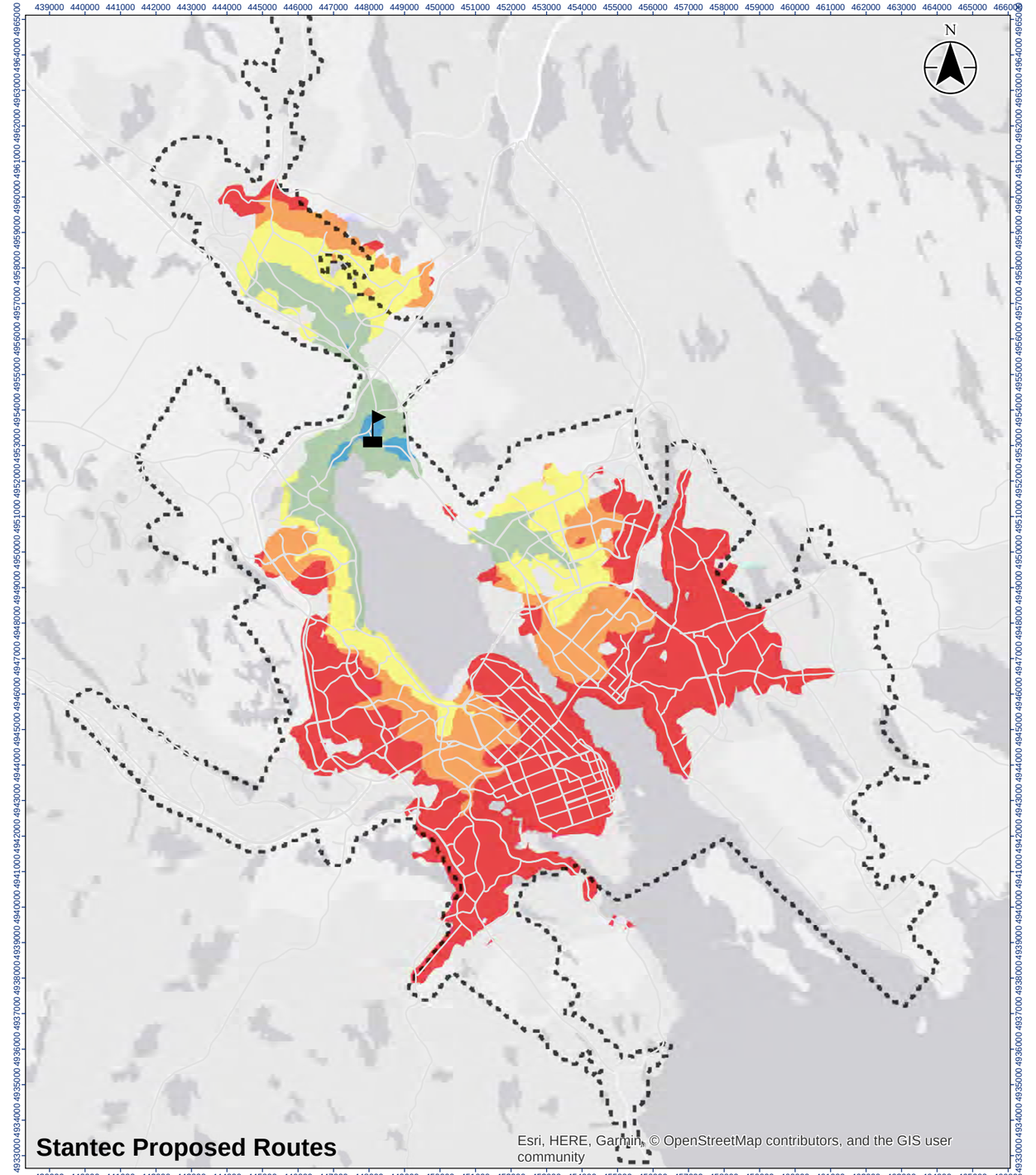
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

50

Figure No.

Origin: Sunnyside Mall | Time Period: Weekday Midday (12:30:00 - 13:30:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Sunnyside Mall

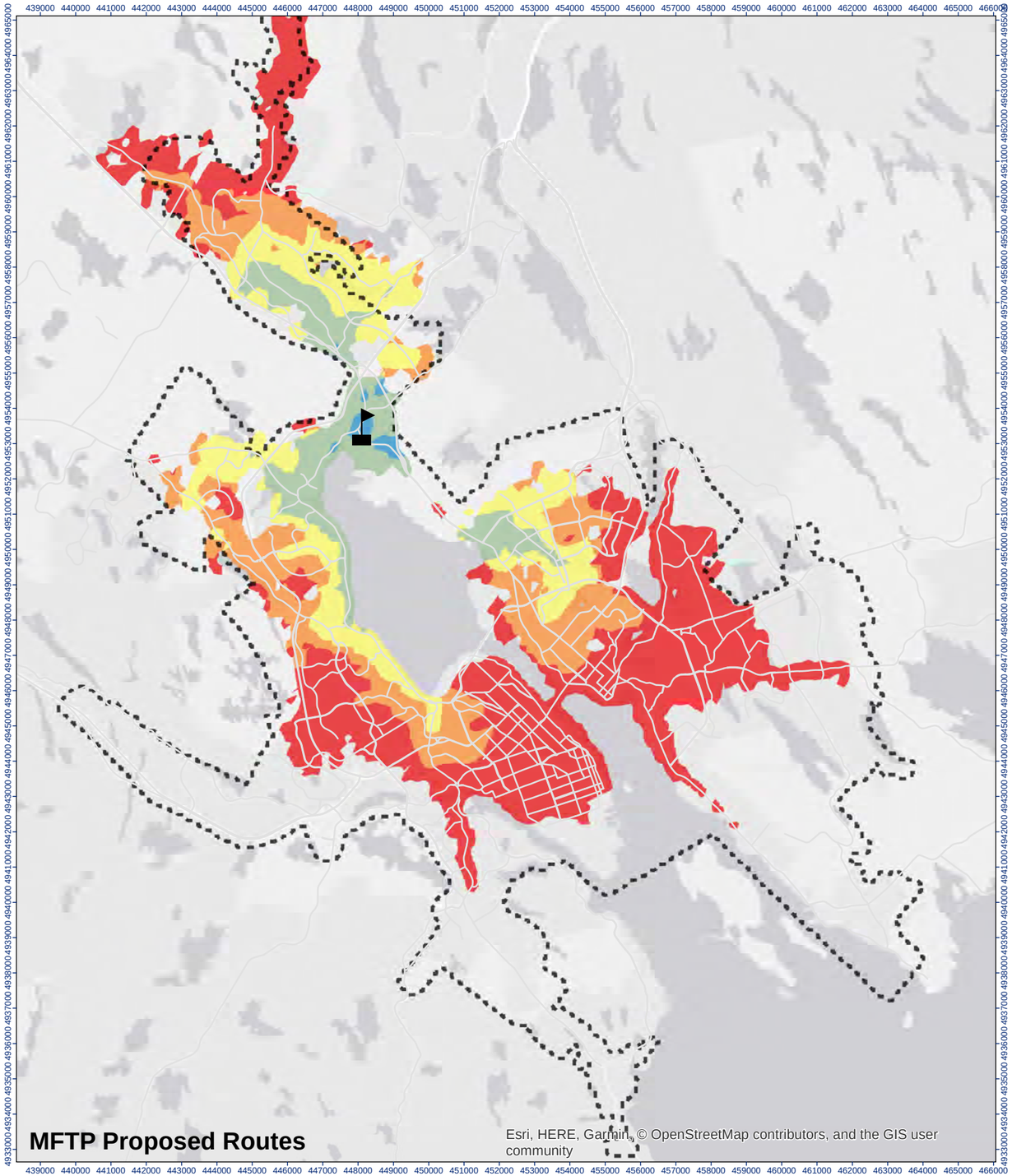
Urban Transit Service Boundary

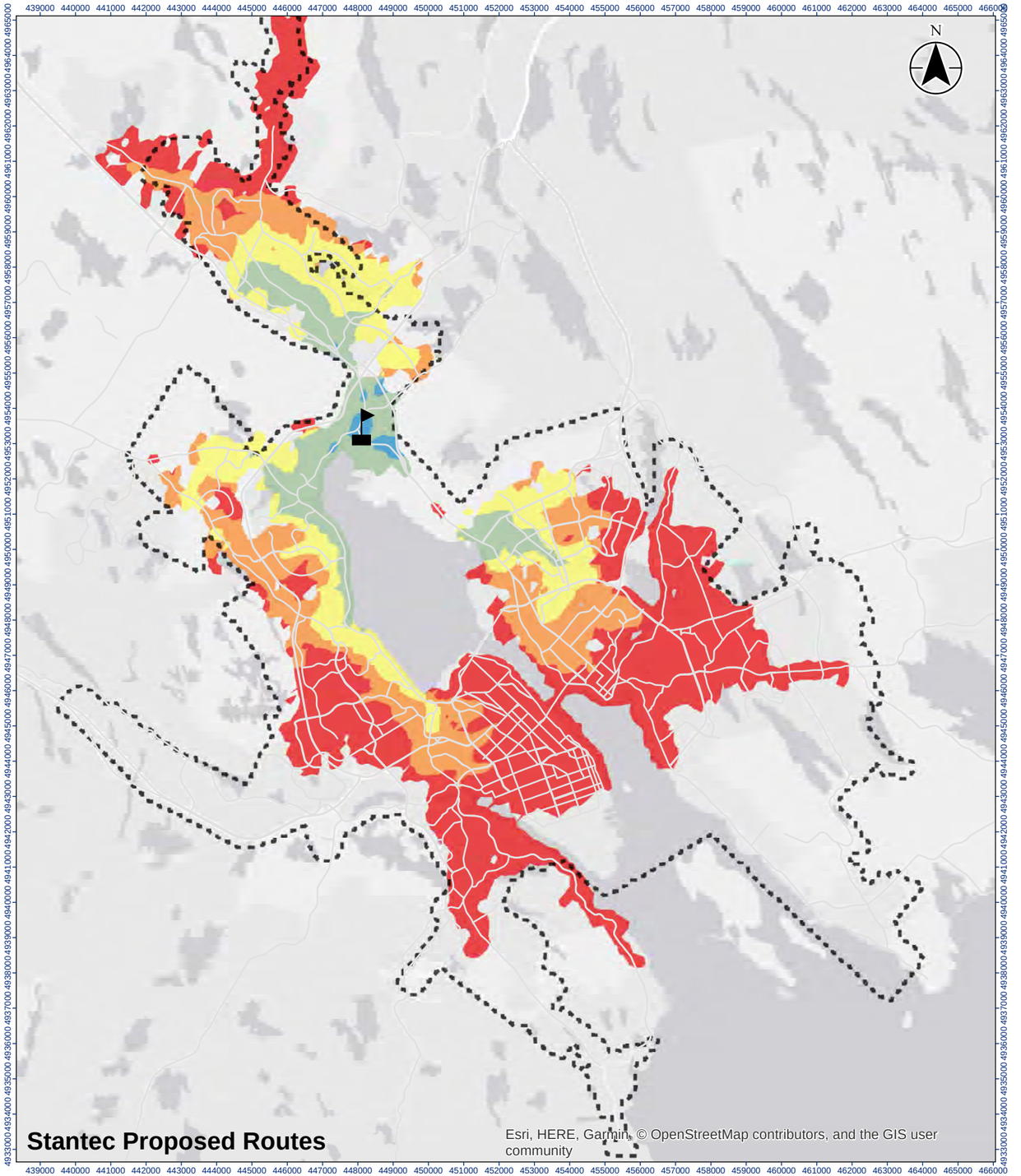
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Legend

Name

Sunnyside Mall

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

51

Figure No.

Origin: Sunnyside Mall | Time Period: Weekday PM Peak (17:00:00 - 18:00:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT

Stantec

Memo

To:	Erin Blay; David Espeseth Halifax Transit	From:	Aaron Baxter Toronto (Wellington St) ON Office
File:	Detailed Evaluation of Isochronal Mapping Methodology	Date:	May 24, 2019

Reference: 160520005

Dear Erin and David,

This memo is intended to provide a thorough analysis and discussion of the methodology used to develop the isochrone mapping, with the end goal of providing a sound justification for pursuing this methodology over other available alternatives. This memo is an outcome of the conversation we had over the phone on Wednesday, May 22nd with Brian Putre, where we discussed the methodology and agreed that we would provide this addition supporting documentation.

METHODOLOGY

To prepare the isochrone mapping for this assignment, we utilized the Open Trip Planner tool for generating the geometries. The Open Trip Planner tool relies on standardized GTFS feeds for generating the isochrone geometries, so naturally we had to create one for each of the new networks: MFTP Corridor Routes and Stantec Proposed Corridor Routes.

For each of the GTFS feeds created, we wanted to be as consistent as possible in the assumptions and techniques we used to generate them; this under the premise that a greater degree of consistency between the preparation of the feeds would lead to a more confident result when comparing the isochrone mapping outcomes.

With this in mind, we created the GTFS feeds according to the following steps:

1. Using historic Automatic Vehicle Location (AVL) data supplied from Halifax Transit, we calculated the average travel time between each route segment (i.e. stop to stop connection).

2. For each of the MFTP Corridor Routes and Stantec Proposed Corridor Routes, we selected the series of stops which would likely be used on each route for both Inbound and Outbound directions.

3. For route segments on each of the two corridor route networks that had not previously been travelled by an existing Halifax Transit bus route – and thus would not have a travel time calculate from historic AVL measurements – we prepared an estimate based on the travel distance between these two stops from an average cruising speed calculated from the AVL data.

4. With an estimate of travel time for each route segment for each corridor route, we assigned an average headway for each. To remain as similar as possible between the two networks -and knowing that the Stantec proposal improved headway on many routes during the weekday operations- we elected to take a conservative estimate by using identical headways for each route. Thus, the headways used for each route are those listed in the main Report on Table 11 in section 4.3

5. Using the headways established in Step 4, and the travel time estimates finalized in Step 3, we prepared GTFS feed information for each of the MFTP and Stantec Proposed Corridor Routes.

6. To finalize the GTFS feeds, we overlayed the GTFS feed information created in Step 5 for each of the networks to the existing Halifax Transit GTFS feeds. We used these overlayed feeds as the basis for the isochrone mapping assignment.

SOURCES OF UNCERTAINTY

This methodology certainly has a number of sources of uncertainty that are important to understand when reading the results. The most accurate travel time comparison from isochrone mapping between the two networks would have to rely on robust operational GTFS feeds, meaning transit schedules that have been refined and tuned for interactions between routes (ex. Transfer optimizations) and travel time variations across the day (ex. Peak hour vs midday travel). As the scope for this assignment was to provide general recommendations on the corridor routes themselves, we were not able to fully flesh out the associated impacts to local route alignments and schedules which might feed into or be replaced by these new corridor routes.

Why not model the proposed changes to the local routes in the MFTP?

Although the changes to the local network for the MFTP Corridor Routes had already been prepared by Halifax Transit, Stantec was not able to perform the same level of rigorous route evaluation at the local level under the scope of this assignment. As we did not have comparable route modifications at the local level for both networks, comparing the Stantec proposed network without these modifications to the MFTP network with these modifications would not have given an accurate basis for comparison; weighting in favour to the MFTP network as transfer and travel time had been coordinated between the local and the corridor routes.

Why overlay the route networks on the existing feed, instead of removing the existing routes the new corridor routes would replace?

As modifications to the local route network were not part of the scope for this assignment, it was unclear which of the local routes would be replaced and/or modified under the Stantec Proposed Corridor Routes. Although the route replacements and modifications were detailed for the MFTP network, the variance in alignments between the MFTP and Stantec Proposed Corridor Networks were significant enough such that removing or modifying the GTFS feeds identically for each network could have left gaps or other network inefficiencies in the Stantec Proposed Network.

What's the impact of simply overlaying the new corridor routes on the existing GTFS feed?

Since we did not remove any of the existing routes or modify any of the headway or departure times for the existing network, the real effect is that the prospective rider on these hypothetical networks would have a lower wait time for initial boarding and a greater opportunity for transferring between routes. The result for the isochrone mapping is that the effective service area – or area reached within a certain amount of travel time – would be larger than would actually be the case in reality. With this in mind, the largest bias might be towards routes or trajectories that involve transfers, since effective headway is lowered the transfer time would also be lower. Nonetheless, this relatively optimistic view of travel time would be shared between both networks, which we believe still makes the comparison between both networks using isochrone mapping an effective tool.

Reference: **160520005**

How should we read the results of the isochrone mapping?

As the effective travel time under this scenario is optimistic, the isochrone mapping service area boundaries should be taken generally with the understanding that there is variance and sources of error. The mapping is intended to illustrate general differences between the networks; at a "birds eye view" level. If the reader keeps in mind that the discrete travel time bounds could vary under real world conditions, then the real conclusions that can be drawn from these maps are around the tradeoffs between accessibility across the HRM. For example, the MFTP network offers direct connection from Lacewood Terminal to Mumford Terminal, whereas the Stantec Proposed offers direct connection from Mumford Terminal to Bridge Terminal. The isochrone mapping allows the reader to get a sense of how the whole sum of corridor routes operate together for each network, though it is limited in terms of accurately defining real world travel times. To prepare a model and analysis that would most closely emulate real-world conditions, substantial additional effort would be required.

Nonetheless, this methodology is repeatable and should more detailed GTFS feeds be prepared for any future hypothetical implementations of any corridor routes, the travel time comparisons between the existing and proposed conditions could be more accurately defined.

Aaron Baxter

MEnv, MCIP/RPP
Transit Advisory Consultant

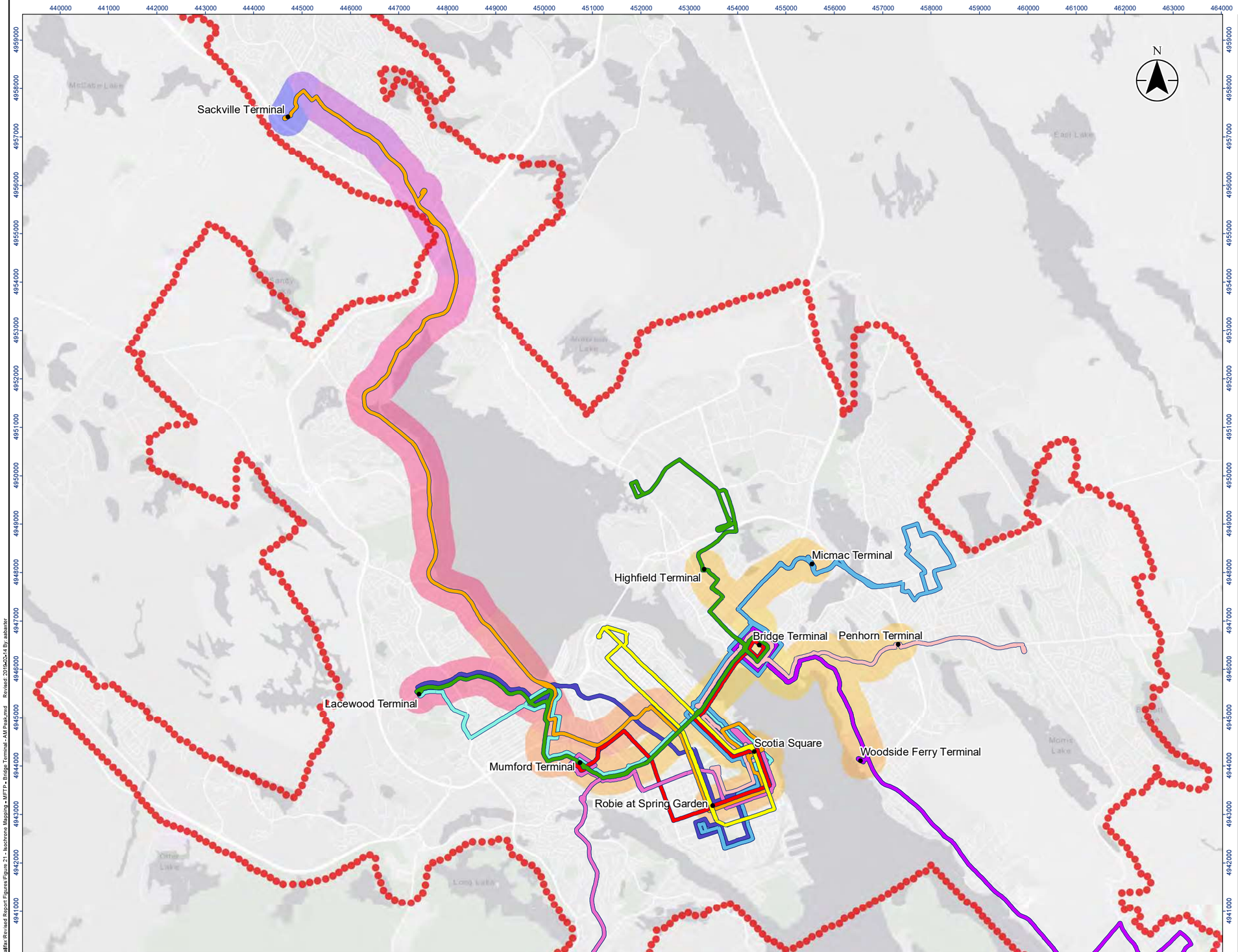
Direct: 416 507 3497
Mobile: 416 529 0426

Stantec Consulting Ltd.
100-401 Wellington Street West
Toronto ON M5V 1E7

Stantec

c. Brian Putre

Attachment D - Isochrone Mapping



Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

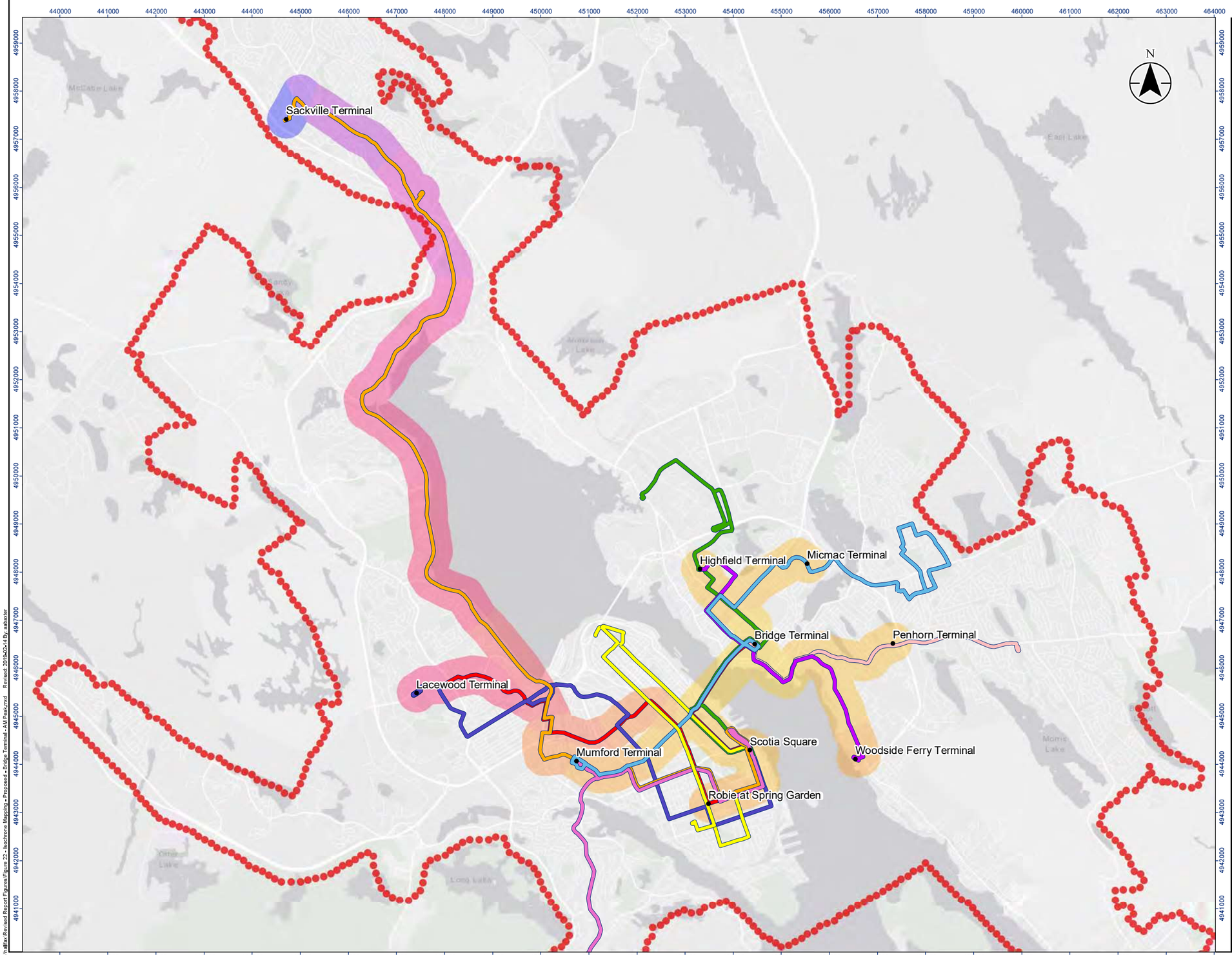
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT / MFTP CORRIDOR ROUTE REVIEW

Figure No.
21

Title
Origin: Bridge Terminal | Time Period: AM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 21 - Isochrone Mapping - MFTP - Bridge Terminal - AM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor
Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000
Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

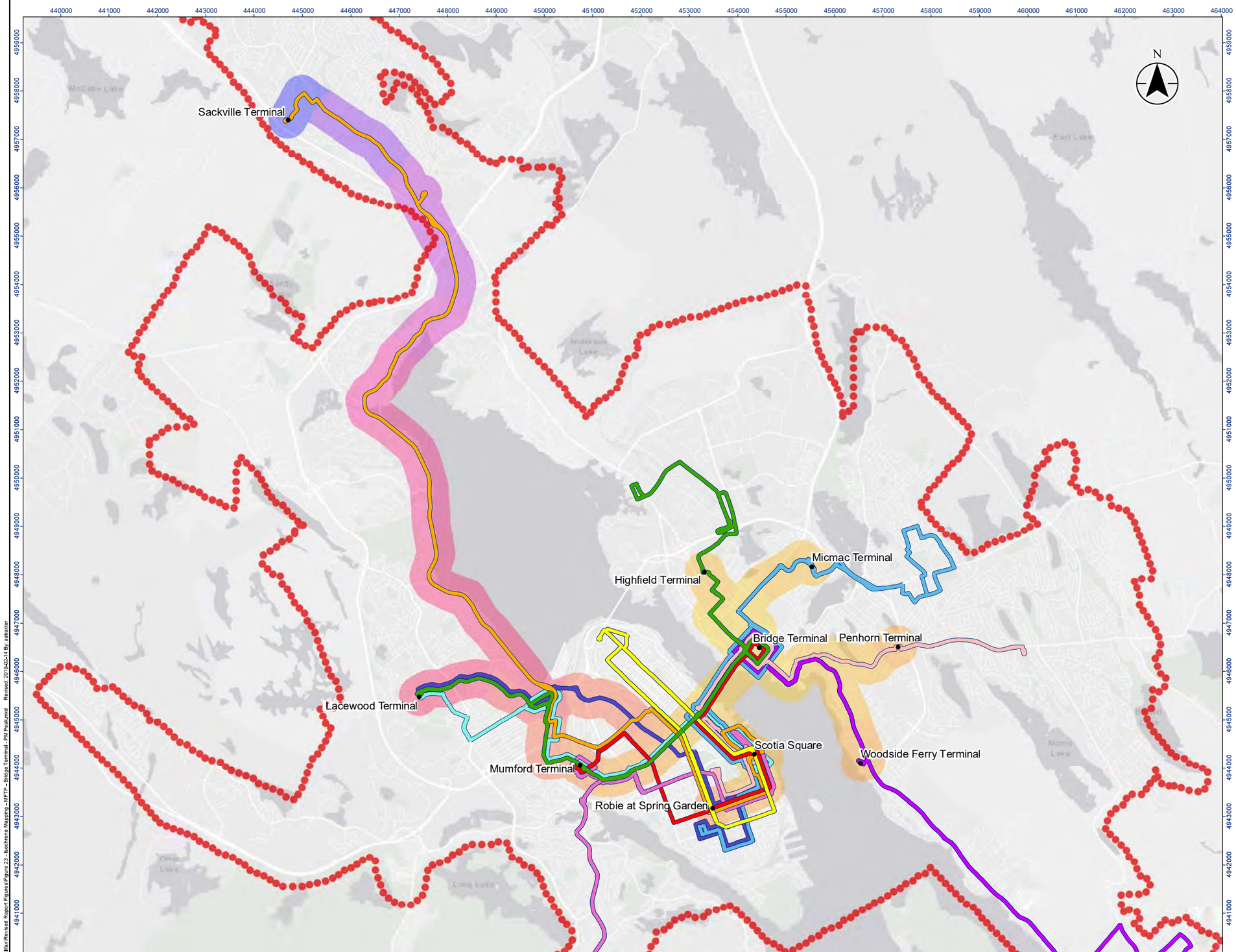
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
22

Title
Origin: Bridge Terminal | Time Period: AM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 22 - Isochrone Mapping - Proposed - Bridge Terminal - AM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT / MFTP CORRIDOR ROUTE REVIEW

Figure No.
23

Title
Origin: Bridge Terminal | Time Period: PM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 23 - Isochrone Mapping - MFTP - Bridge Terminal - PM Peak.mxd Revised: 2019-02-14 By: aabaxter

Sackville Terminal
Highfield Terminal
Micmac Terminal
Bridge Terminal
Penhorn Terminal
Lacewood Terminal
Mumford Terminal
Scotia Square
Woodside Ferry Terminal
Robie at Spring Garden

N

Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor
Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000
Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
24

Title
Origin: Bridge Terminal | Time Period: PM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 24 - Isochrone Mapping - Proposed - Bridge Terminal - PM Peak.mxd Revised: 2019-02-14 By: aabaxter

Sackville Terminal
Highfield Terminal
Micmac Terminal
Bridge Terminal
Penhorn Terminal
Lacewood Terminal
Mumford Terminal
Scotia Square
Woodside Ferry Terminal
Robie at Spring Garden

N

Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

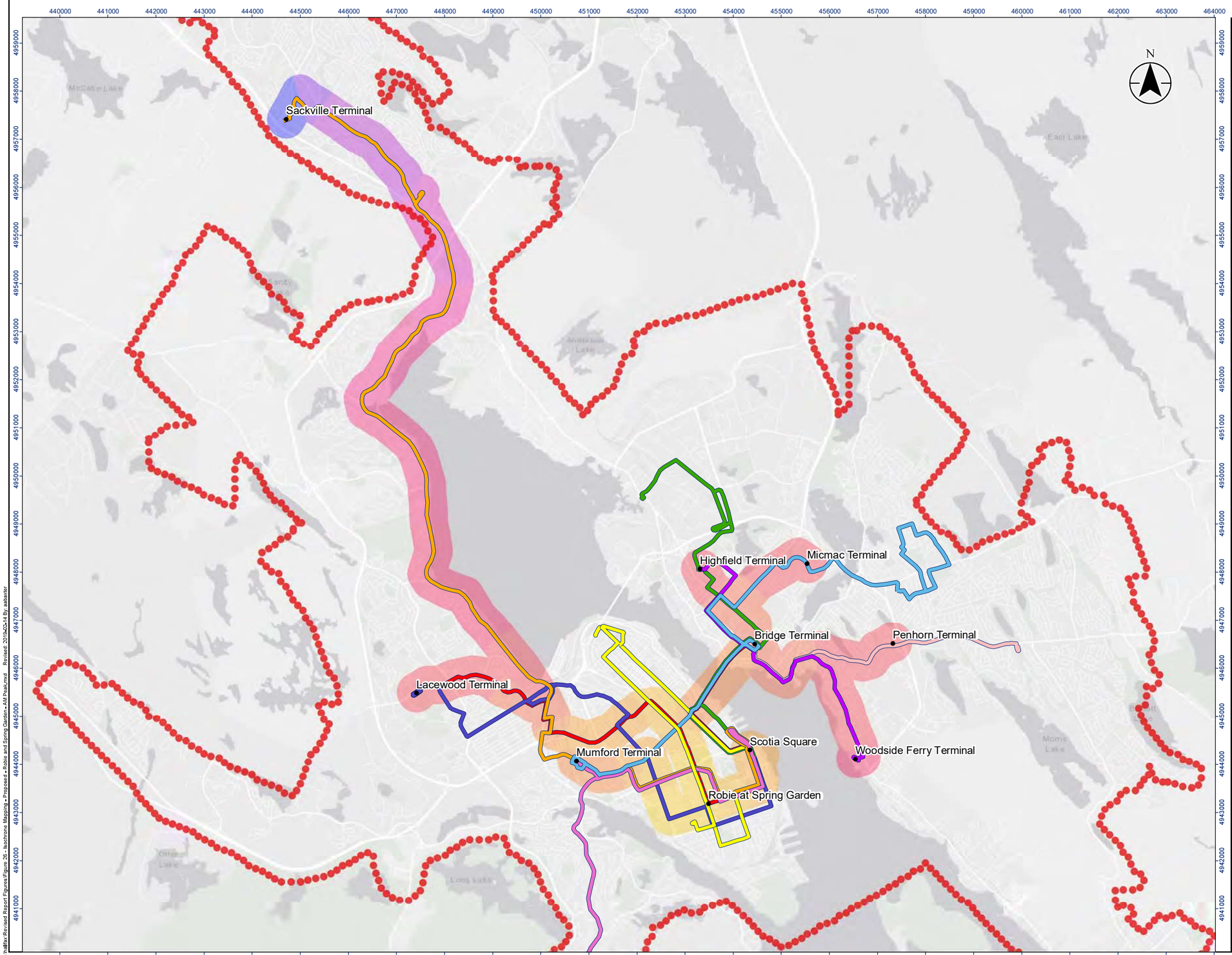
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT / MFTP CORRIDOR ROUTE REVIEW

Figure No.
25

Title
Origin: Robie and Spring Garden | Time Period: AM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 25 - Isochrone Mapping - MFTP - Robie and Spring Garden - AM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor
Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000
Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
6

Title
Origin: Robie and Spring Garden | Time Period: AM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 26 - Isochrone Mapping - Proposed - Robie and Spring Garden - AM Peak.mxd Revised: 2019-02-14 By: aabaxter

Sackville Terminal
Highfield Terminal
Micmac Terminal
Bridge Terminal
Penhorn Terminal
Lacewood Terminal
Mumford Terminal
Scotia Square
Woodside Ferry Terminal
Robie at Spring Garden

N

Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

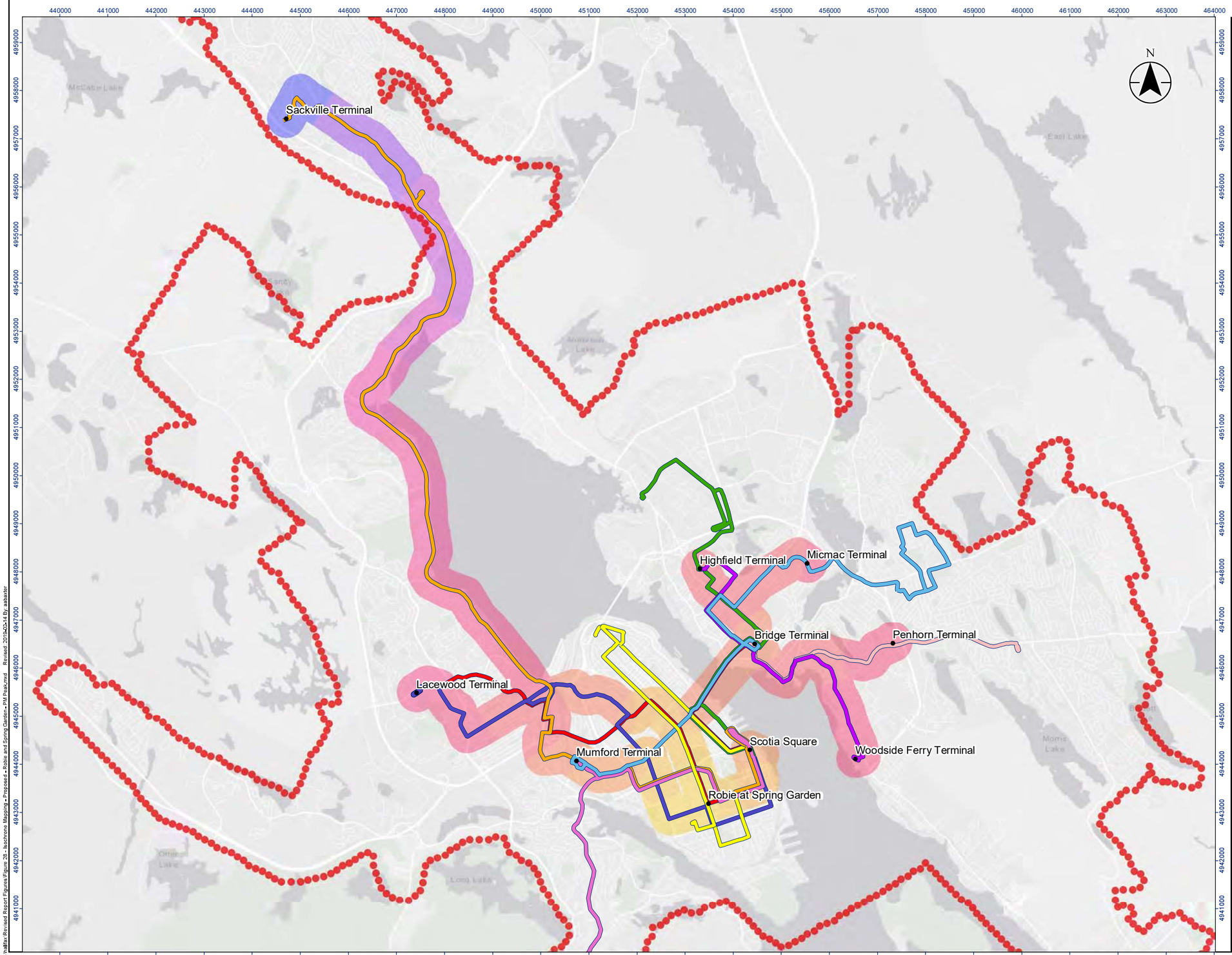
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT / MFTP CORRIDOR ROUTE REVIEW

Figure No.
27

Title
Origin: Robie and Spring Garden | Time Period: PM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 27 - Isochrone Mapping - MFTP - Robie and Spring Garden - PM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor
Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000
Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

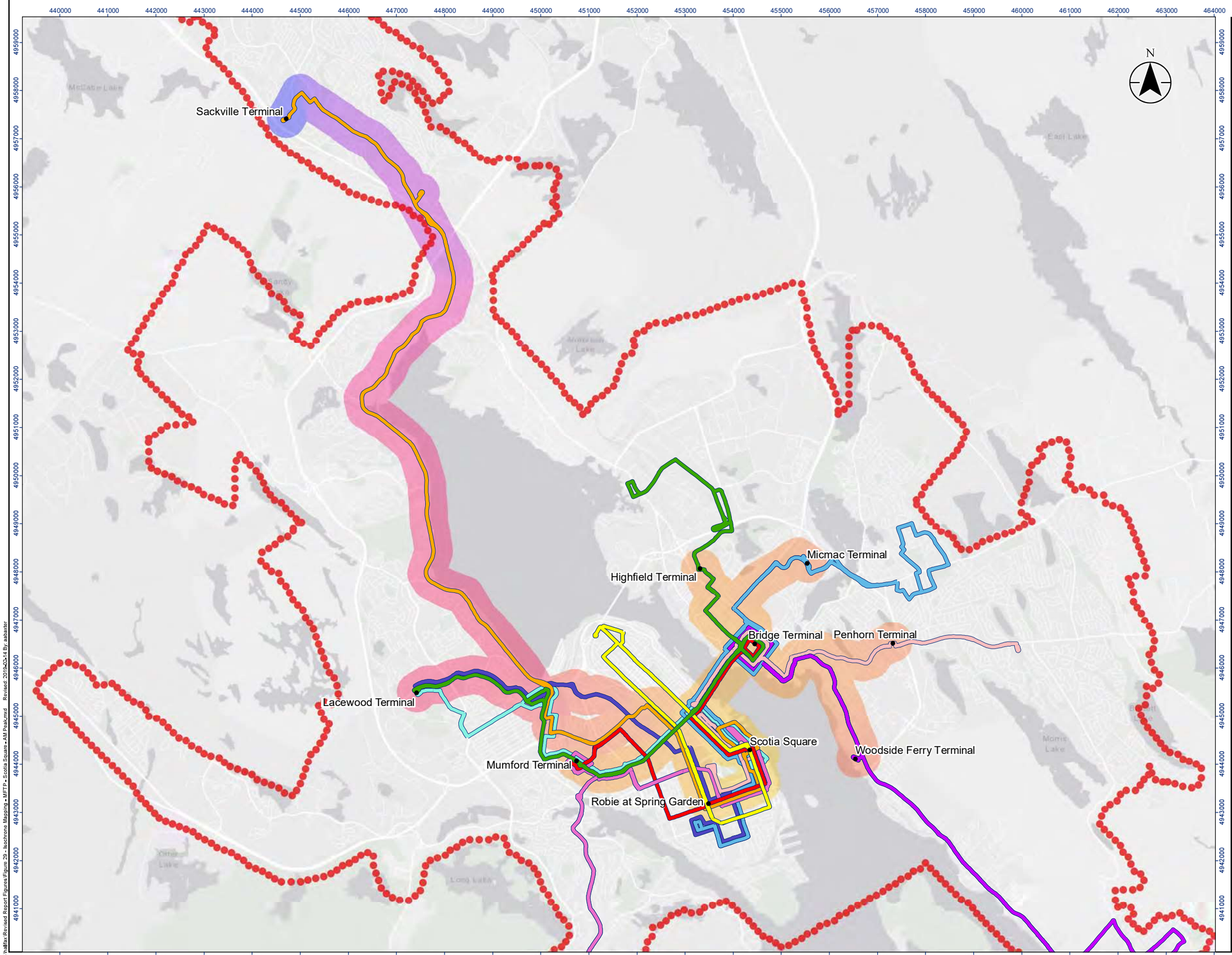
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
28

Title
Origin: Robie and Spring Garden | Time Period: PM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 28 - Isochrone Mapping - Proposed - Robie and Spring Garden - PM Peak.mxd Revised 2019-02-14 By aabaxter



Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes from Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

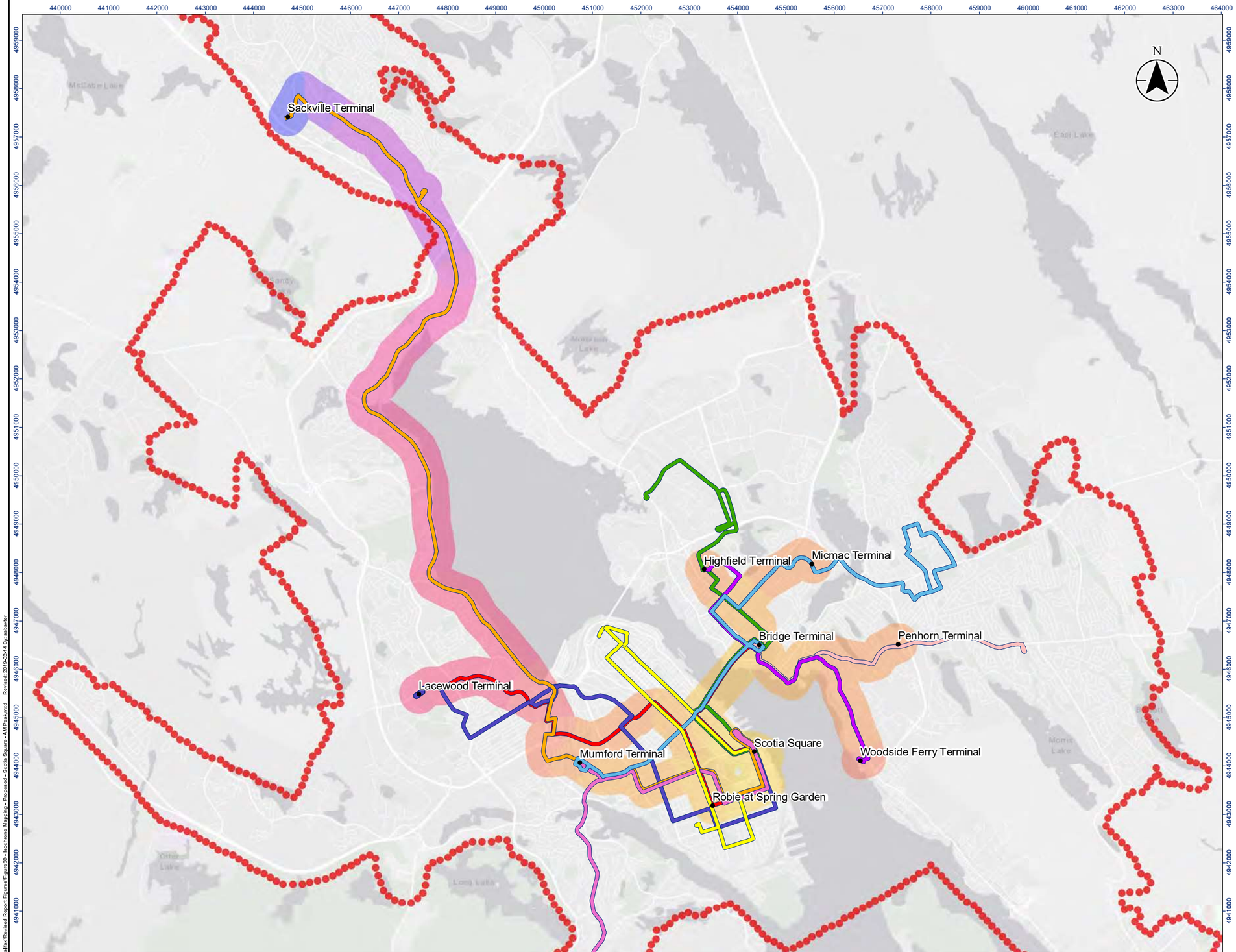
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT / MFTP CORRIDOR ROUTE REVIEW

Figure No.
29

Title
Origin: Scotia Square | Time Period: AM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 29 - Isochrone Mapping - MFTP - Scotia Square - AM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor
Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000
Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

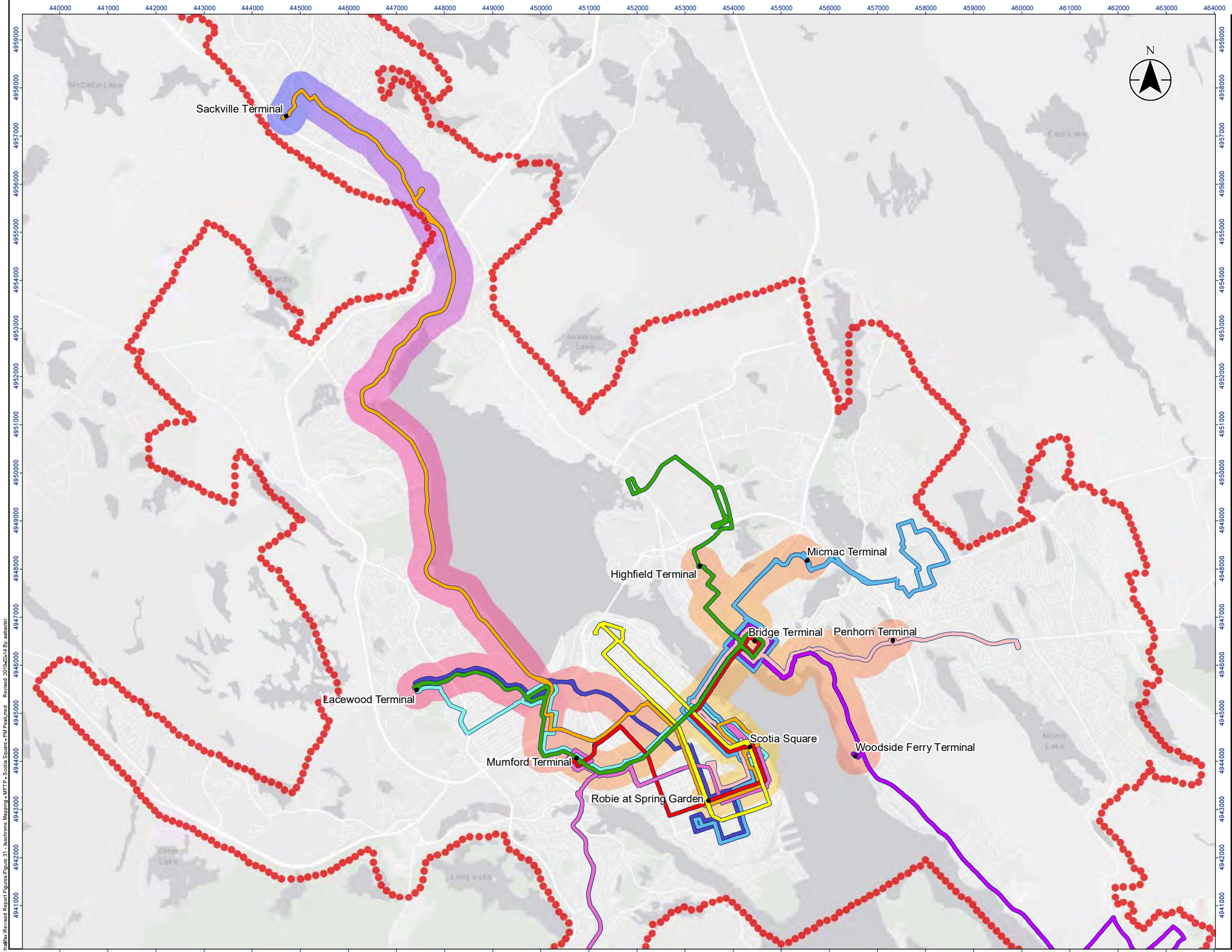
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
30

Title
Origin: Scotia Square | Time Period: AM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure30 - Isochrone Mapping - Proposed - Scotia Square - AM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes from Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

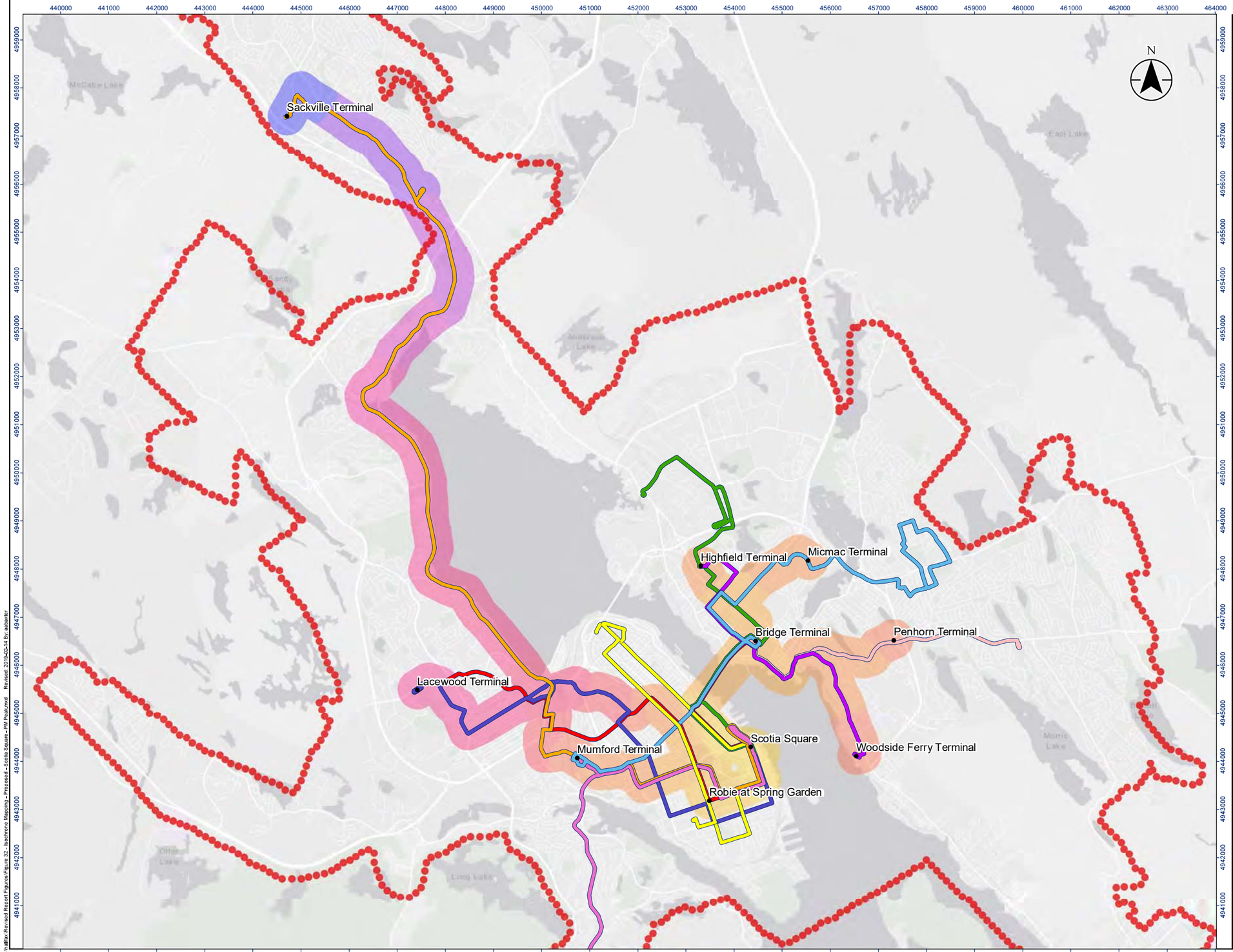
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT / MFTP CORRIDOR ROUTE REVIEW

Figure No.
31

Title
Origin: Scotia Square | Time Period: PM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 31 - Isochrone Mapping - MFTP - Scotia Square - PM Peak.mxd Revised: 2019-02-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor
Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000
Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
32

Title
Origin: Scotia Square | Time Period: PM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 32 - Isochrone Mapping - Proposed - Scotia Square - PM Peak.mxd Revised 2019-02-14 By aabaxter

Sackville Terminal
Lacewood Terminal
Highfield Terminal
Micmac Terminal
Bridge Terminal
Penhorn Terminal
Mumford Terminal
Scotia Square
Robie at Spring Garden
Woodside Ferry Terminal

N

Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes from Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

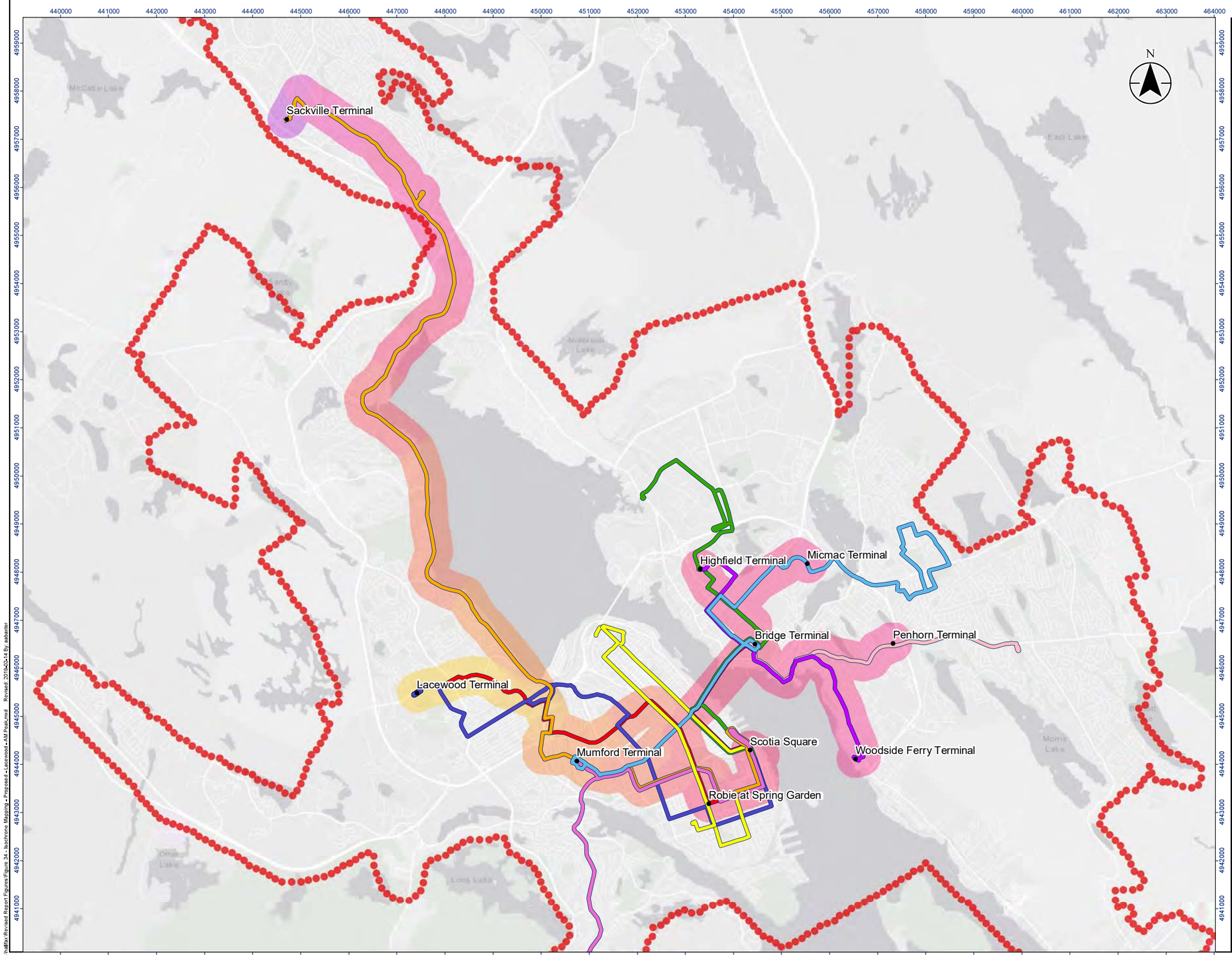
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT / MFTP CORRIDOR ROUTE REVIEW

Figure No.
33

Title
Origin: Lacewood | Time Period: AM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 33 - Isochrone Mapping - MFTP - Lacewood - AM Peak.mxd Revised: 2019-03-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor
Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000
Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
34

Title
Origin: Lacewood | Time Period: AM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 34 - Isochrone Mapping - Proposed - Lacewood - AM Peak.mxd Revised: 2019-02-14 By: aabaxter

Sackville Terminal
Lacewood Terminal
Highfield Terminal
Micmac Terminal
Bridge Terminal
Penhorn Terminal
Scotia Square
Woodside Ferry Terminal
Mumford Terminal
Robie at Spring Garden

N

Stantec

HALIFAX TRANSIT

Legend

MFTP Corridor Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000 Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

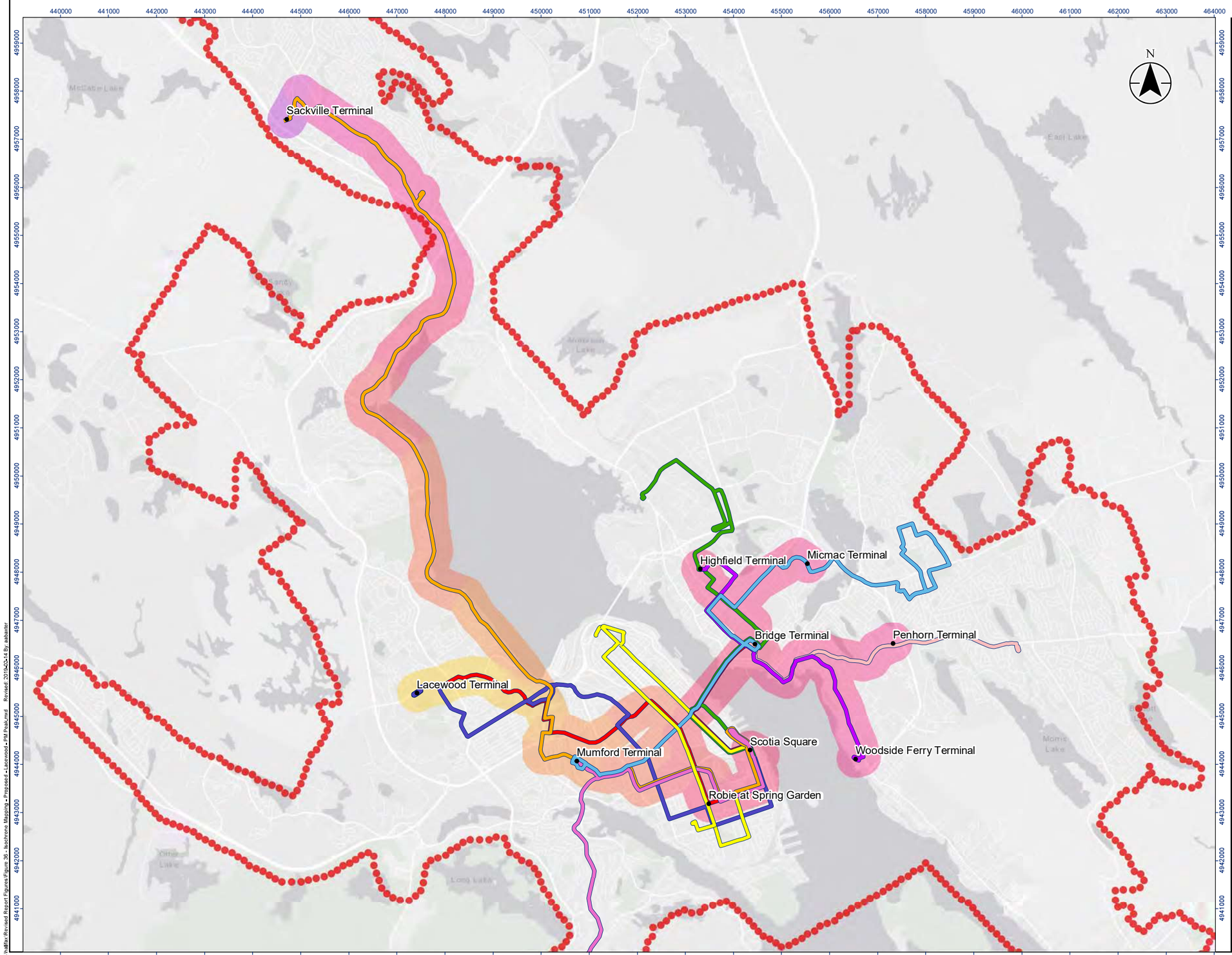
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

Client/Project
HALIFAX TRANSIT / MFTP CORRIDOR ROUTE REVIEW

Figure No.
35

Title
Origin: Lacewood | Time Period: PM Peak | Network: MFTP

C:\GIS\Halifax\Revised Report Figures\Figure 35 - Isochrone Mapping - MFTP - Lacewood - PM Peak.mxd Revised: 2019-03-14 By: aabaxter



Stantec

HALIFAX TRANSIT

Legend

Proposed Corridor
Route Alignment

1 3 4 5 6 7 8 9 10

Urban Transit Service Boundary

Travel Minutes From Origin

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

0 500 1,000
Meters

1:80,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Assumed walking speed of 1.33 mps

Project Location
Halifax Regional Municipality

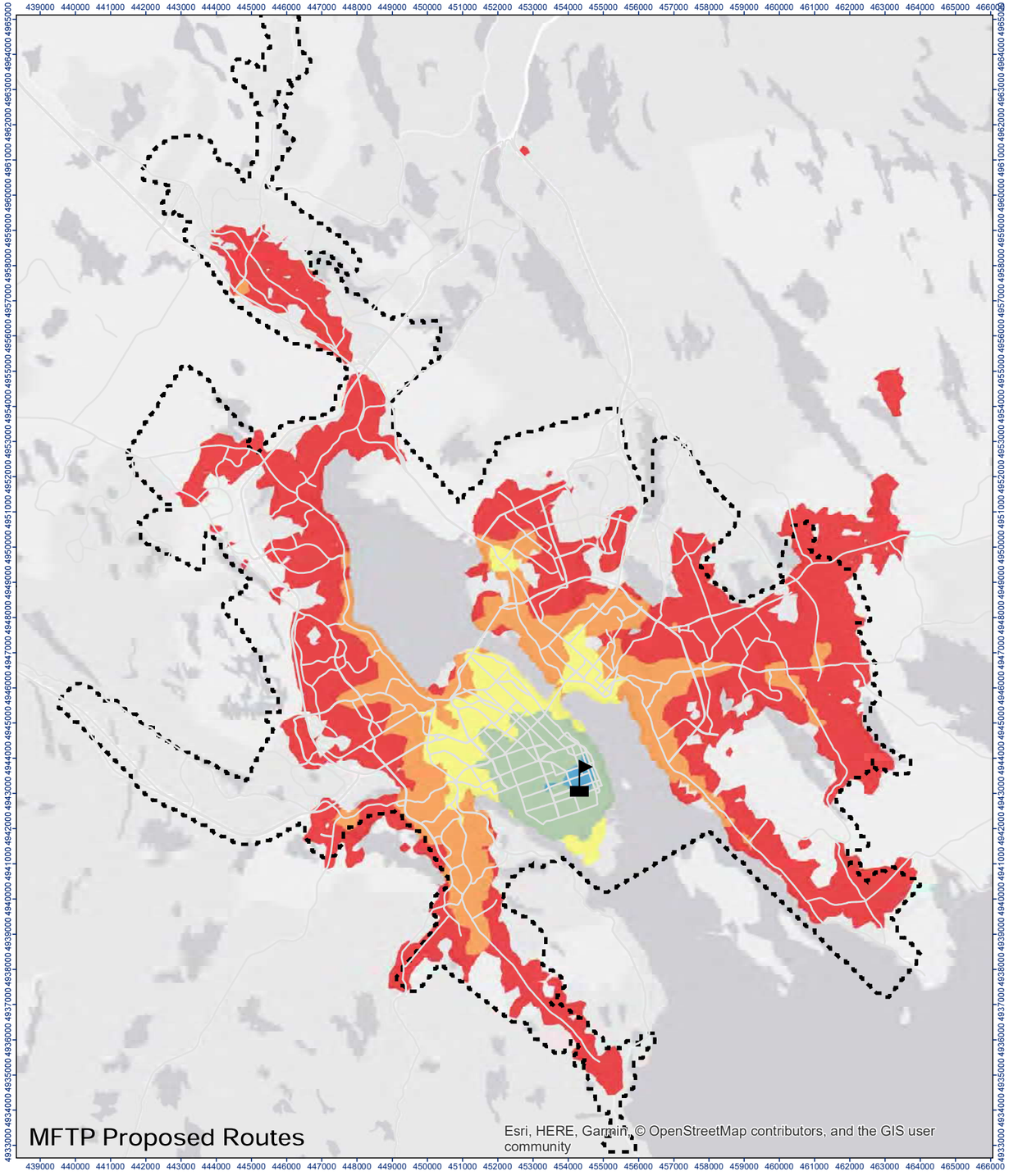
Isochrones Along Corridor Routes REVA
Prepared by Aaron Baxter on 2019-02-14
Technical Review by BP on 2019-02-14
Independent Review by SP on 2019-02-14

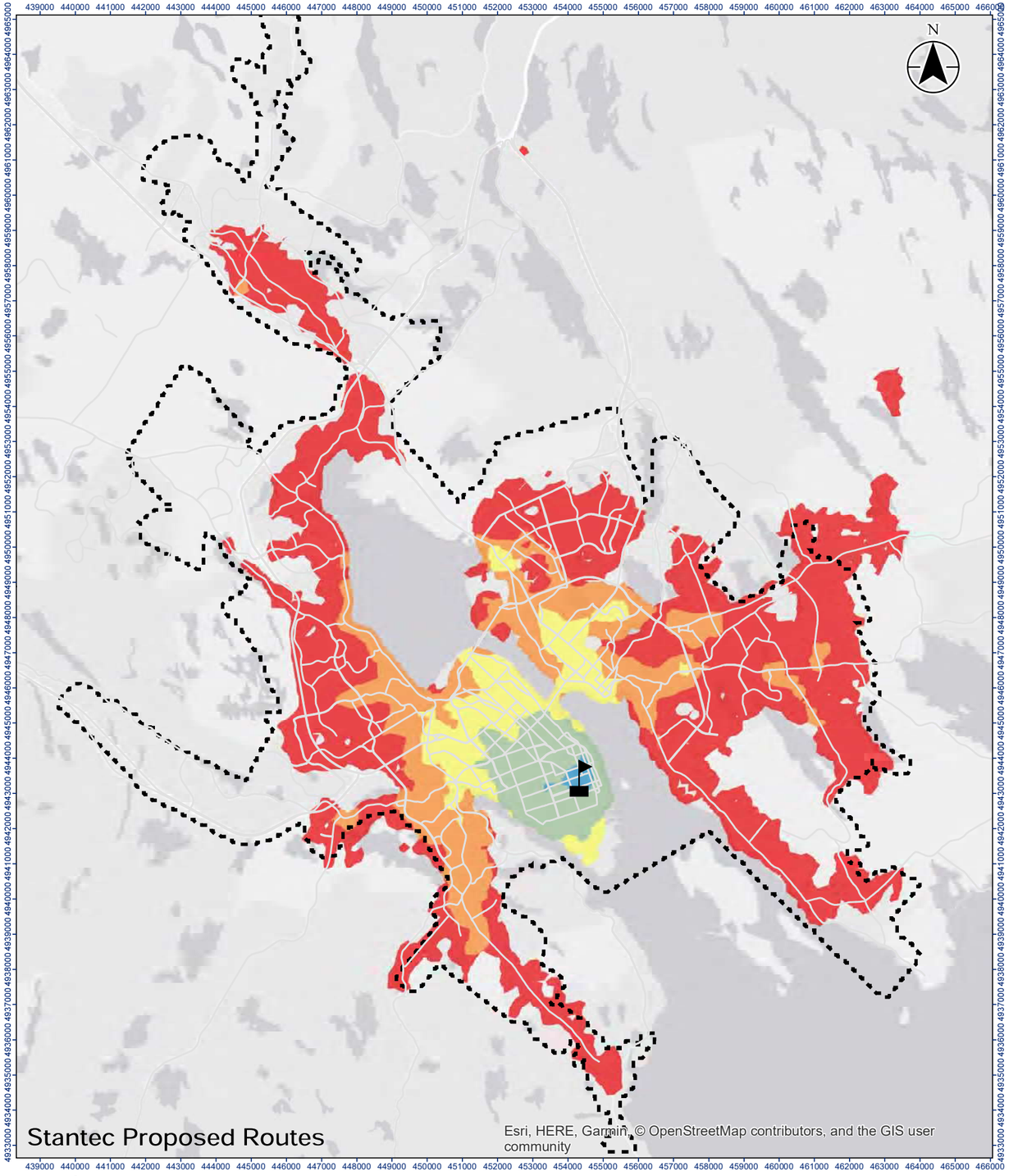
Client/Project
HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Figure No.
36

Title
Origin: Lacewood | Time Period: PM Peak | Network: Proposed

C:\GIS\Halifax\Revised Report Figures\Figure 36 - Isochrone Mapping - Proposed - Lacewood - PM Peak.mxd Revised: 2019-02-14 By: aabaxter





Legend

Name

Halifax Central Library

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

37

Figure No.

Origin: Halifax Central Library| Time Period: Weekday AM Peak (8:30:00 - 9:30:00)

Title

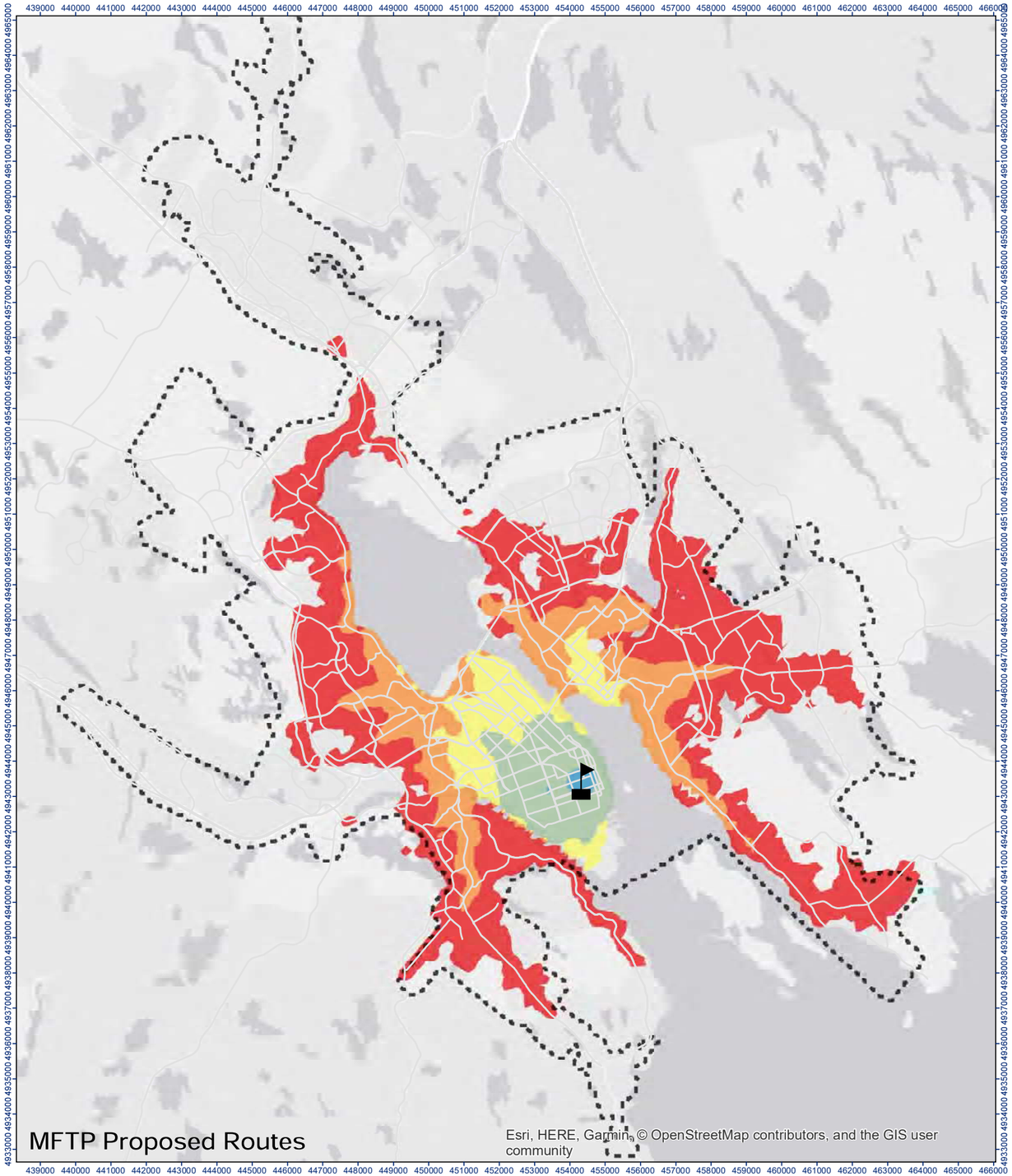
Notes

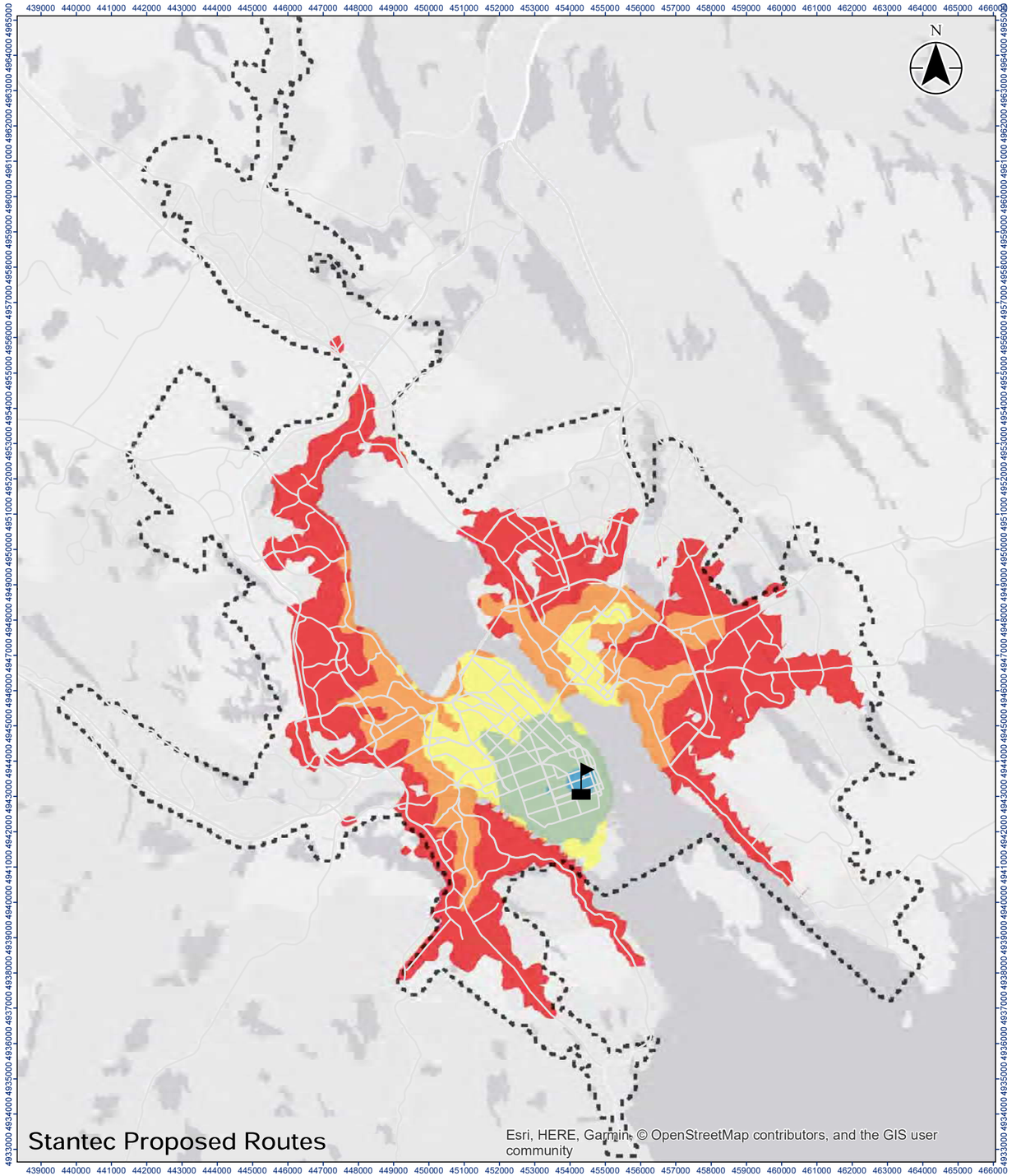
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

38

Figure No.

Origin: Halifax Central Library| Time Period: Weekday Midday (12:30:00 - 13:30:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Halifax Central Library

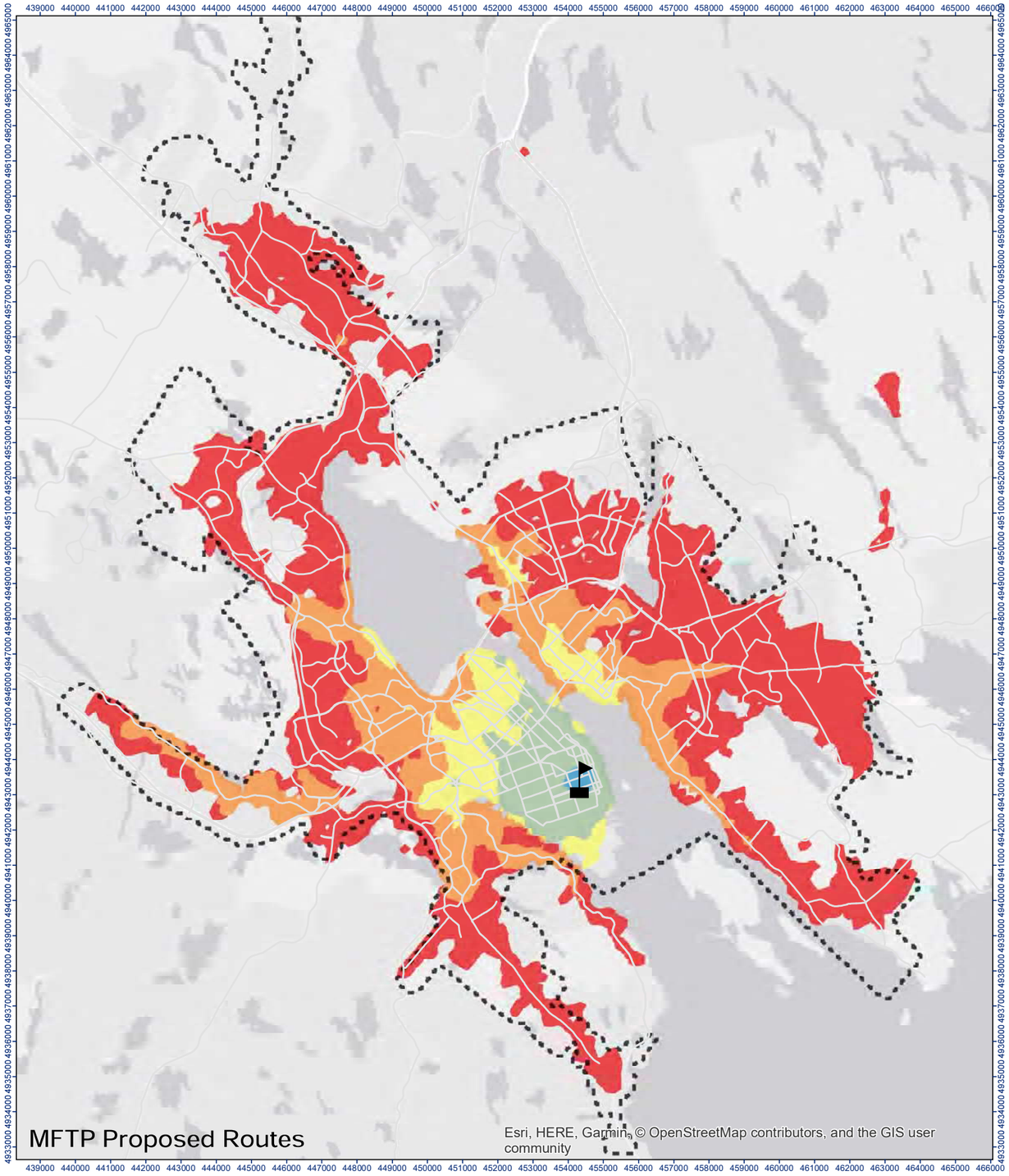
Urban Transit Service Boundary

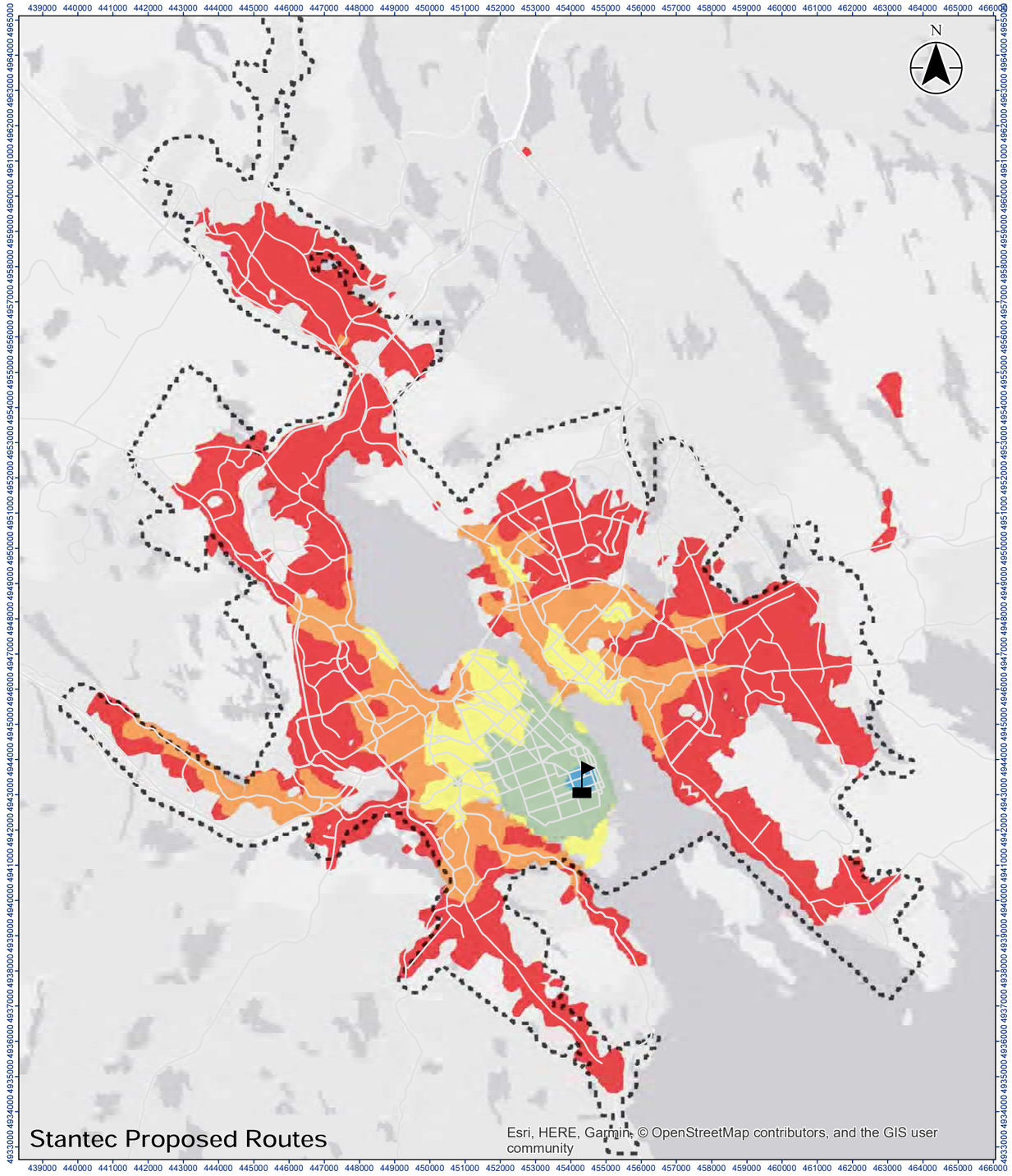
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

39

Figure No.

Origin: Halifax Central Library| Time Period: Weekday PM Peak (17:00:00 - 18:00:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Halifax Central Library

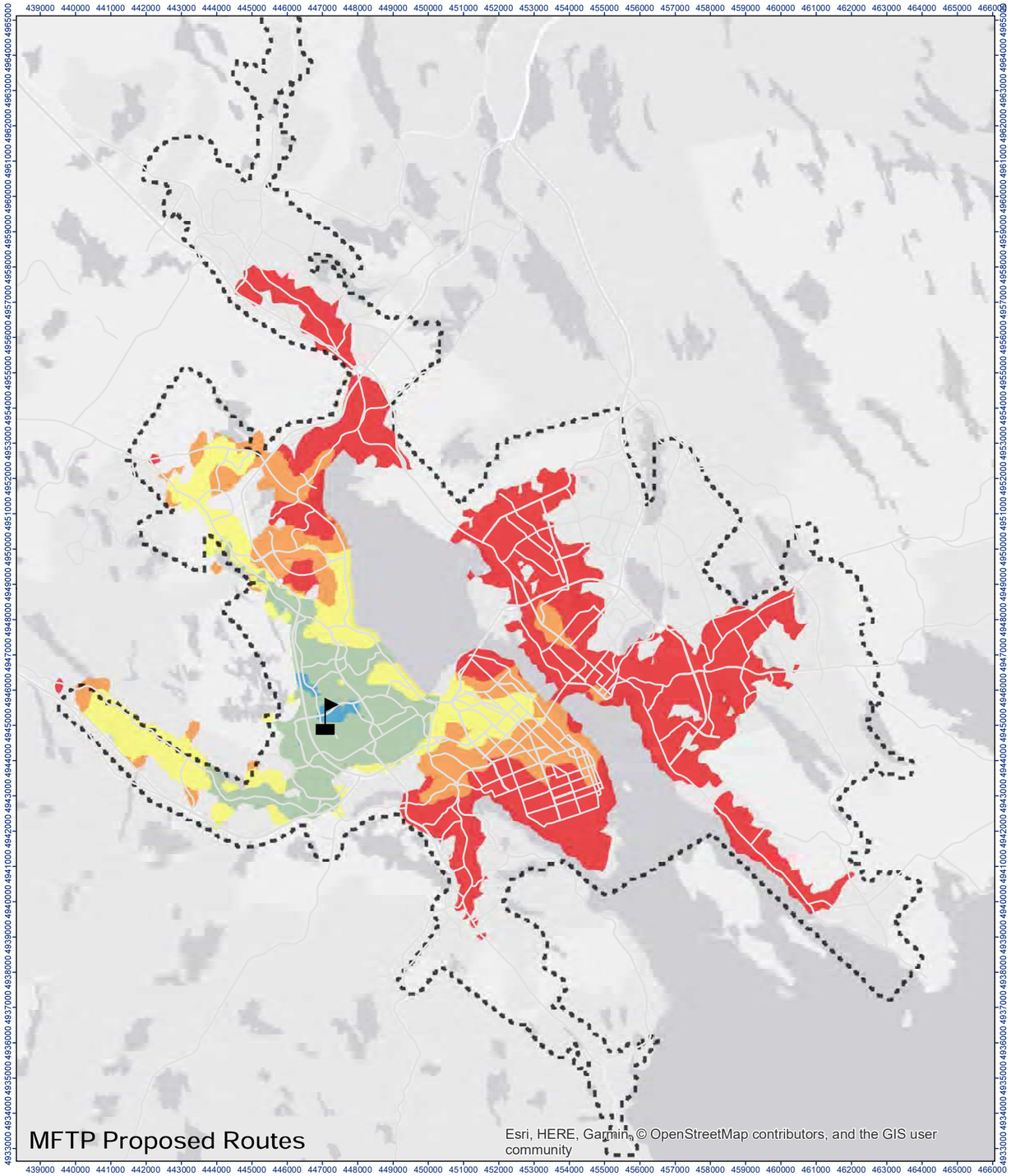
Urban Transit Service Boundary

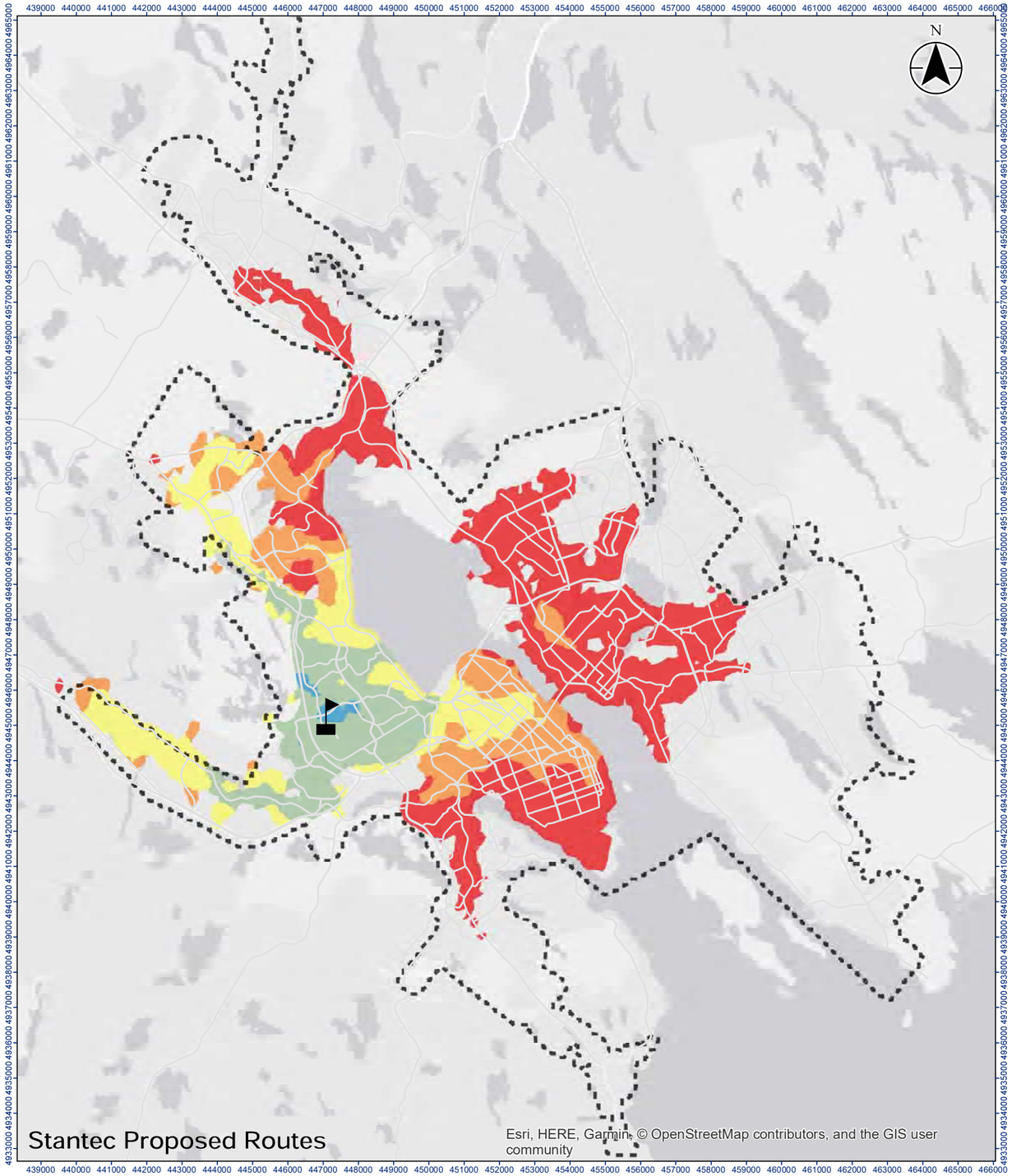
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

40

Figure No.

Origin: Keshen Goodman Public Library| Time Period: Weekday AM Peak (8:30:00 - 9:30:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Keshen Goodman Public Library

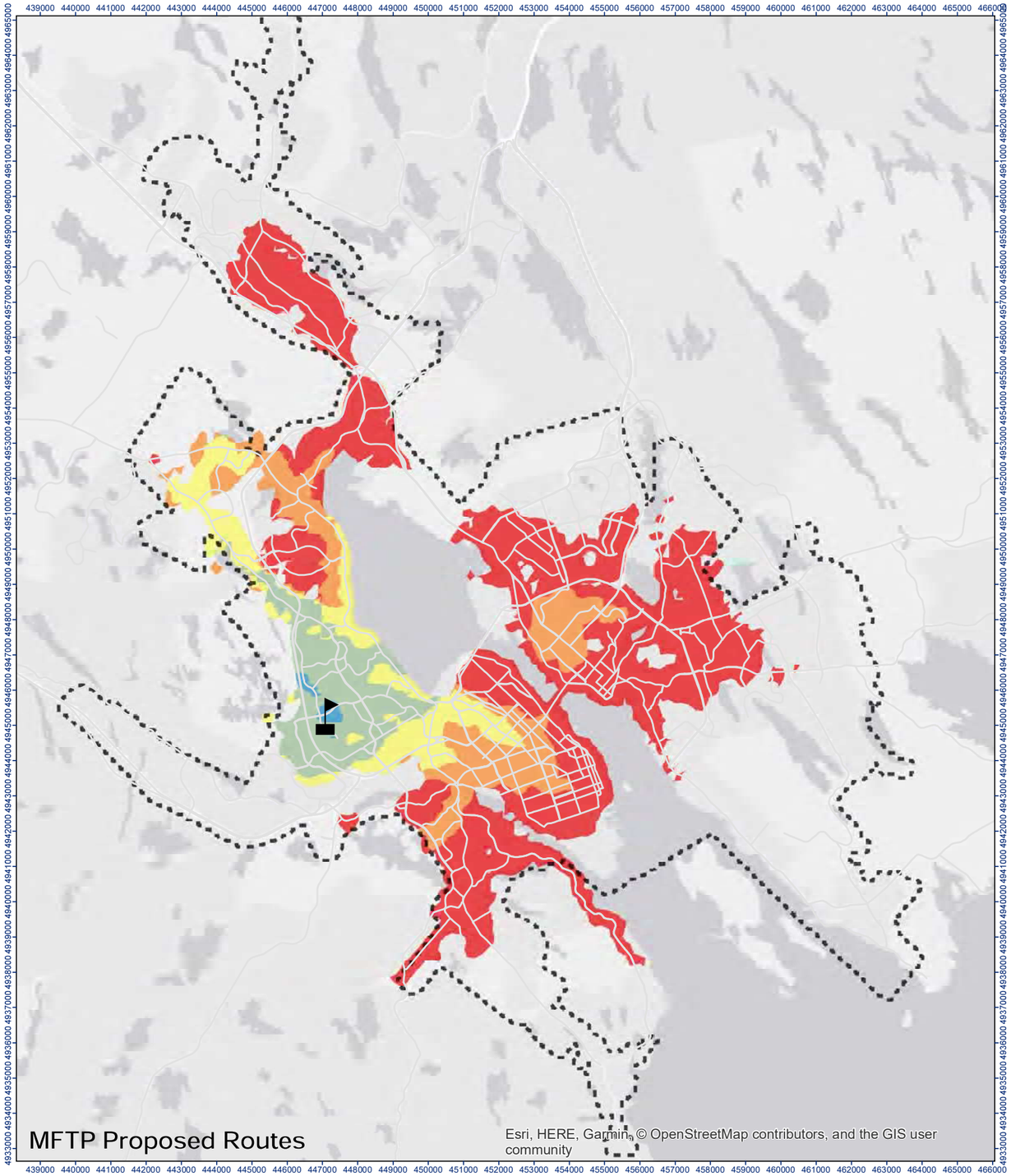
Urban Transit Service Boundary

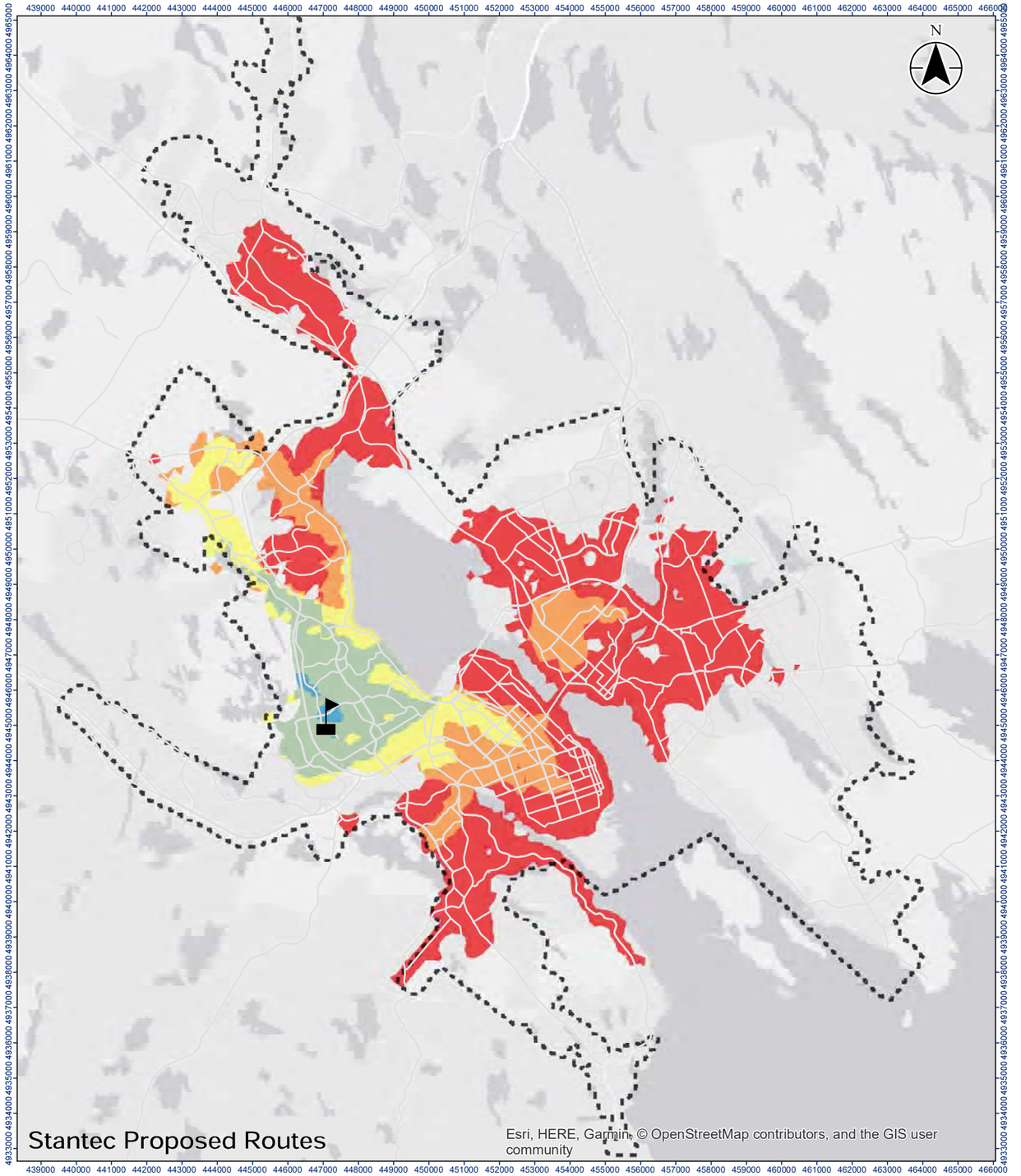
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

41

Figure No.

Origin: Keshen Goodman Public Library| Time Period: Weekday Midday (12:30:00 - 13:30:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Keshen Goodman Public Library

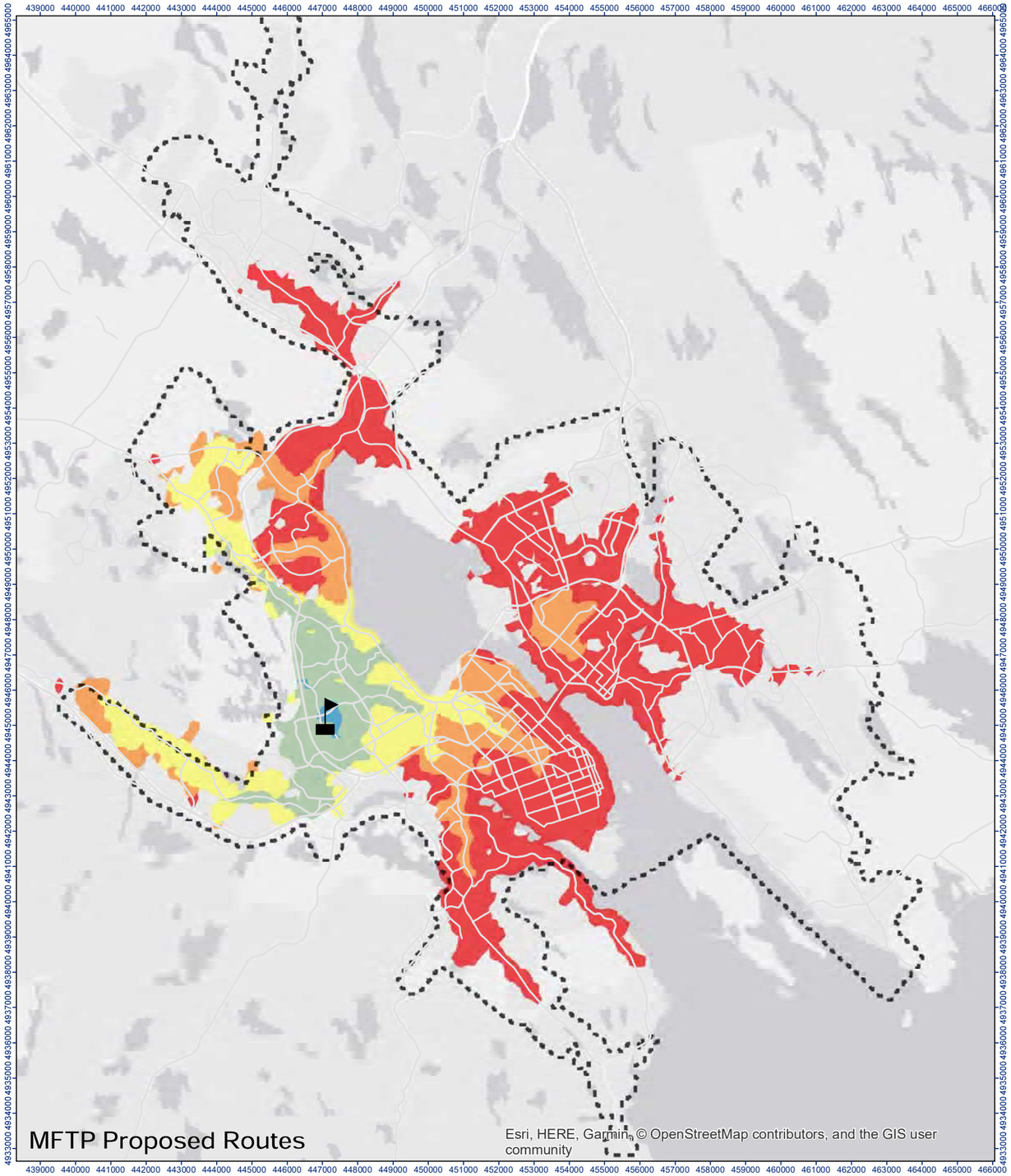
Urban Transit Service Boundary

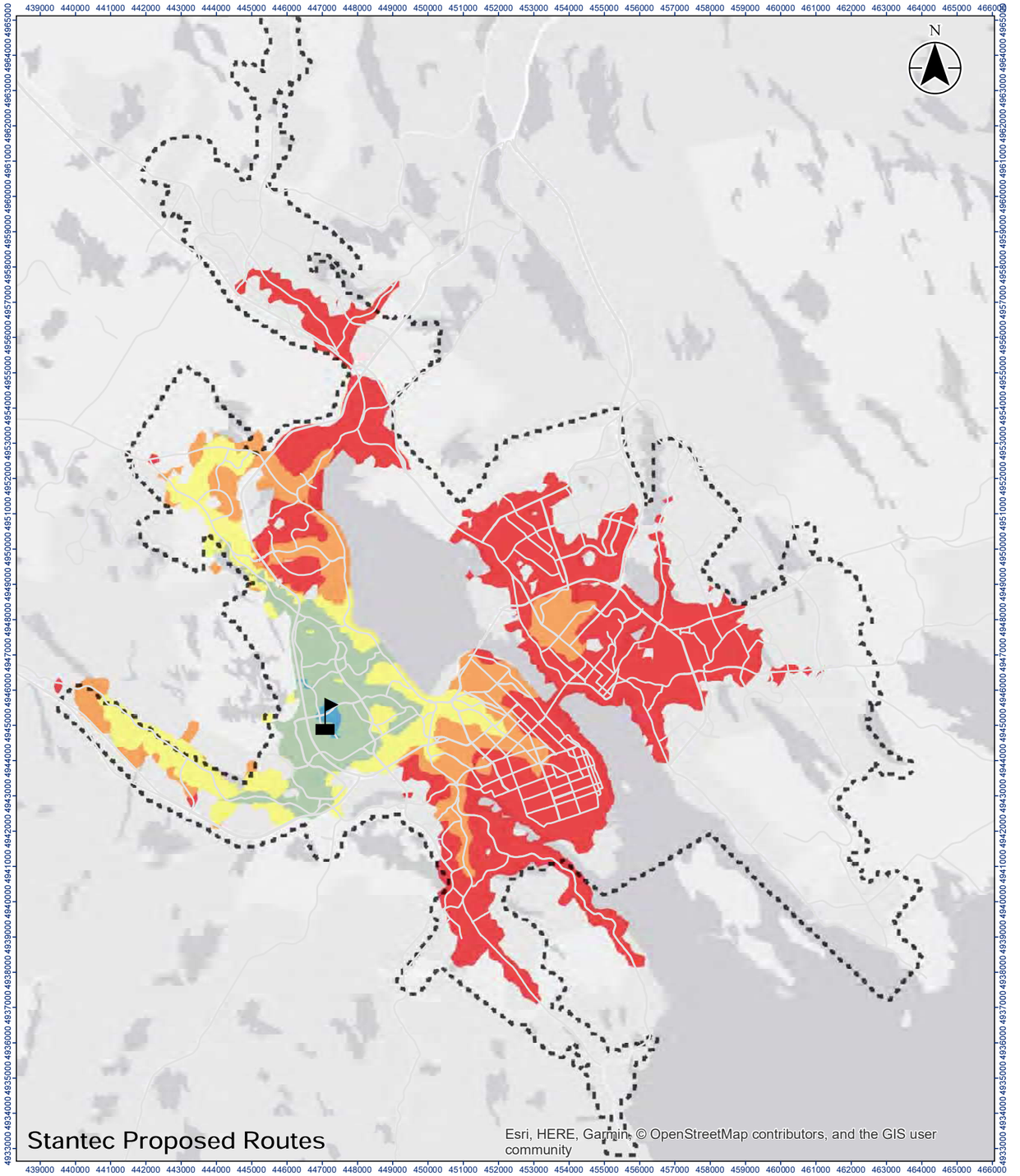
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

42

Figure No.

Origin: Keshen Goodman Public Library| Time Period: Weekday PM Peak (17:00:00 - 18:00:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Keshen Goodman Public Library

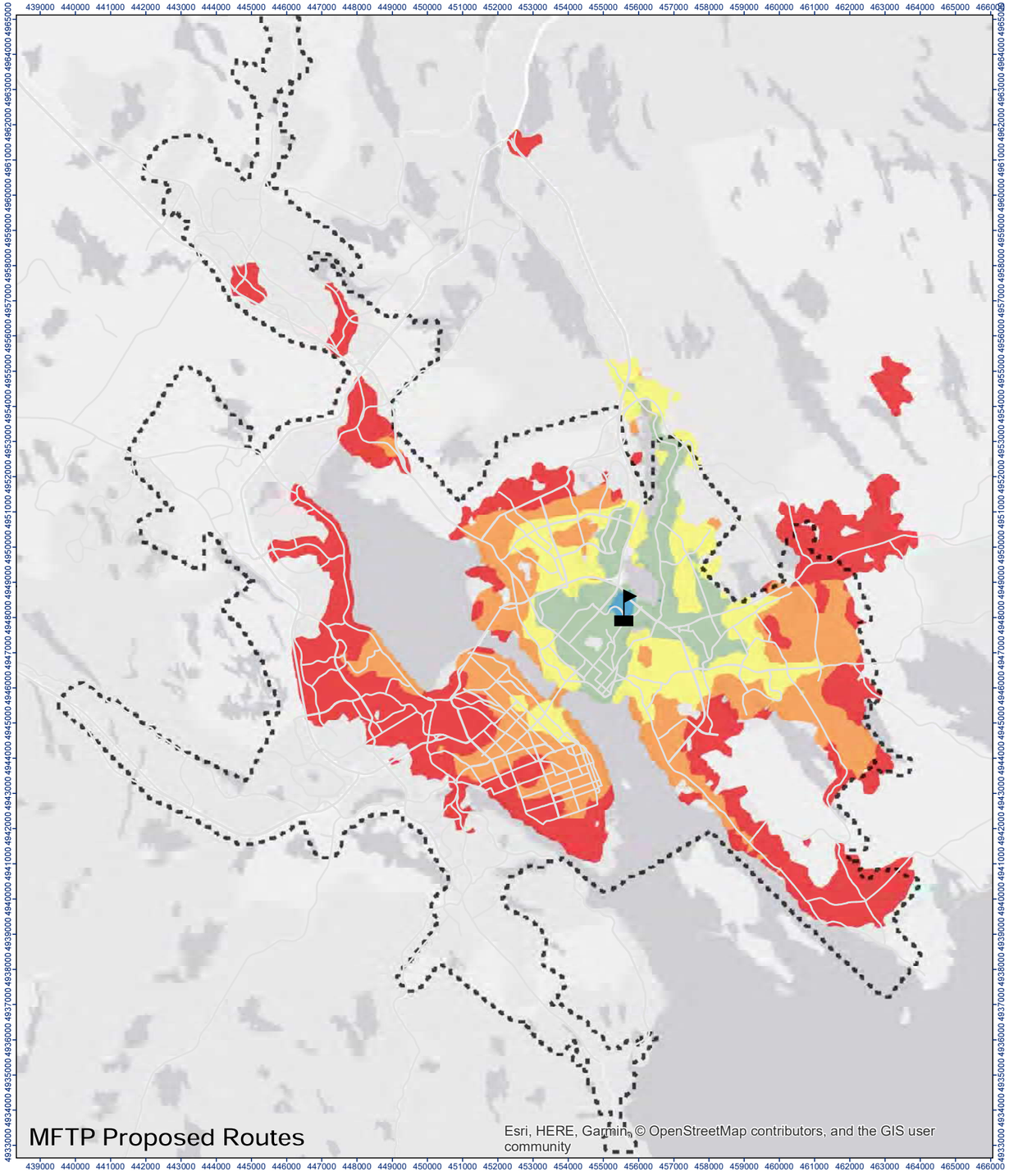
Urban Transit Service Boundary

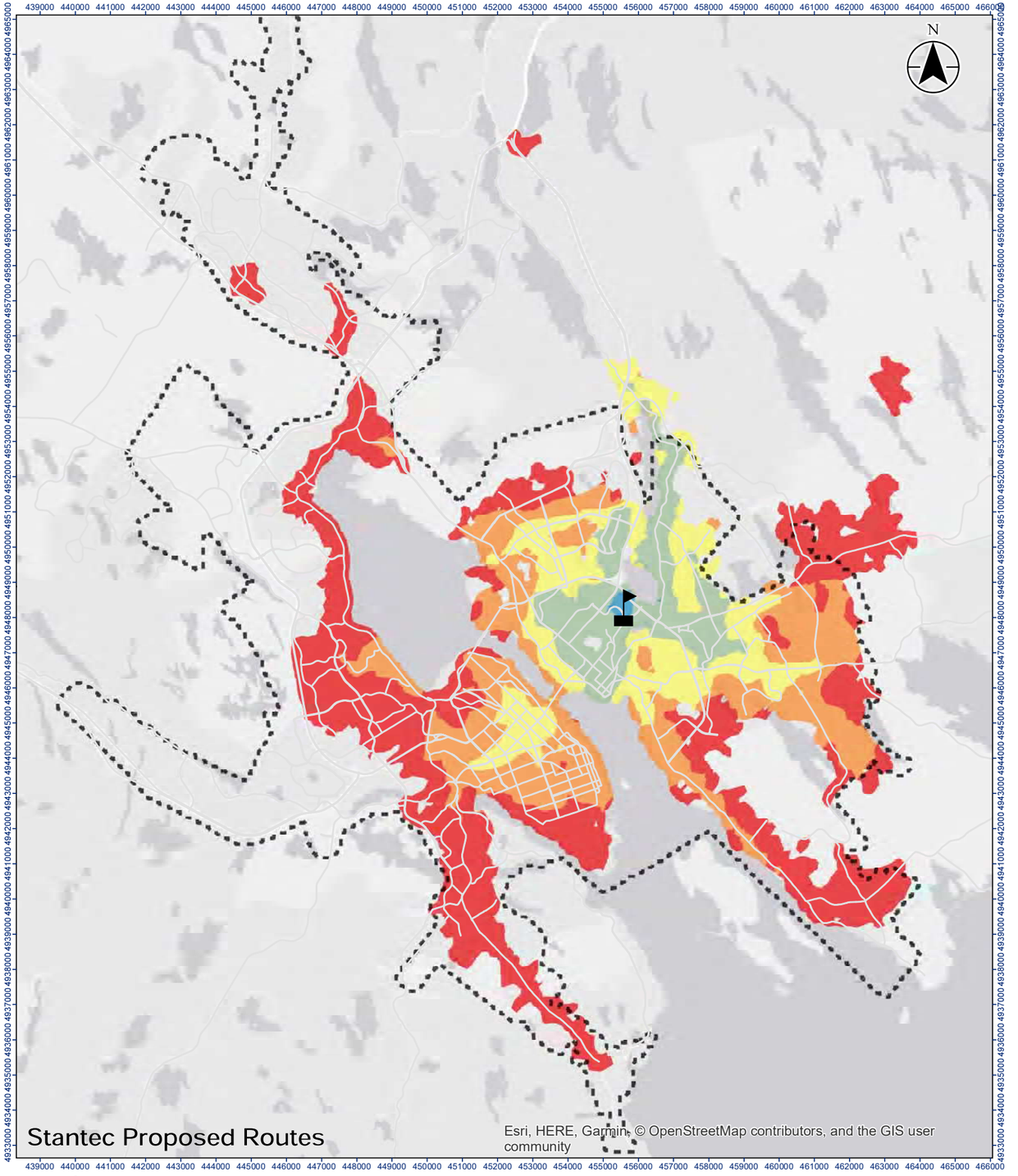
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

43

Figure No.

Origin: Mic Mac Mall| Time Period:
Weekday AM Peak (8:30:00 - 9:30:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Mic Mac Mall

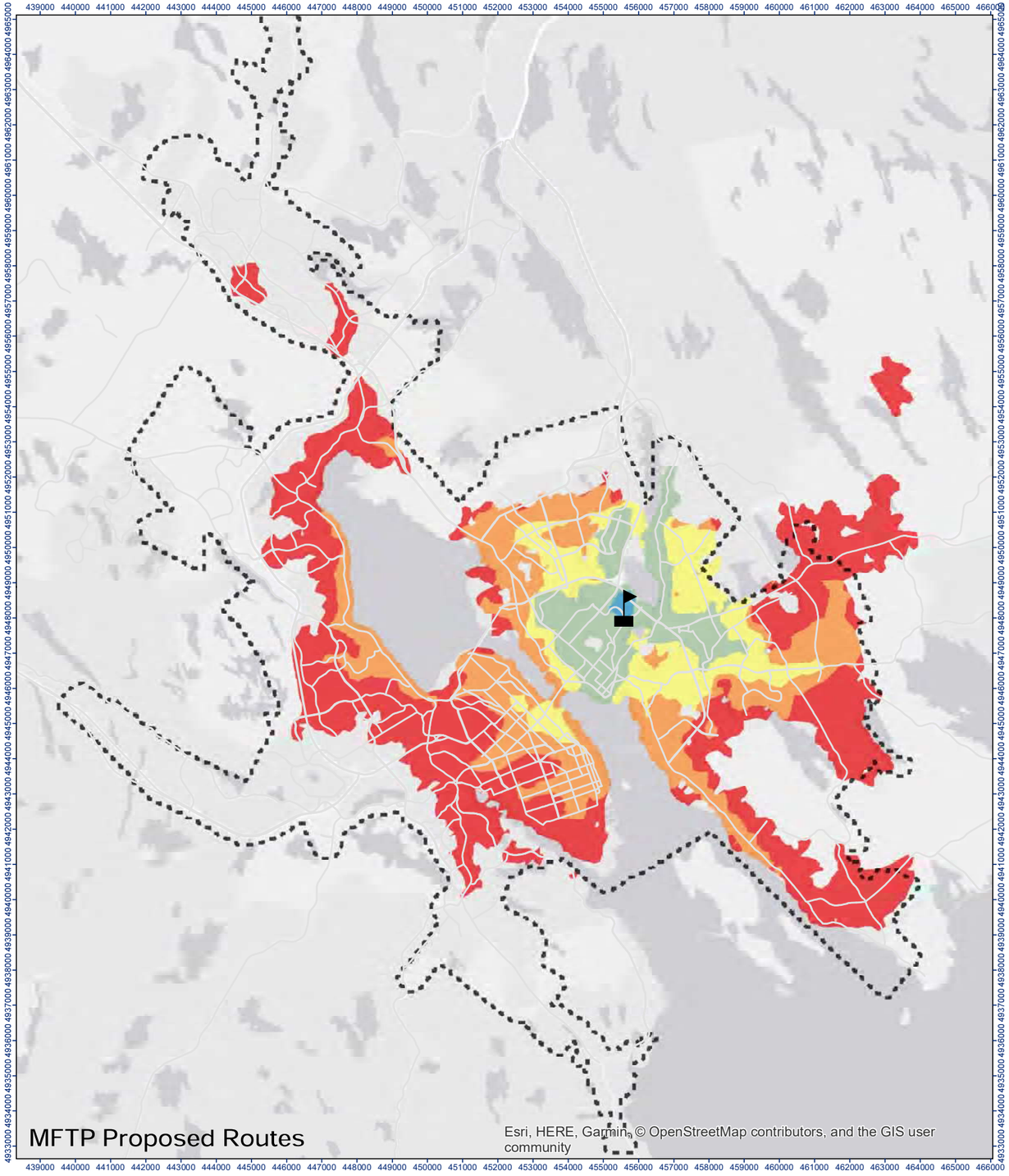
Urban Transit Service Boundary

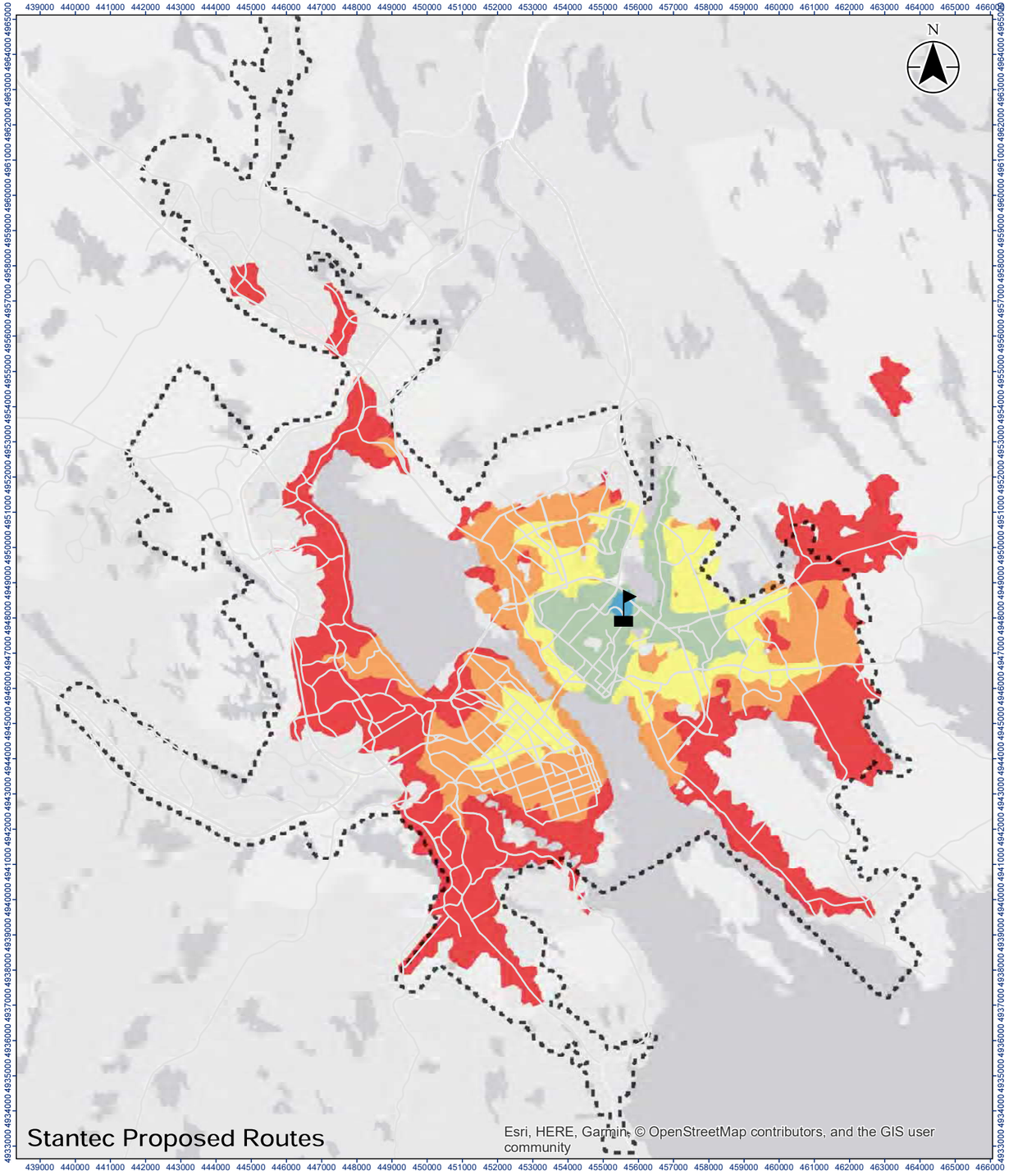
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

44

Figure No.

Origin: Mic Mac Mall | Time Period:
Weekday Midday (12:30:00 - 13:30:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Mic Mac Mall

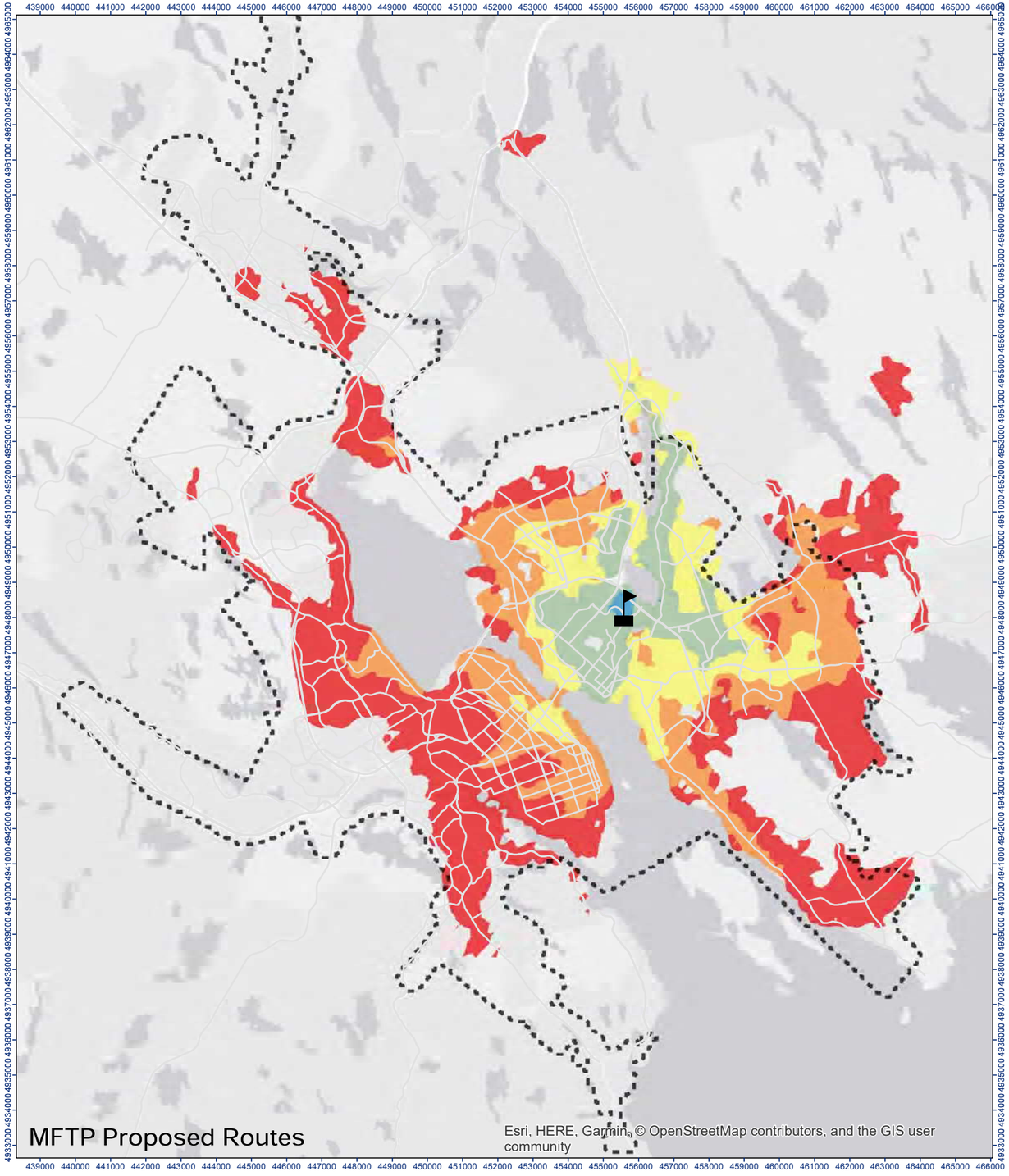
Urban Transit Service Boundary

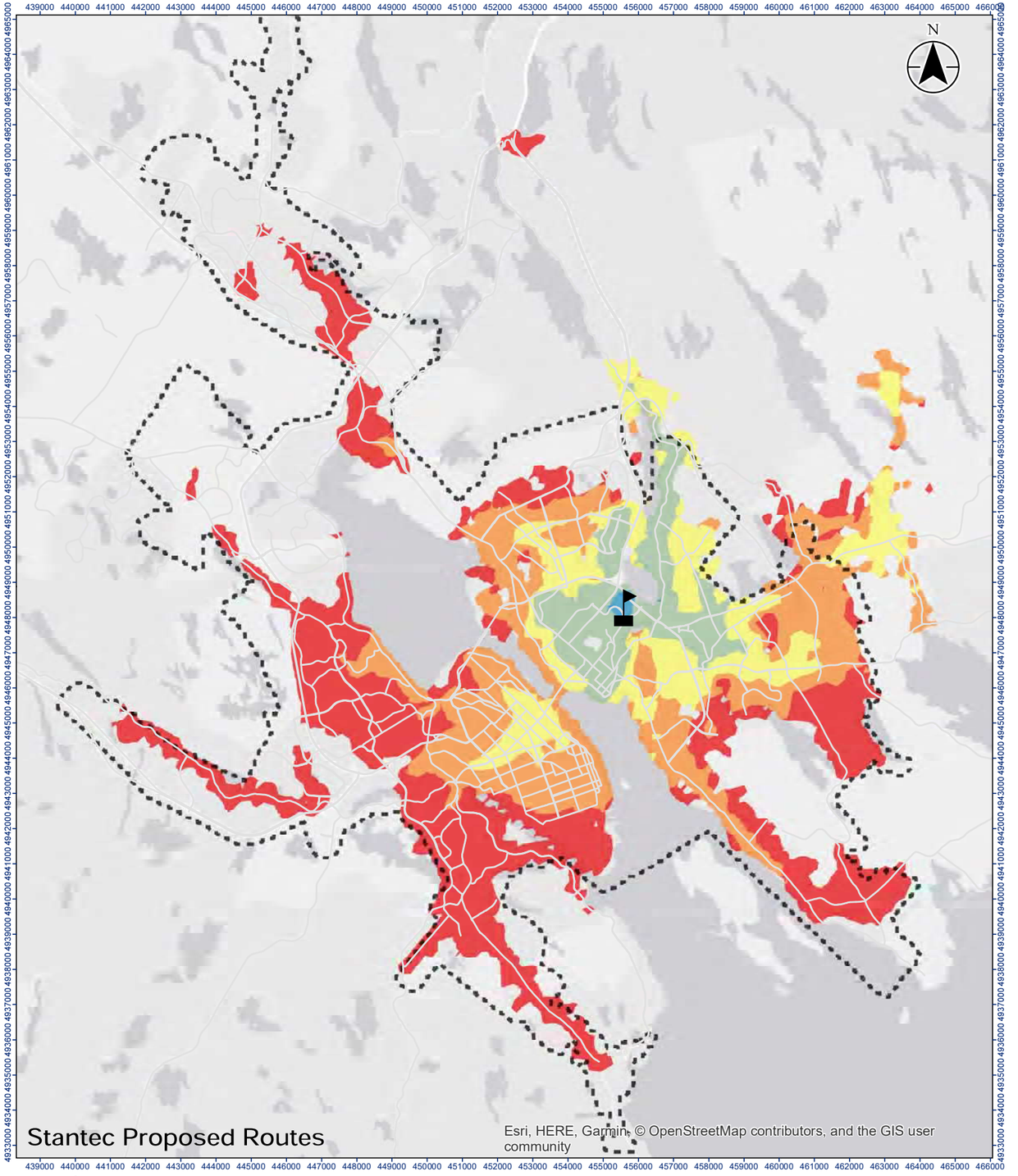
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Legend

Name

Mic Mac Mall

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

45

Figure No.

Origin: Mic Mac Mall| Time Period:
Weekday PM Peak (17:00:00 - 18:00:00)

Title

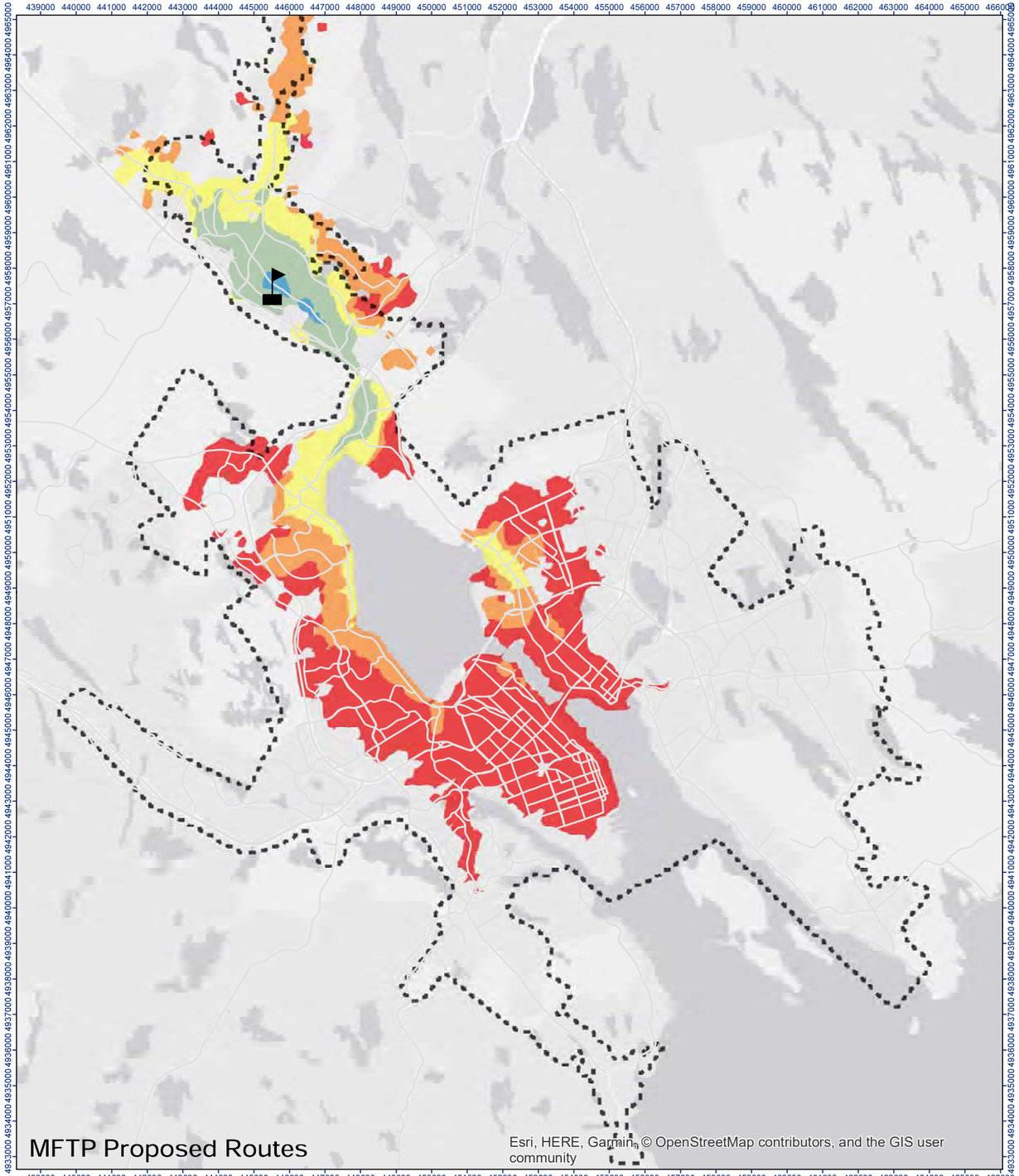
Notes

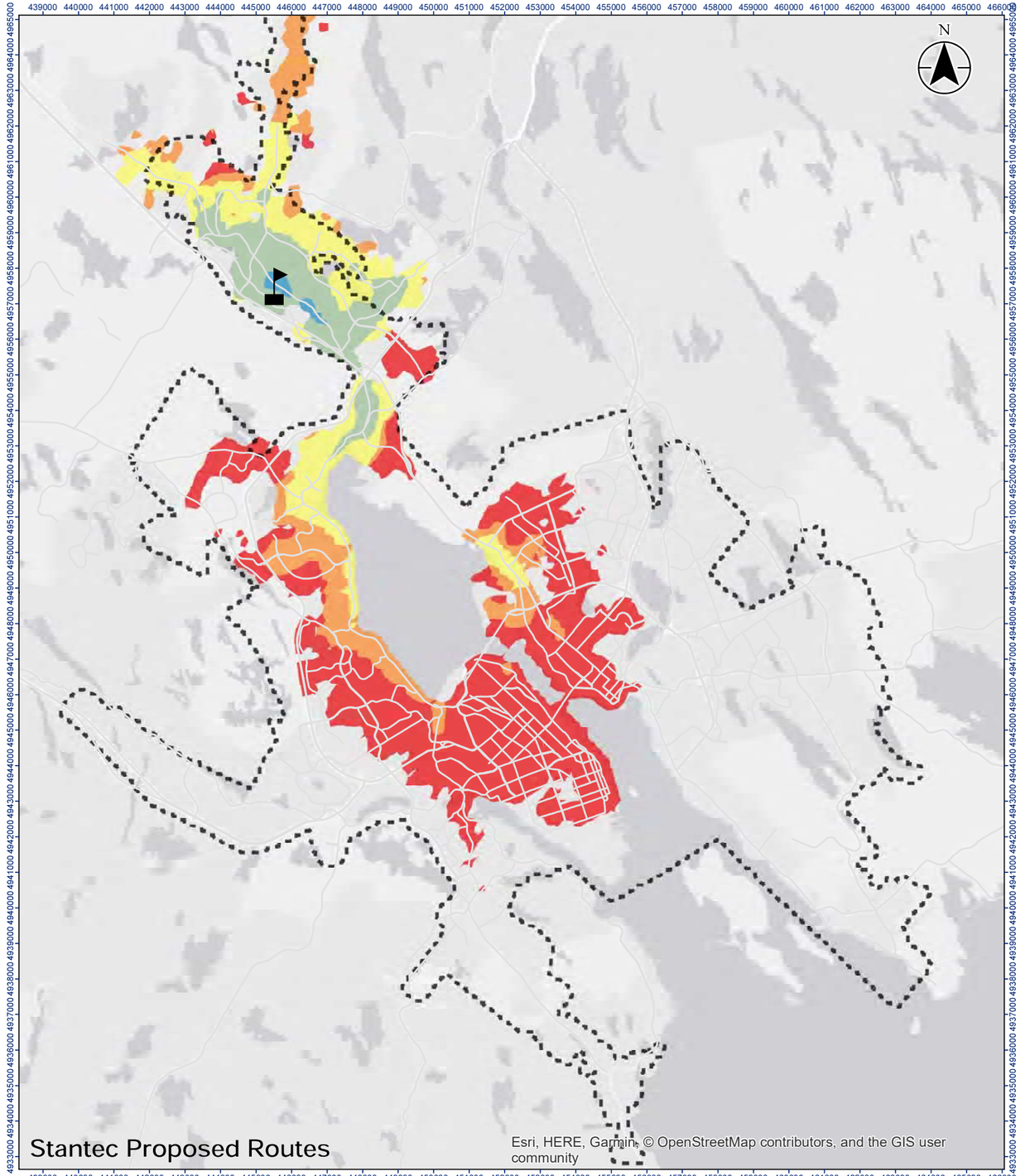
1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

46

Figure No.

Origin: Sackville Public Library | Time Period: Weekday AM Peak (8:30:00 - 9:30:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Sackville Public Library

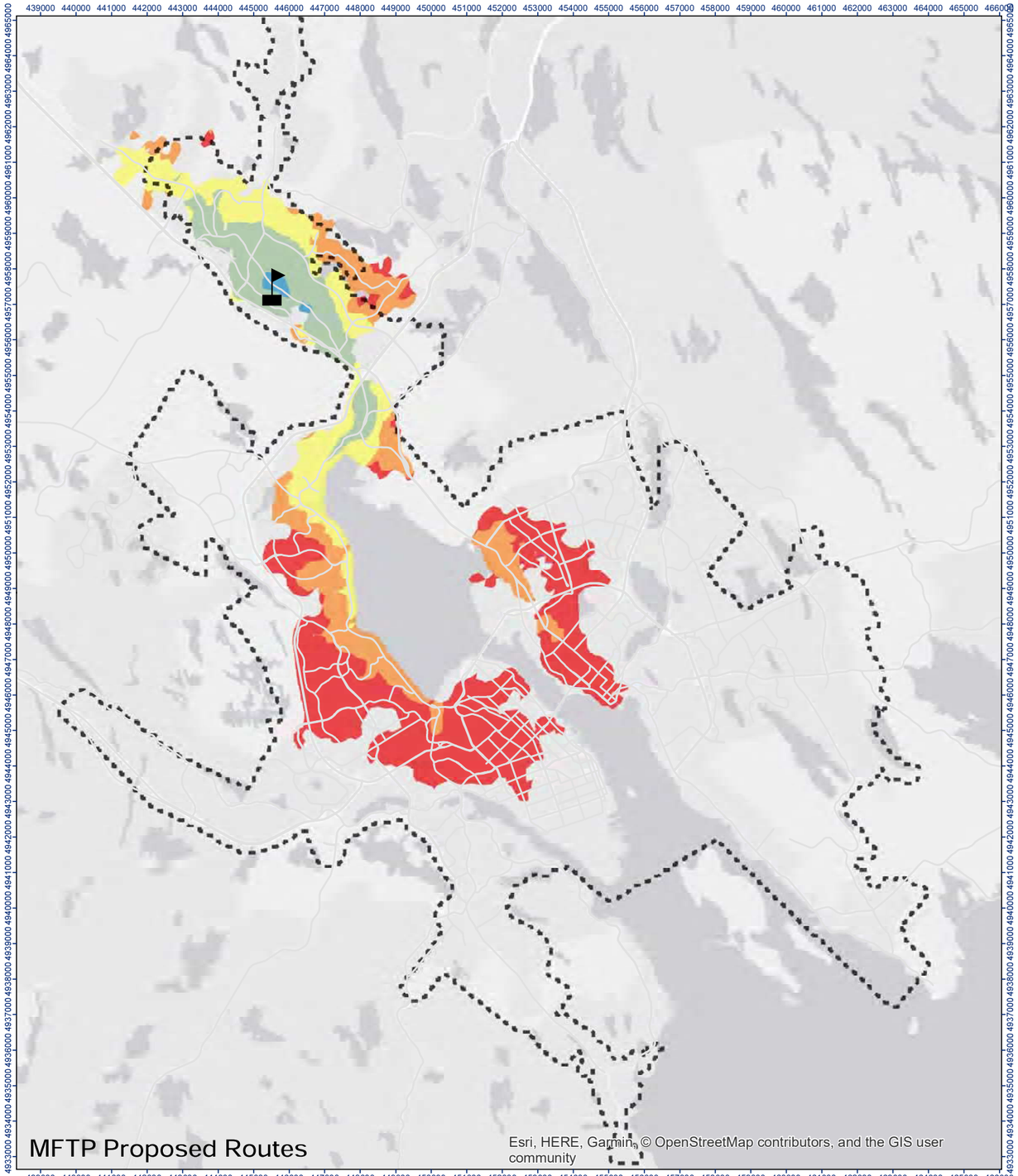
Urban Transit Service Boundary

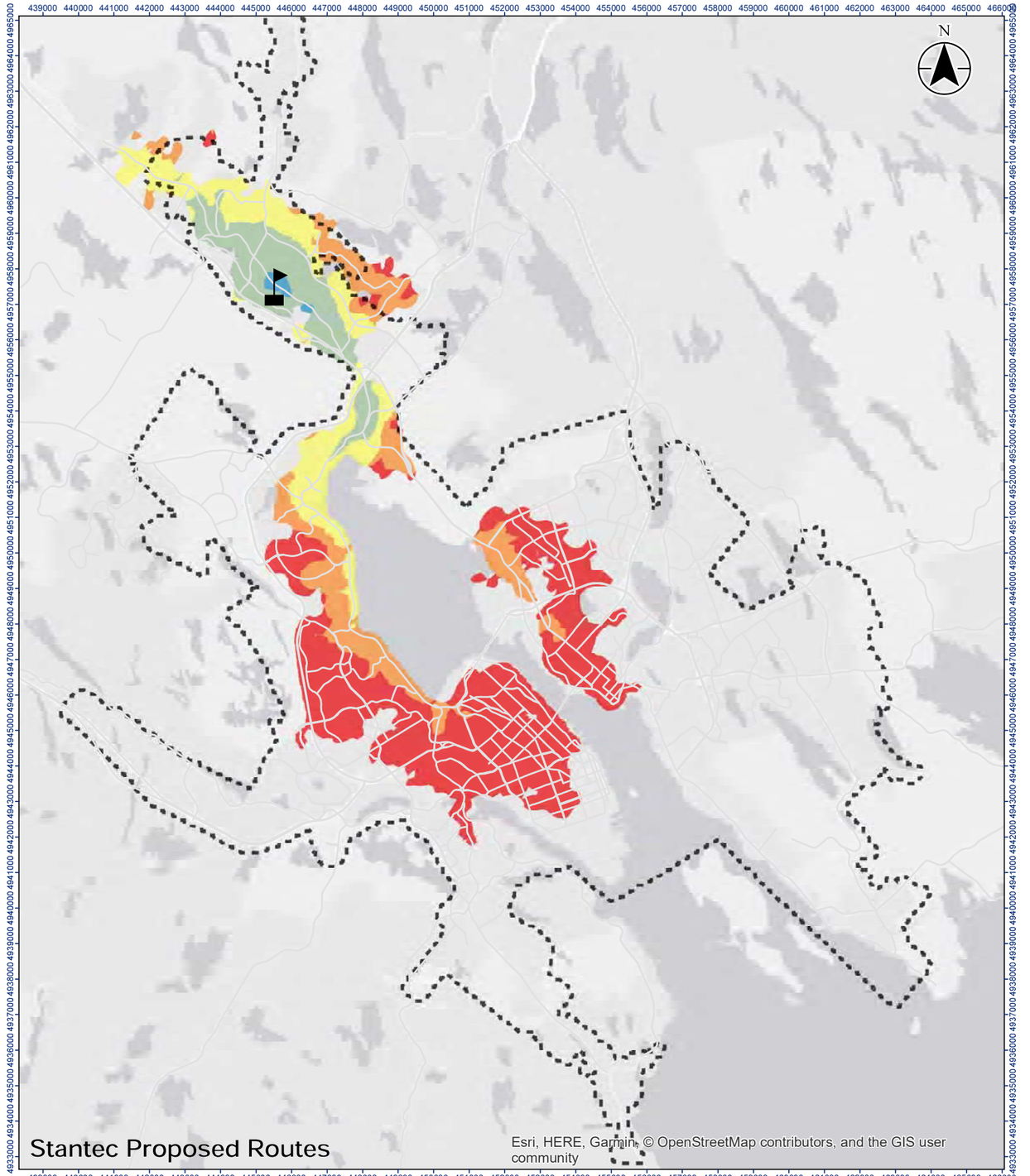
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

47

Figure No.

Origin: Sackville Public Library | Time Period: Weekday Midday (12:30:00 - 13:30:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Sackville Public Library

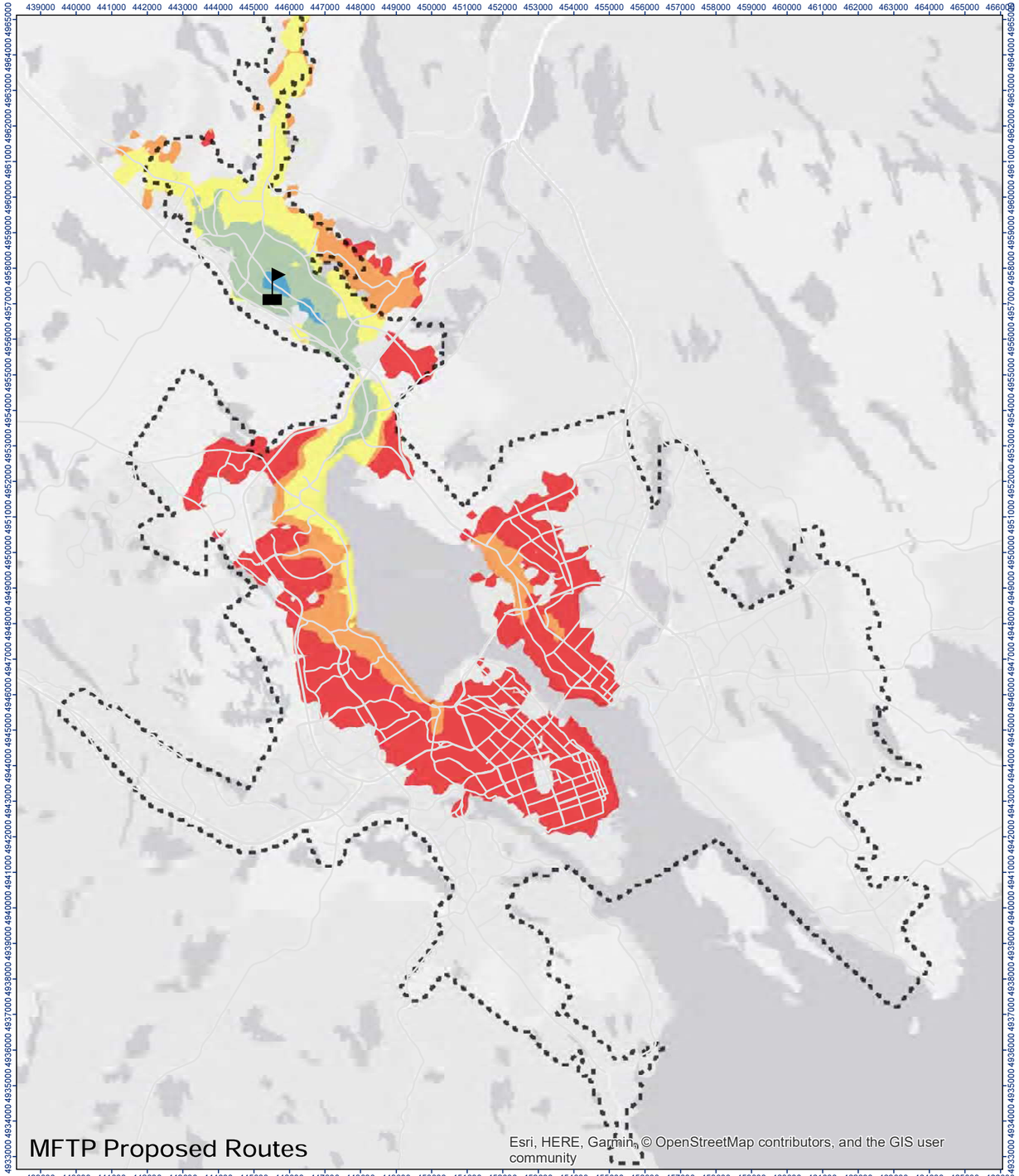
Urban Transit Service Boundary

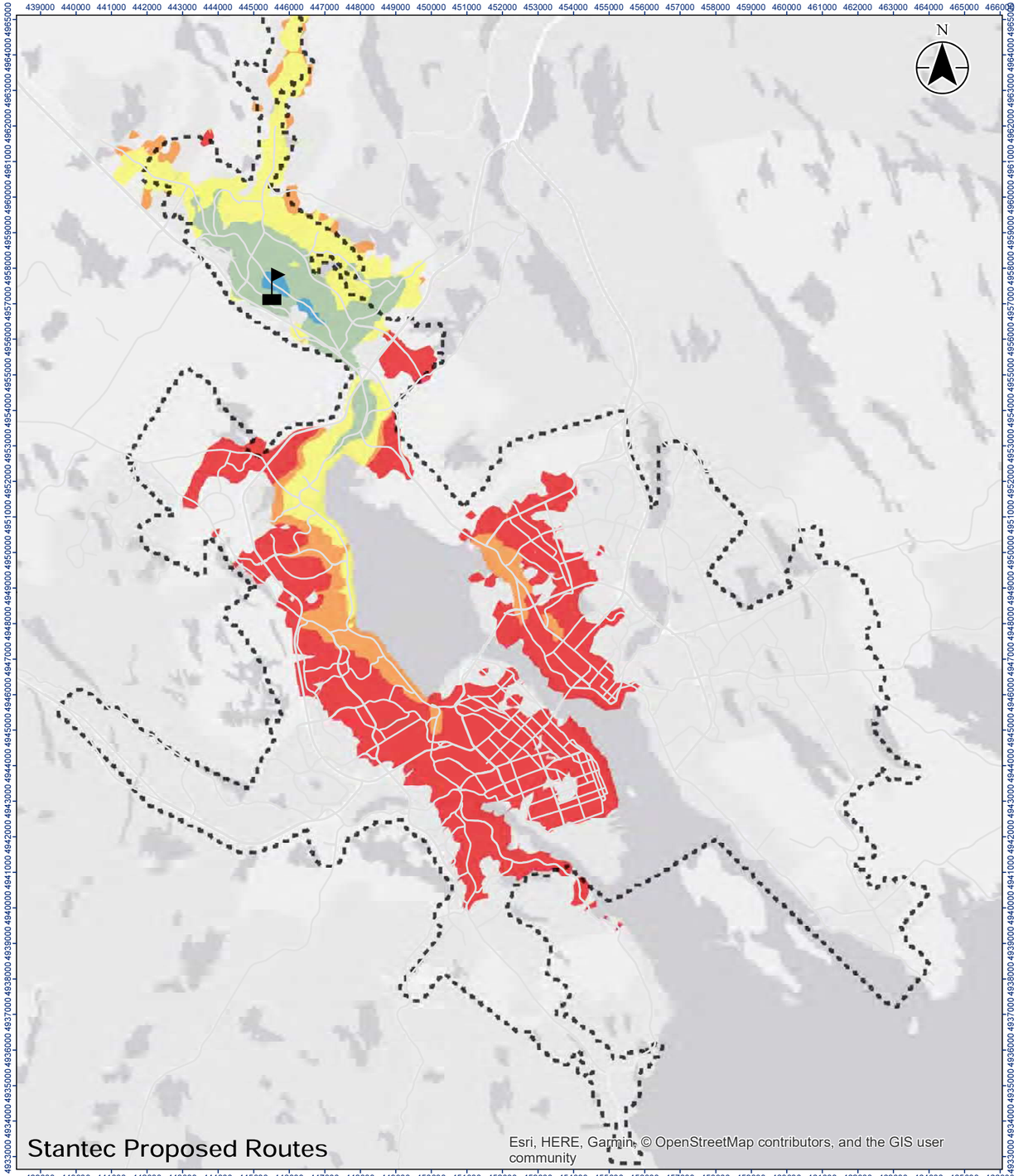
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

48

Figure No.

Origin: Sackville Public Library | Time Period: Weekday PM Peak (17:00:00 - 18:00:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Sackville Public Library

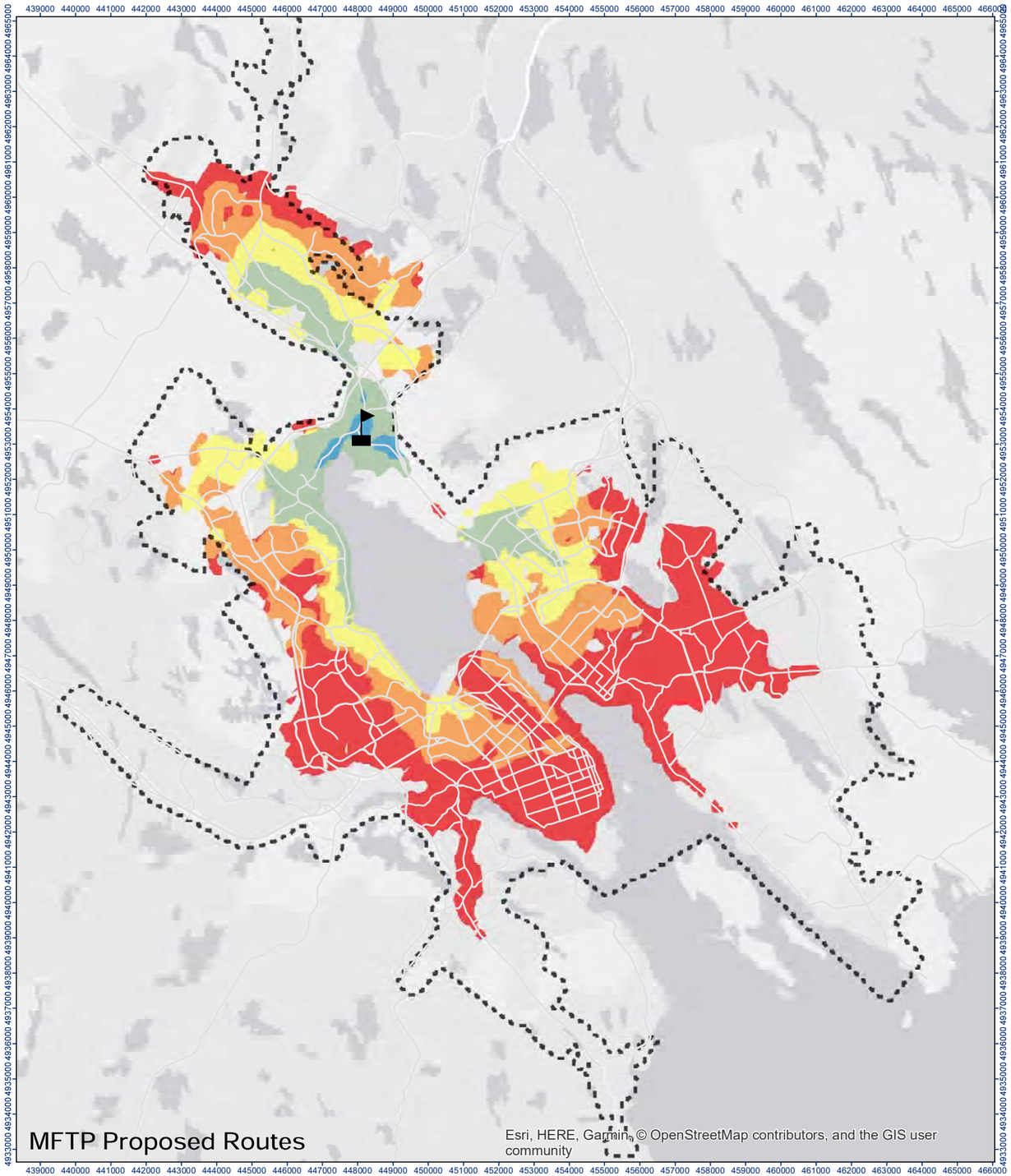
Urban Transit Service Boundary

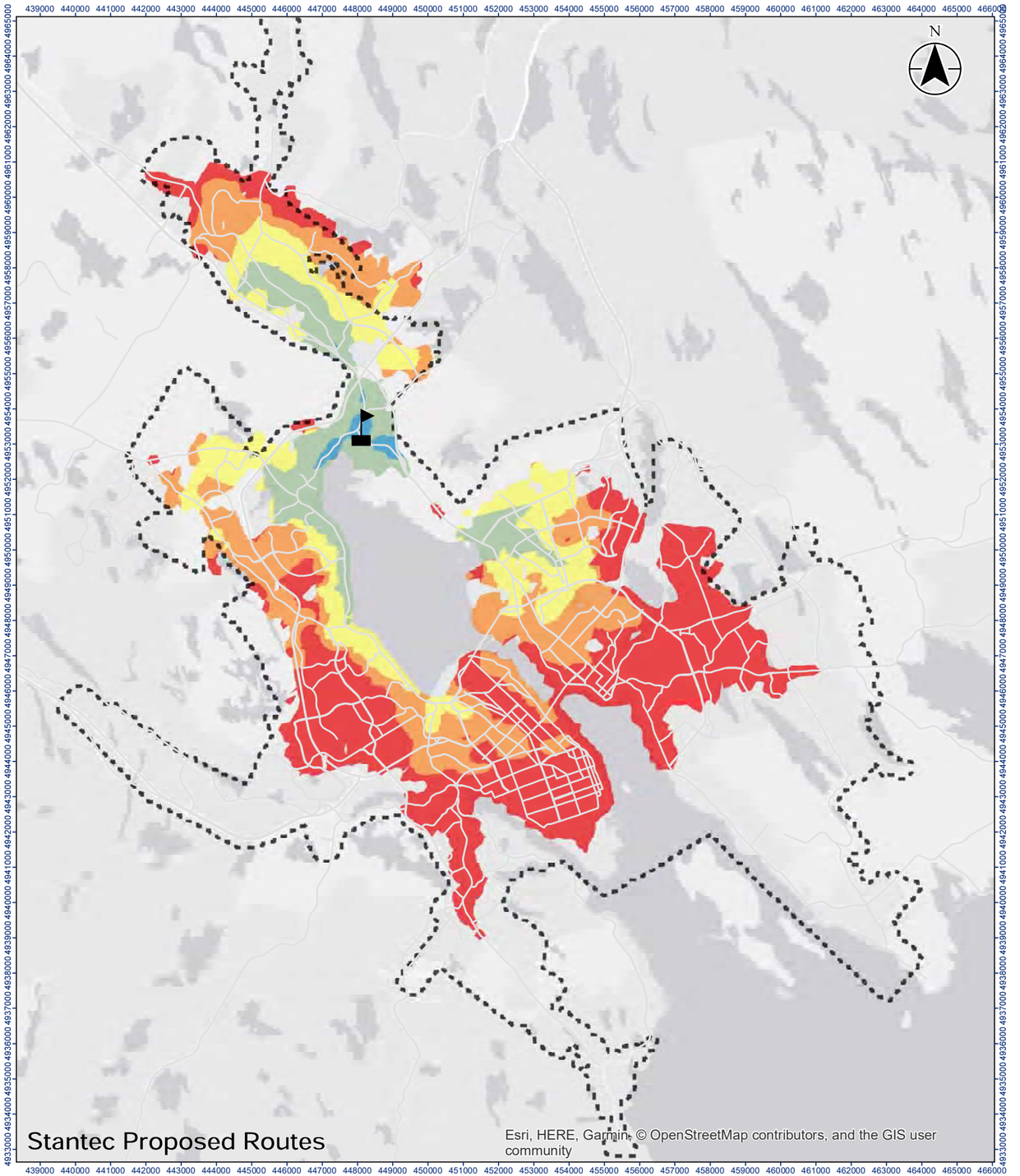
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

49

Figure No.

Origin: Sunnyside Mall | Time Period: Weekday AM Peak (8:00:00 - 9:00:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Sunnyside Mall

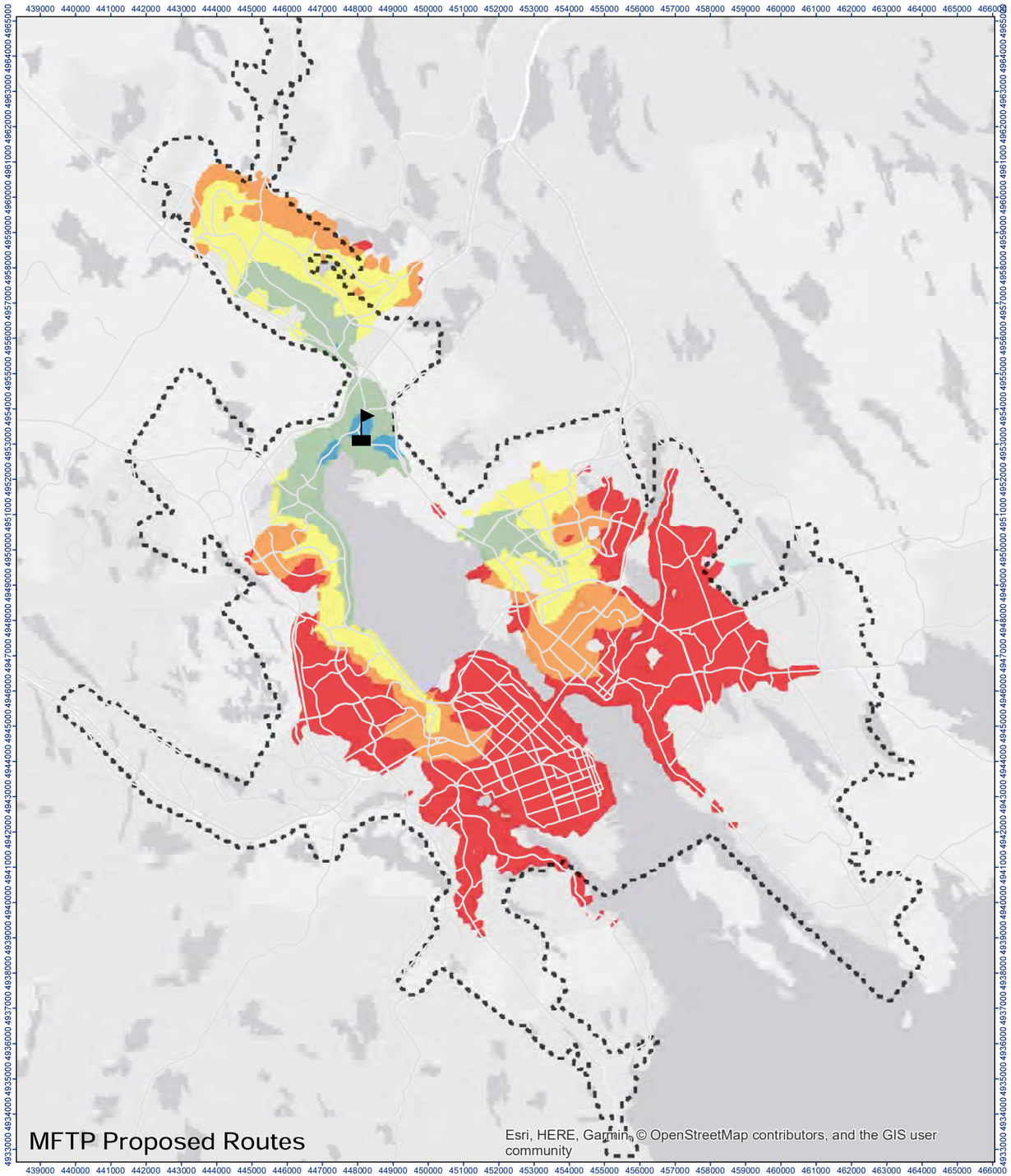
Urban Transit Service Boundary

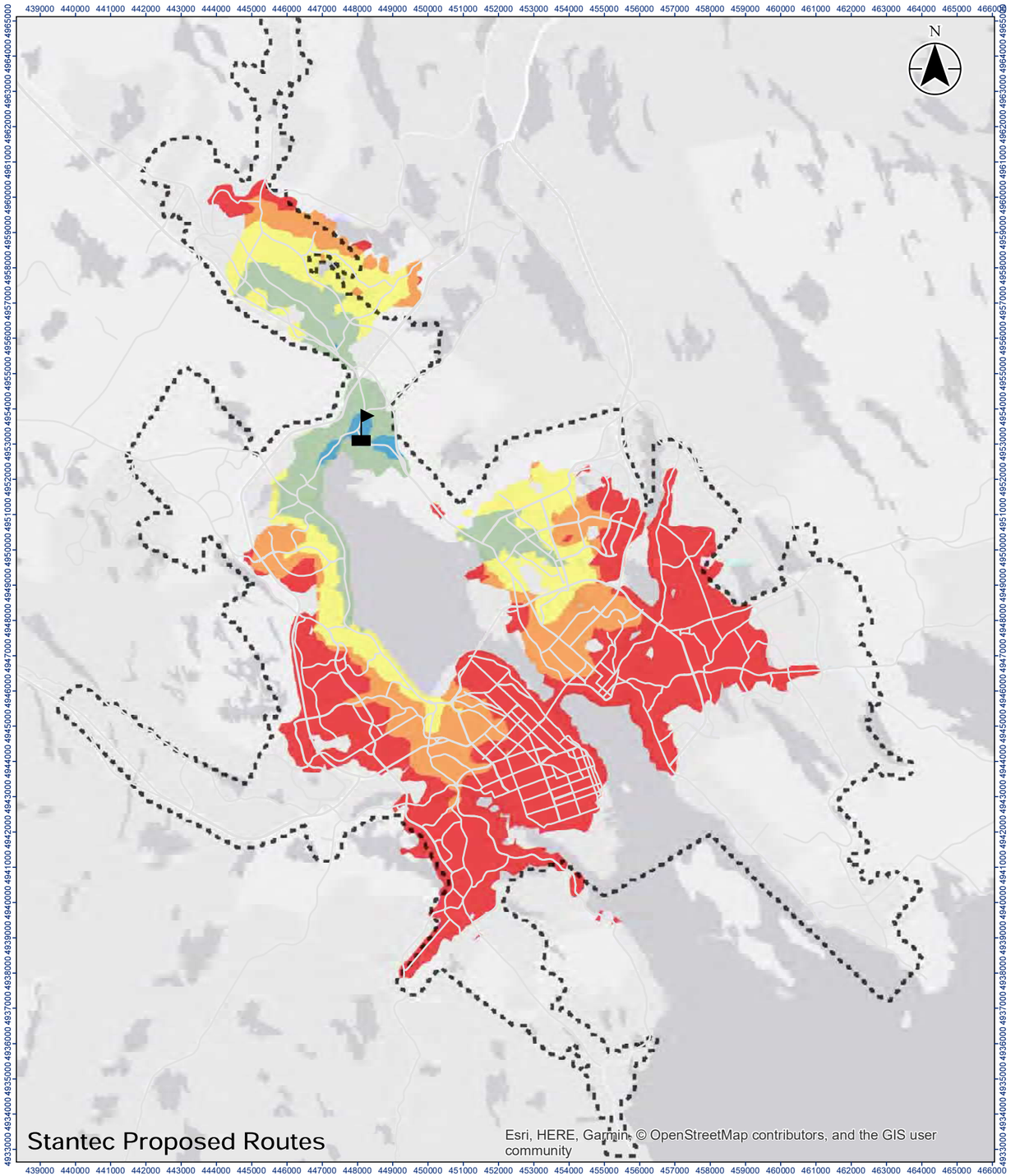
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

50

Figure No.

Origin: Sunnyside Mall | Time Period: Weekday Midday (12:30:00 - 13:30:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Sunnyside Mall

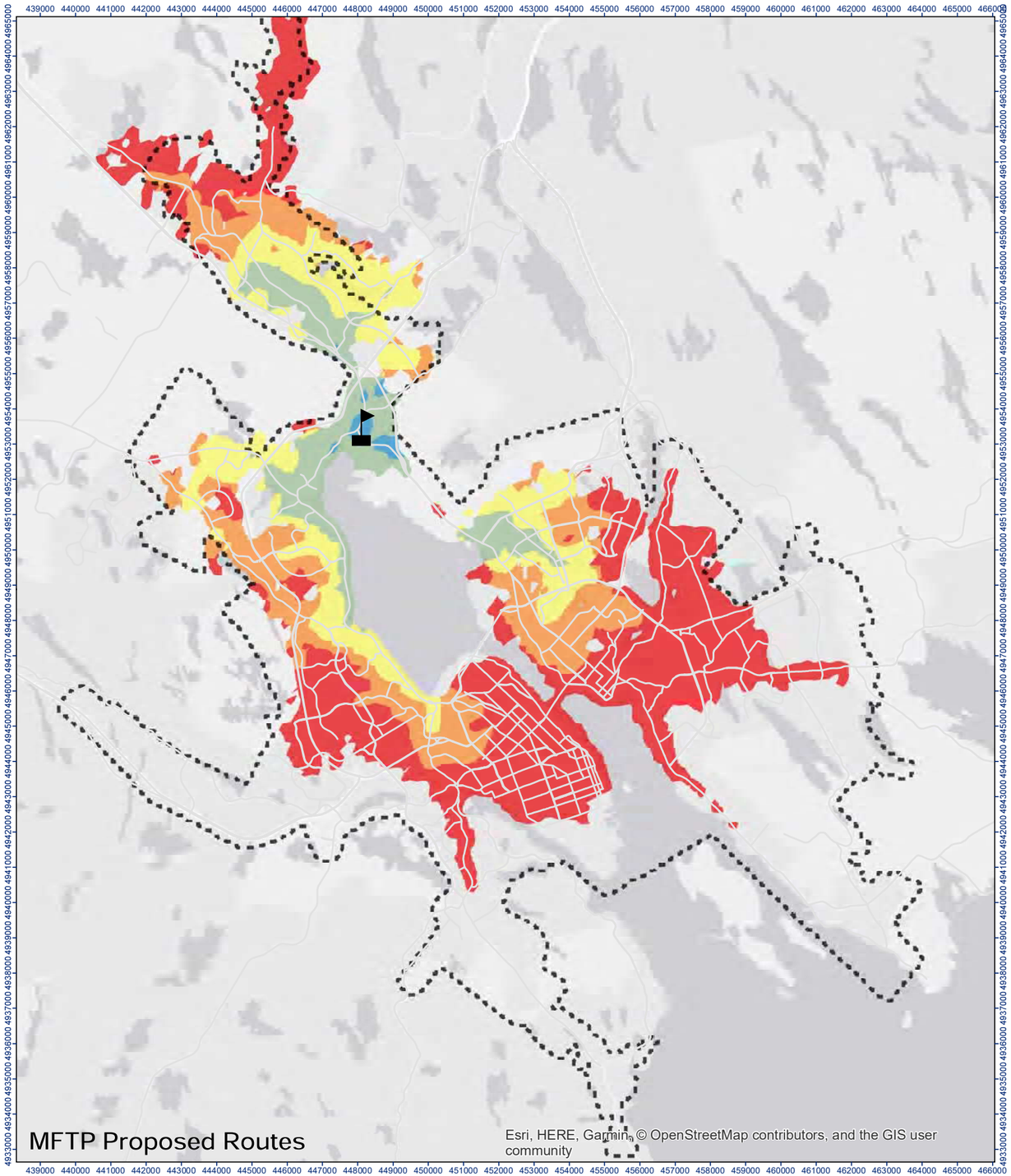
Urban Transit Service Boundary

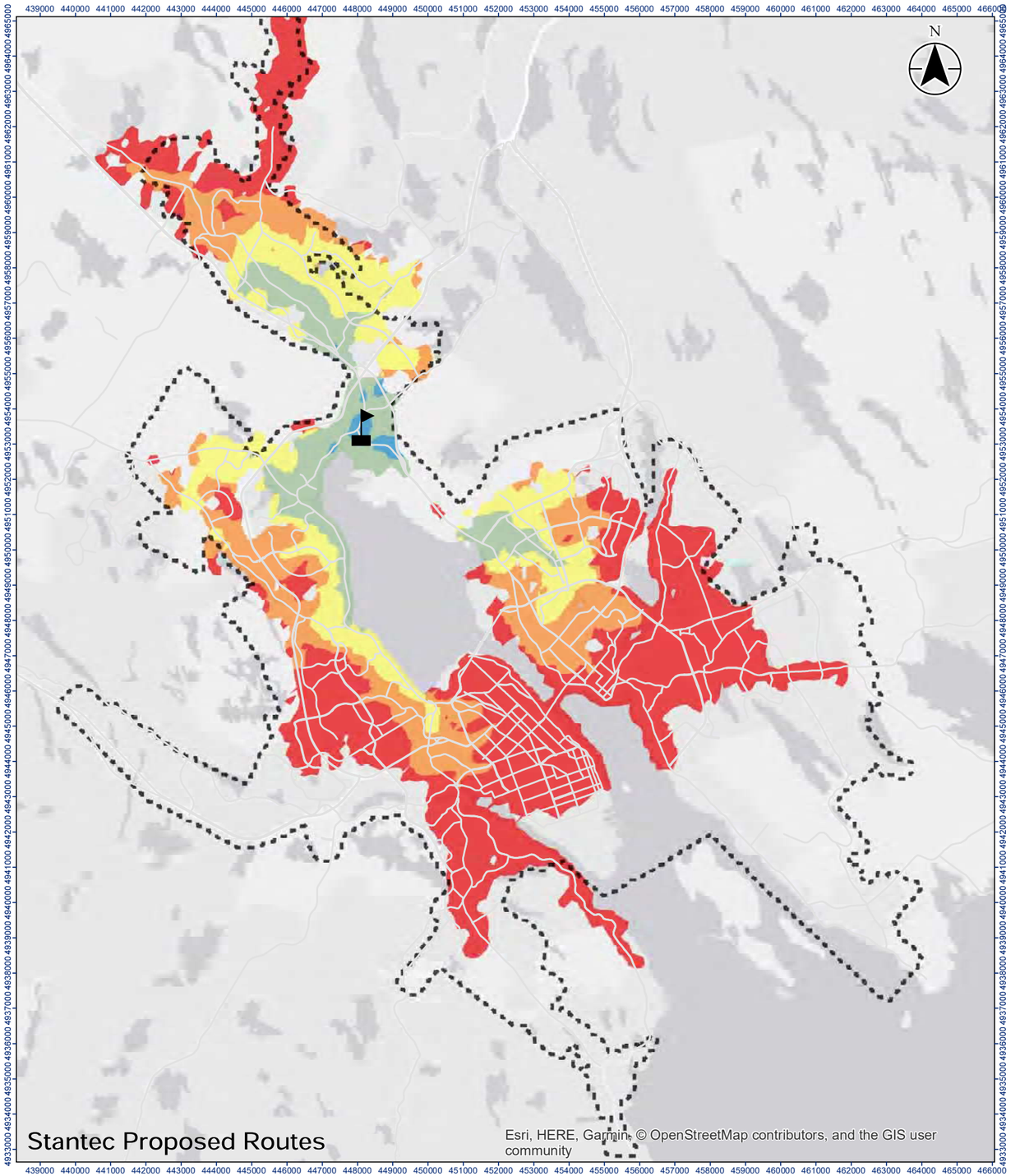
Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT





Halifax Regional Municipality

Project Location

HALIFAX TRANSIT /
MFTP CORRIDOR ROUTE REVIEW

Client/Project

51

Figure No.

Origin: Sunnyside Mall | Time Period: Weekday PM Peak (17:00:00 - 18:00:00)

Title

Notes

1. Coordinate System: NAD 1983 UTM Zone 20N
2. Data provided by Halifax Transit
3. Isochrones generated using Open Trip Planner

Prepared by Bhargav Channa R. on 2019-04-30
Technical Review by AB on 2019-04-30
Independent Review by BP on 2019-04-30

Legend

Name

Sunnyside Mall

Urban Transit Service Boundary

Travel Time (Minutes)

10 20 30 40 60

Stantec

HALIFAX TRANSIT