Appendix J

S-Line Corridor Transit Assessment

DILLON CONSULTING

Memo

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Date: May 5, 2023

Subject: S-Line Corridor Initial Assessment of Future Transit Needs Memo

Our File: #20-3410

1.0 Introduction

Dillon Consulting Limited (Dillon) was retained by the City of Hamilton to complete Phases 1 through 4 of the Municipal Class Environmental Assessment (EA) process for improvements to Rymal Road. The initial scope of the Rymal Road Environmental Assessment focused on various improvement scenarios to the corridor including the addition of roadway lanes to address projected capacity deficiencies and other issues. During the initial phase of the project the need to understand the future ridership demands on the S-Line Transit corridor became increasingly clear – particularly as it relates to linear infrastructure requirements within the Rymal Road EA study limits. With other segments of the future S-Line corridor currently undergoing similar planning processes, the City identified the need to conduct a future ridership study for the entirety of the S-Line Corridor. This work, which will inform planning along the Transit corridor towards 2051, is the focus of the current technical memo.

The purpose of this Transit Ridership Study is to assess potential passenger demand for the S-Line facility at various future time horizons (10, 20, and 30 years). The study corridor was divided into six sections for analysis, as seen below in **Figure 1**.

East-West section of S-Line:

1. Garner Road (Wilson to Glancaster)
2. Rymal West (Glancaster to Upper James)
3. Rymal Central (Upper James to Dartnall)
4. Rymal East (Dartnall to Upper Centennial)

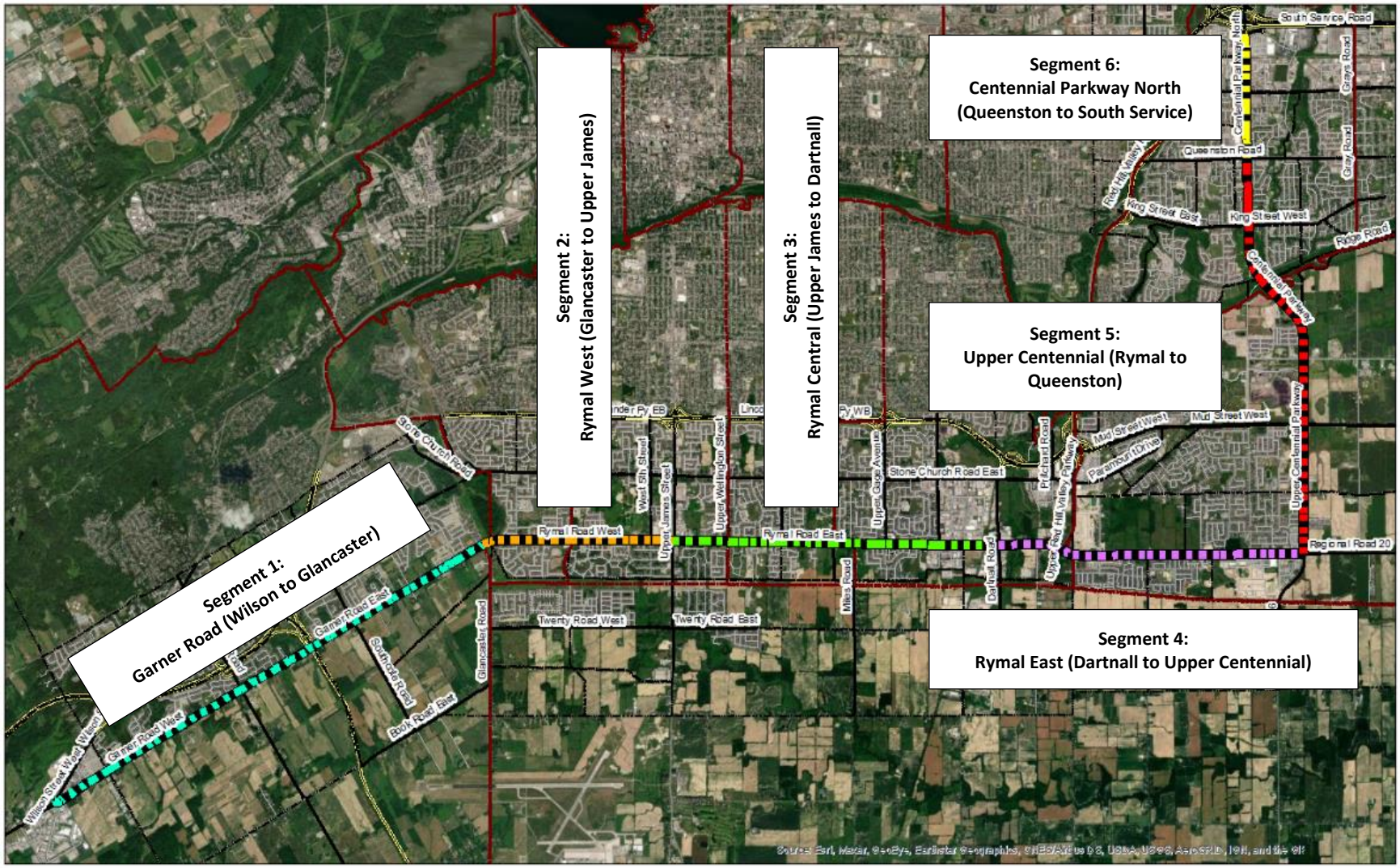
North-South section of S-Line:

1. Upper Centennial (Rymal to Queenston)
2. Centennial Parkway North (Queenston to South Service)

High-level ridership estimates were developed for the three planning horizons using a spreadsheet analysis tool. The following technical memorandum provides a description of the process, information

gathered, a summary of the findings, and the identification of the level of transit measures recommended for each of the six segments of the S-Line corridor for 2021, 2031 and 2041.

Figure 1: S-Line Transit Ridership Study Corridor Segments.



2.0 Existing Conditions and Assumptions

The following section provides an overview of the existing conditions review and transportation demand assumptions along the corridor.

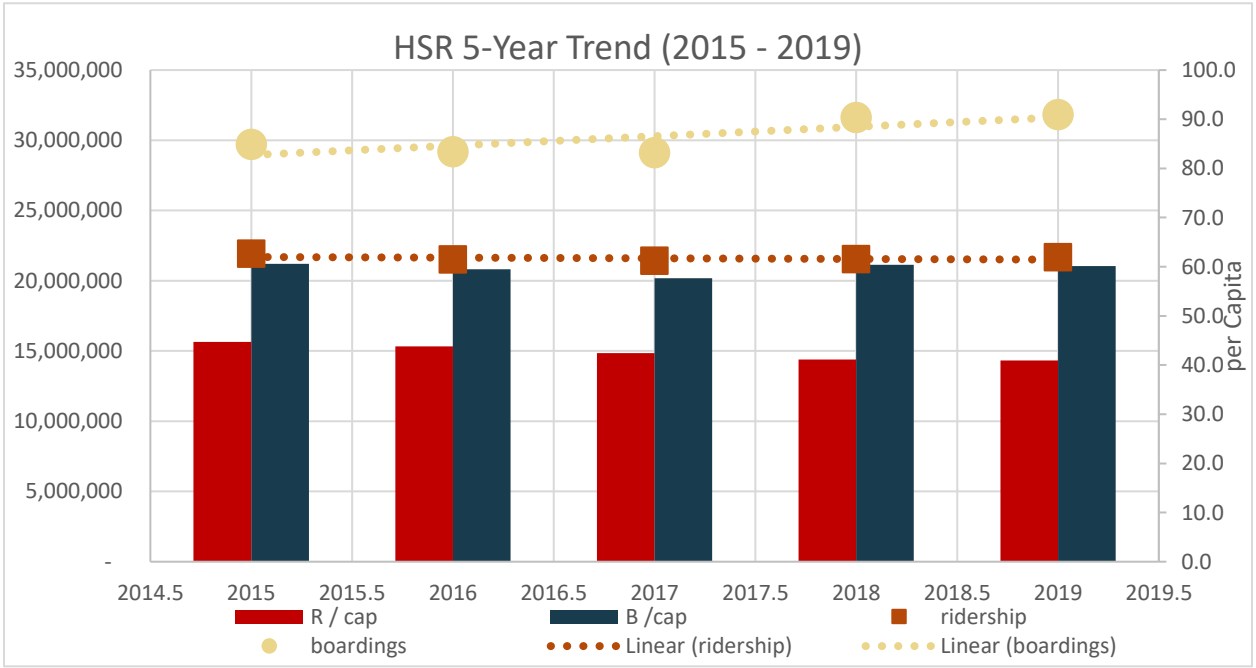
2.1 Canadian Urban Transit Association

The 2019 Canadian Urban Transit Association (CUTA) Factbook was used to determine the trips per capita in the greater Hamilton transit service area. This data is provided to CUTA through fare box ridership reported by Hamilton Street Railway (HSR), the City of Hamilton's conventional transit service provider and a Division of the Public Works Department.

The reported transit service area population of Hamilton (including Waterdown, Ancaster, Dundas and Rural Areas) is 529,394 of the 579,000 total residents. The existing total regular service linked trips completed by HSR is 21,659,817. Using the existing service area population and existing trips it was determined that there were an estimate 40.9 transit trips per capita within the City of Hamilton in 2019.

Figure 2 presents 5 years of reported CUTA data from 2015 to 2019. It is noted that while boardings have increased, overall ridership has been maintained suggesting an increase in the number of boardings per rider during each transit trip (i.e. increased transferring between routes which can be due to service changes and transfers to A-line and B-Line). The ridership per capita has been maintained steady between 40 and 45 transit trips per capita.

Figure 2: Historic HSR Annual Boardings, Riders and Transit Trip Rates



Within the greater City of Hamilton Route 18 operates independently in the rural community of Waterdown as a single route. To calculate a more representative trips per capita rate for the urbanized HSR service area, both Waterdown and its trip counts were removed from the overall ridership calculation. The results are presented in **Table 1**, and result in an increase of estimated 1.5 trips/capita in 2019.

Table 1: Trips per Capita. (HSR)

	Population	Trips	Trips / Capita
Hamilton (All routes)	529,394	21,659,817 trips / year	40.9
Waterdown (Route 18)	-19,500	-42,000 trips / year	2.2
Hamilton (no Route 18)	=509,900	=21,617,800 trips / year	42.4

A rate of approximately 43 trips/capita/year is therefore assumed to be representative of the average ridership levels for the urbanized HSR service area in 2019 based on CUTA Factbook Data.

To determine if 43 trips/capita is a suitable rate to use for a city the size of Hamilton, CUTA Factbook data was consulted based solely on population, as presented in **Table 2.**

Table 2: Trips per Capita. (Equivalent Population Group)

Population Group	Trips / Capita 2017	Trips / Capita 2018	Trips / Capita 2019
Group 2: 400,001 – 2,000,000	62.2	62.8	62.7
Group 3: 150,001 – 400,000	40.6	40.3	40.7

** Population groups Obtained from CUTA include most transit agencies across Canada.*

While Hamilton's population suggest that it is part of Population Group 2, it achieves average system trips per capita in line with smaller cities with populations less than 400,000. In the future it would be reasonable to assume that Hamilton could achieve trips per capita more in line with Population Group 2.

2.2 Transportation Tomorrow Survey

The *Transportation Tomorrow Survey (TTS)* was used to identify the city-wide average for peak and annual trips per capita, as seen in **Table 3** below. The City wide average of 44.2 is similar to the fare box ridership reported by HSR in the CUTA Factbook. It is recognized that the City wide average represents a variety of land use types and neighbourhoods.

Table 3: TTS City-wide Average for Peak and Annual Trips per Capita.

	AM Peak Period (6:00 – 9:00)	Daily (24h)
All Trips	239,200	1,090,600
% Transit	6.8%	6.7%
Transit Trips	16,313	72,782
Weekday Transit Trip Rate	0.0330	0.1474
Annual Transit Trip Rate	9.9	44.2

The TTS also provides more refined data based on the *City of Hamilton Summary by Ward March 2018.* The Wards are shown in **Figure 3***.* **Table 4** presents the peak period and daily trip rates, transit shares, and transit trip rates for each Ward.

Ward 2 is the central business district (CBD) area and is the densest. Ward 3 includes waterfront and a portion of the CBD. These wards do not represent the typical urban characteristics of the Rymal Road study area. This is indicative of the higher density and transit shares than other areas in the city. Wards 6, 7, and 8, represent typical developed Hamilton population densities (between 24 and 49 p/ha).

Figure 3: TTS Wards in Hamilton.

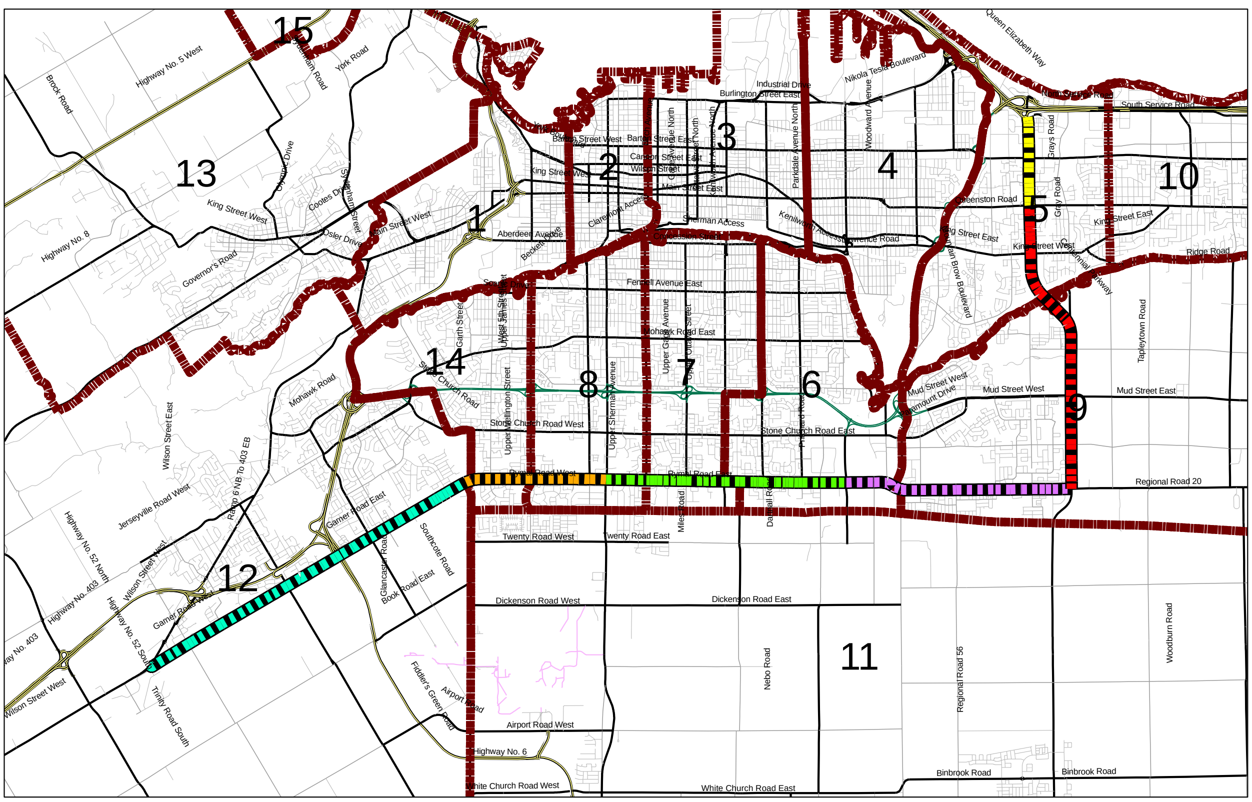


Table 4: Population and Density of Wards in Hamilton.

Ward	Population (2016)	Density (p/ha)	AM Peak Period Trip Rate (All Trips)	Daily Trip Rate (All Trips)	AM Peak Period Transit Share %	Daily Transit Share %	AM Peak Period Transit Trip Rate (trips per capita)	Total Annual Transit Trip Rate (trips per capita)	S-Line
Ward 1	30,300	19.8	0.45	2.45	16%	13%	0.071	95.6	
Ward 2	39,700	67.1	0.40	2.05	18%	18%	0.072	110.4	
Ward 3	35,000	23.1	0.40	1.99	12%	14%	0.048	83.8	
Ward 4	32,200	15.8	0.41	1.93	11%	11%	0.045	63.6	
Ward 5	38,300	19.5	0.41	1.83	9%	7%	0.037	38.5	
Ward 6	38,300	23.8	0.49	2.10	6%	6%	0.030	37.7	X
Ward 7	62,900	48.5	0.46	1.96	8%	7%	0.037	41.2	X
Ward 8	46,000	34.0	0.49	2.17	7%	7%	0.035	45.5	X
Ward 9	29,000	3.9	0.49	1.91	2%	3%	0.010	17.2	X
Ward 10	25,700	8.2	0.44	2.00	4%	3%	0.018	18.0	
Ward 11	42,800	2.2	0.50	2.14	1%	1%	0.005	6.4	X
Ward 12	37,700	1.3	0.47	2.25	1%	1%	0.005	6.7	X
Ward 13	23,200	0.8	0.45	2.29	6%	3%	0.027	20.6	
Ward 14	16,500	14.6	0.45	1.98					X
Ward 15	27,800	2.2	0.51	2.19					
TOTAL	**525,400**		**0.46**	**2.08**	**6.8%**	**6.7%**	**0.0310**	**41.6**	

Note: Total Annual Transit Trip Rate based on 24hr weekday trips x 300 weekday equivalent
Source: 2016 TTS

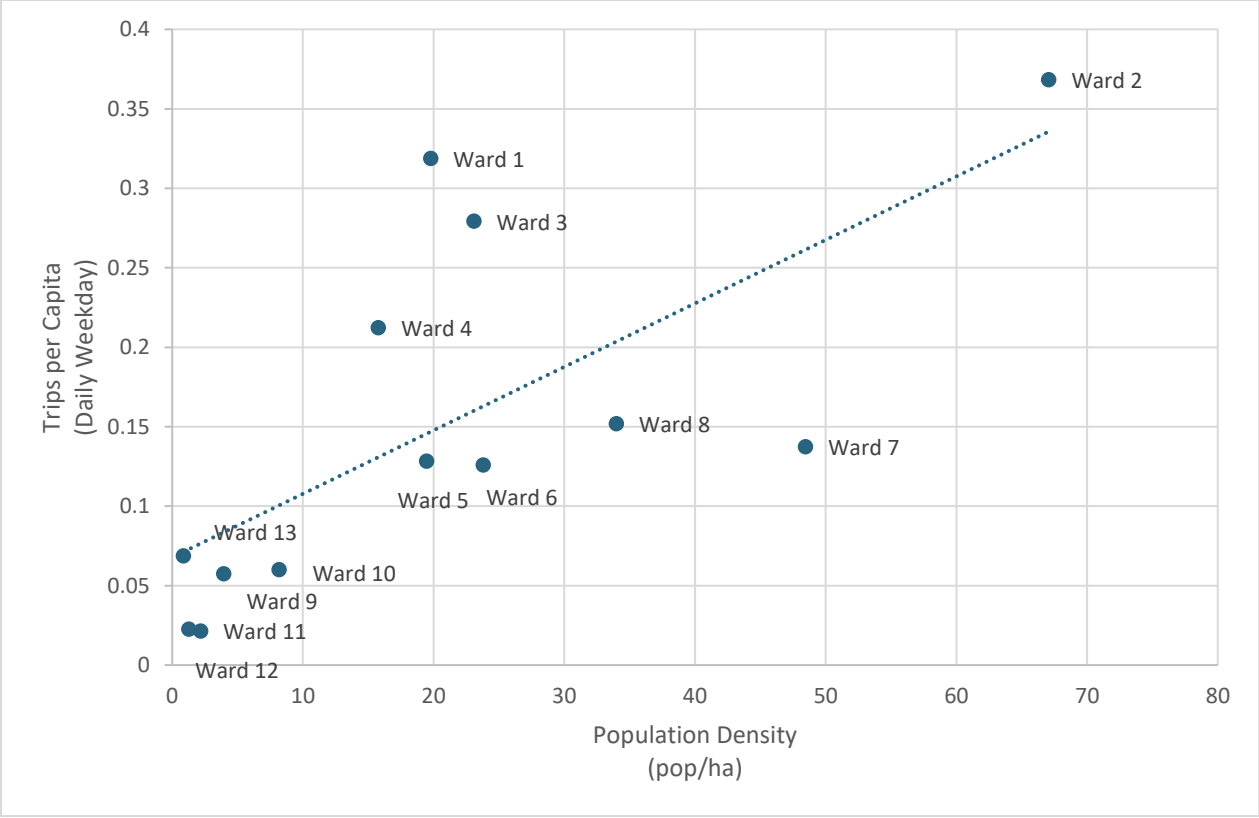
As noted in **Table 4**, transit trip rates vary from between 6.4 to 110 trips per capita. Wards 1 and 2 represent the more developed and downtown area with transit trip rates that are significantly higher than other areas. It is postulated that, as daily trip rate for all modes are similar with Wards 1 and 2, the higher trip rate is due to higher transit mode shares. Each Ward's population density was plotted against their reported average transit trip rate to determine trip making characteristics of the wards within Hamilton (**Figure 4**).

Wards 1 and 2, with transit shares of 13% and 18% respectively, result in the highest trip rates while Ward 4, with a transit share of 11%, is more representative of established neighbourhoods with good existing transit services. It is recognized that the population density for Ward 4 is also low due to the industrial areas along the waterfront, and the residential / commercial areas are denser (the point on the figure would therefore be shifted to the right being more in line with the trend line shown on **Figure 4**.

Wards 9, 10, 11, 12, and 13 show both low population density and transit trip rates.

Wards that are to be served by the future S-Line indicate existing transit trip rates less than 45.5 transit trips per person per year, with several wards achieving less than 20 transit trips per person per year.

Figure 4: Annual Trips per Capita Compared to Population Density.



2.3 Existing Transit Demand Potential for S-Line Catchment Area

The potential transit demand that is currently being accommodated within the S-Line corridor was estimated based on the existing TTS data. The existing population within 1km of the corridor was determined using the traffic zone system as shown in **Figure 5**. For each traffic zone, the percentage of the zone that is within 1km of the S-Line was calculated and applied to the zone populations. The result is an estimated total population within 1km within each analysis segment.

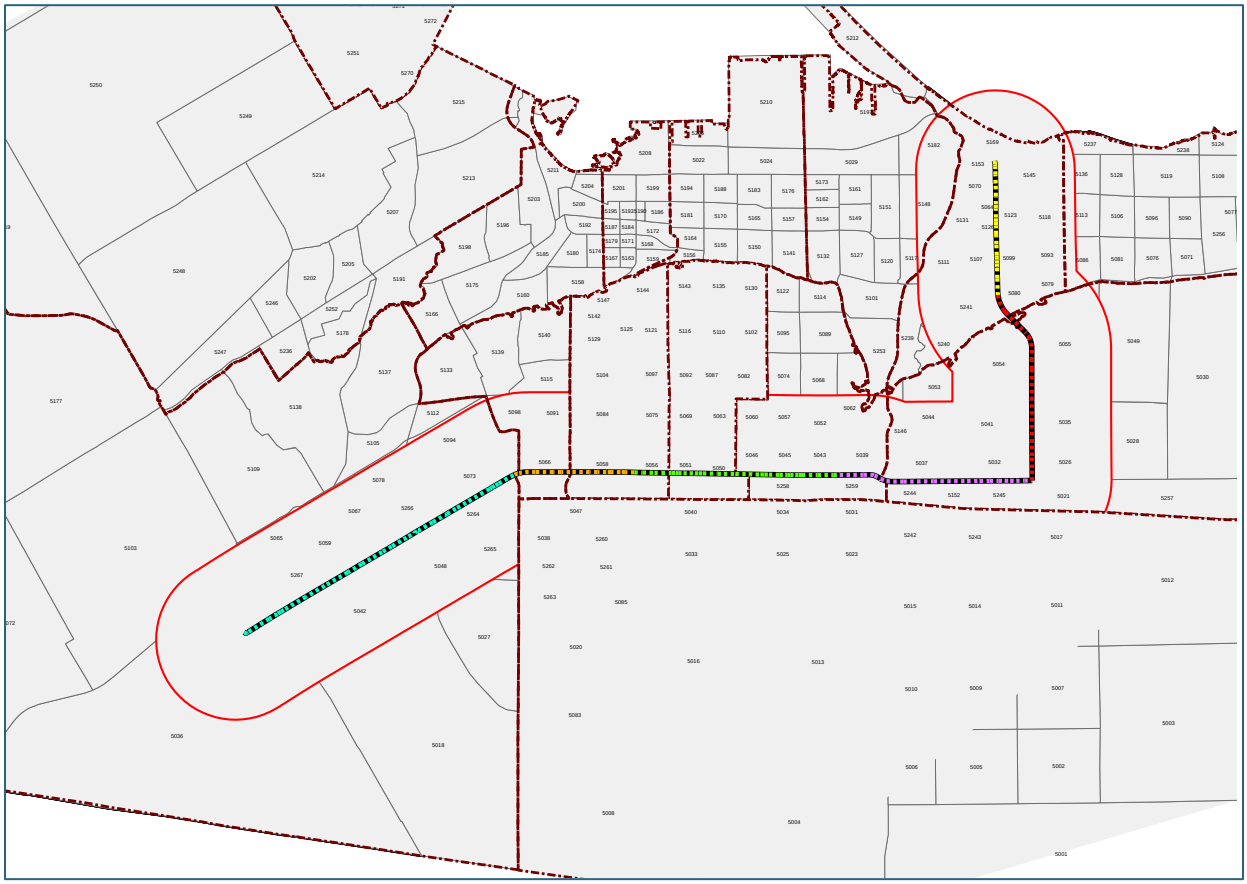
The existing transit trip rates that were identified (at the ward level) were applied to the population for each analysis segment. The result is an estimated total existing transit demand within 1km of the future S-Line corridor. **Table 5** presents the Annual and AM Peak Period transit trips that would be generated within each analysis segment.

Table 5: Existing 1km Catchment Area Population and Transit Demand

	Population within 1 km (2021)	Annual Transit Trip Rate	Annual Transit Trip Origins	Daily Transit Trip Origins	AM Peak Period Transit Trip Rate	AM Peak Period Transit Trips	% AM Peak Trips / Daily
Segment 1	20,550	6.7	138,600	**462**	0.005	96	21%
Segment 2	14,050	21.9	222,650	**742**	0.017	170	23%
Segment 3	20,850	38.3	820,100	**2734**	0.031	678	25%
Segment 4	13,550	25.2	234,500	**782**	0.018	134	22%
Segment 5	17,800	25.6	569,050	**1897**	0.021	509	24%
Segment 6	10,200	39.3	396,450	**1,322**	0.037	377	28%
TOTAL	**97,000**		**2,381,350**	**7,939**		**1,964**	**24%**

The AM peak period represent on average approximately 24% of Daily transit trips (assuming 300 weekday equivalent days per year). This is also in line with typical industry travel patterns, with approximately 25% of the daily demand being generated in each of the peak periods. Increases in flexible work arrangements and work from home as a result of COVID-19 has the potential to further spread travel demand throughout the day, however that is not being considered in this analysis at this time.

Figure 5: Traffic Zones within 1 km of Future S-Line Corridor



2.4 Station and Route Activity from HSR

Route 44 operates along the entire study corridor. Using Automated Passenger Counter (APC) data for Route 44, daily passenger volumes between stations and peak load point per segment direction was determined. (**Table 6** and **Table 7** below)

The following key travel trends are noted from the data:

- The peak point location where there are the most passengers being served between stations represents approximately 30% of the total route boardings. (peak point is determined by developing a passenger activity profile as shown in Figure 6 for the eastbound and westbound directions by adding boardings to route passengers and subtracting alightings for each stop).
- Passenger demands are relatively balanced between the segments with few areas demonstrating uncharacteristically high peak points. This suggests a well-structured route, the service frequency is not just serving a single peak point, and passengers are using the bus through the whole route.

It should be noted that with the COVID-19 global pandemic, ridership levels have decreased compared to pre-COVID levels, while service levels have remained similar. Therefore 2019 ridership data was used.

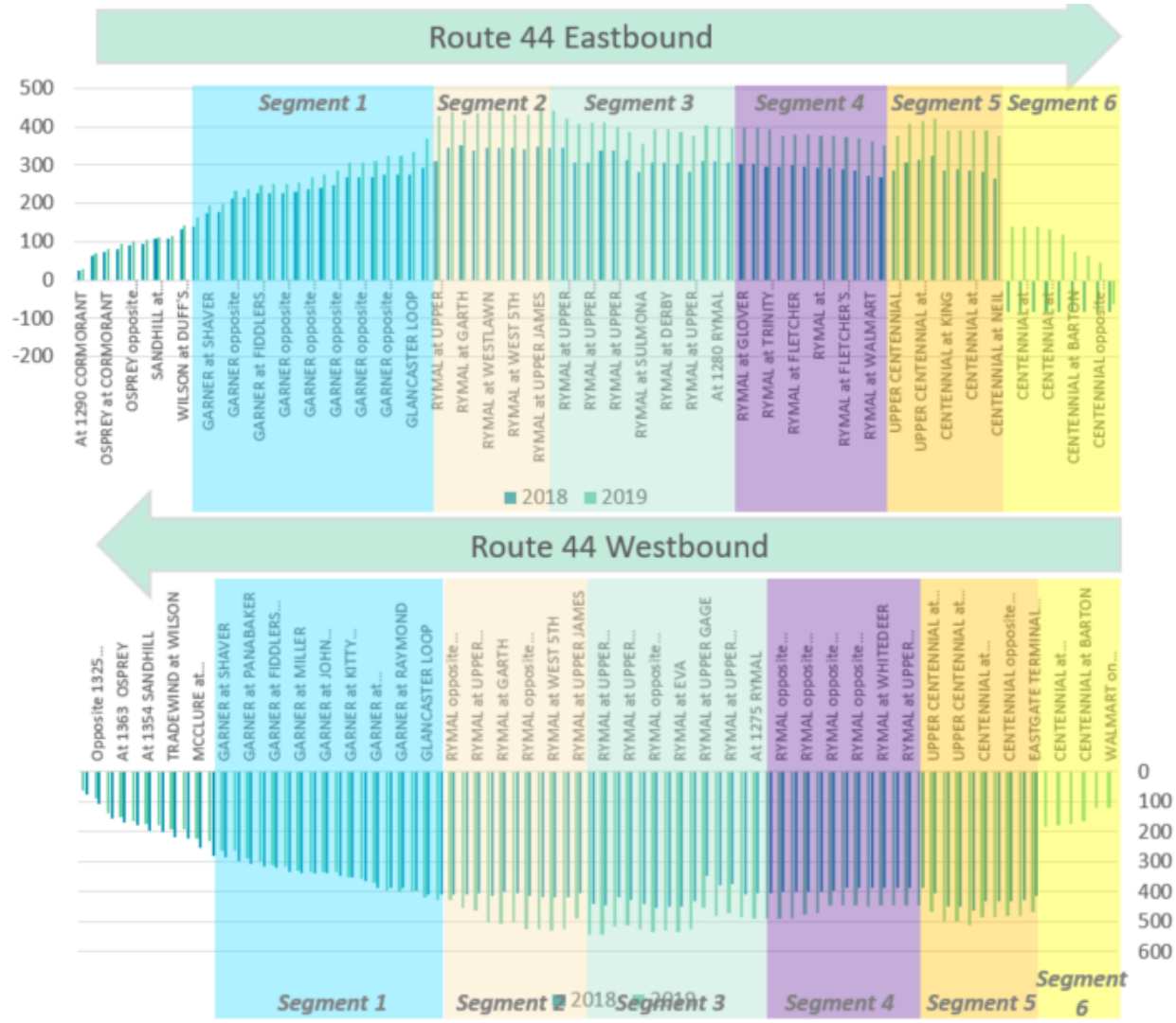
Table 6: Route 44 Activity and Peak Load Point (Eastbound Direction)

Eastbound	Boardings	Alightings	Activity	Pk Pt	% of RTE Boardings
Ancaster Business Park	174	9	183		
Segment 1	193	36	230	**322**	19.8%
Segment 2	358	234	592	**441**	27.1%
Segment 3	555	589	1,144	**447**	27.5%
Segment 4	216	260	476	**398**	24.5%
Segment 5	270	484	754	**422**	26.0%
Segment 6	32	234	266	**138**	8.5%
TOTAL	**1,625**	**1,837**	**3,462**		

Table 7: Route 44 Activity and Peak Load Point (Westbound Direction)

Westbound	Boardings	Alightings	Activity	Pk Pt	% of RTE Boardings
Ancaster Business Park	16	186	202		
Segment 1	33	219	253	**402**	22.0%
Segment 2	248	374	622	**529**	28.9%
Segment 3	584	585	1,169	**544**	29.8%
Segment 4	254	209	462	**488**	26.7%
Segment 5	494	233	727	**511**	28.0%
Segment 6	216	34	250	**163**	8.9%
TOTAL	**1,829**	**1,654**	**3,483**		

Figure 6: Daily Passenger Volumes



Note that the APC data presented in **Figure 6** represents total average daily route activity, and is not specific to a period during a typical weekday.

Staff from HSR had completed a further analysis to assess potential relationships between peak period and peak hour route activity. The following were noted:

- Between 30% and 80% of the peak period loads are within the highest peak hour
- Much of the ridership is between 40% and 60% of the peak period
- The data confirmed a typical rule of thumb that the peak hour is approximately 50% of the peak period demands.

Figure 7: Eastbound Peak Hour Factor of Existing Condition

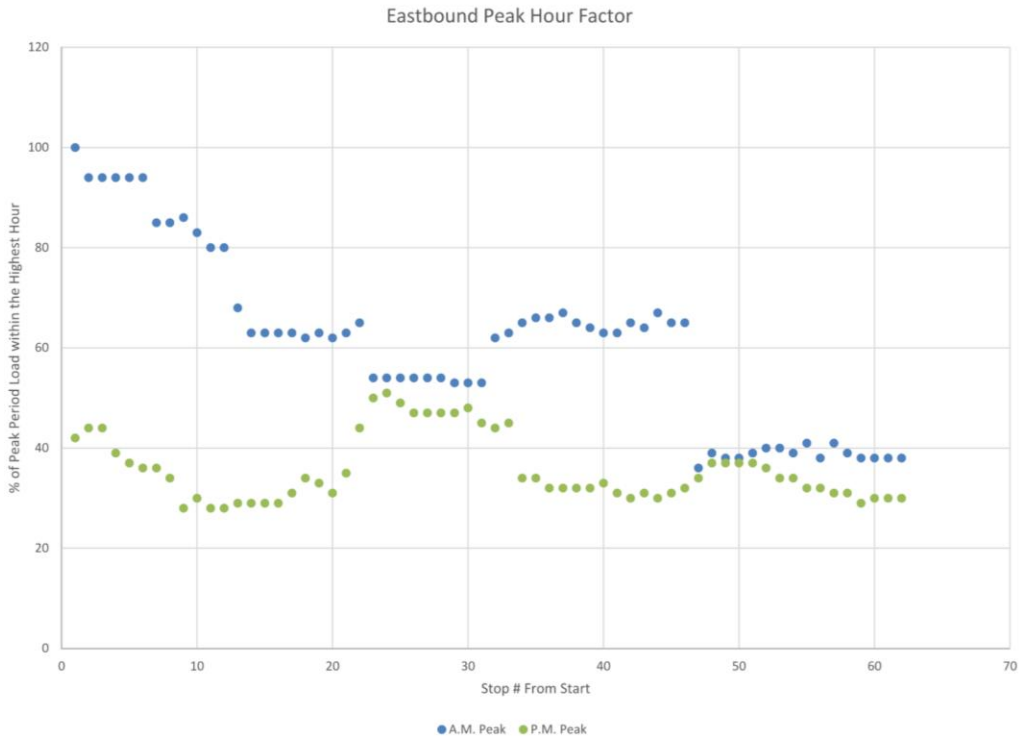
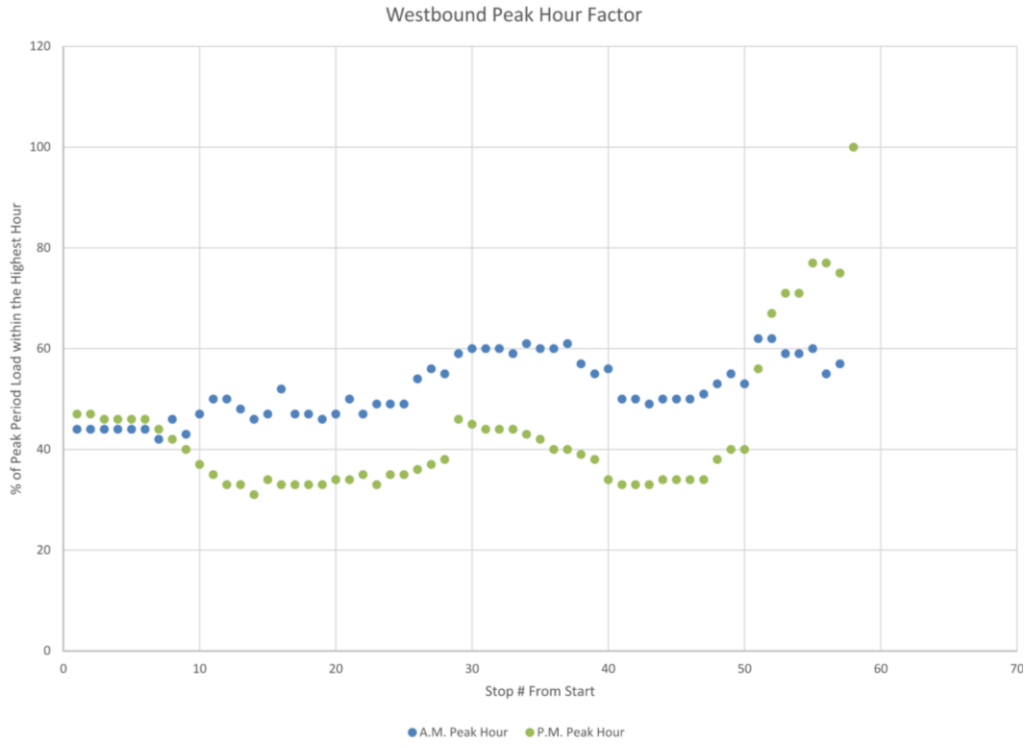


Figure 8: Westbound Peak Hour Factor of Existing Condition



2.5 Captured Transit Demand

Using the data that was compiled in Sections 2.3 and 2.4, the percentage of existing transit demand potential that is captured by Route 44 can be estimated.

The demand of each segment of the corridor was calculated by dividing the boardings on Route 44 (2019 APC data) by the potential transit demand within 1 km (2021 population * 2016 TTS transit trip rate). This calculation is displayed below in **Table 8.**

Table 8: Captured Transit Demand Along Route 44

	TTS			HSR	% of Daily Transit Demand Captured on Route 44	Other Routes Available
	Population within 1 km (2021)	Annual Transit Trips (Annual Ward Trip Rates x Population)	Daily Transit Trip Origins (Annual / 300)	Daily Transit Boarding's on Route 44		
Segment 1	26,500	178,586	595	227	38%	16
Segment 2	3,350	104,746	349	606	174%	34, 35, 43
Segment 3	26,700	1,021,043	3,403	1139	33%	20, 24, 26, 27, 35
Segment 4	15,850	409,373	1,365	470	34%	11, 21, 42, 43
Segment 5	13,050	336,681	1,122	764	68%	5, 52, 58
Segment 6	3,200	126,886	423	248	59%	1, 2, 44, 56
TOTAL	**88,650**	**2,177,316**	**7,258**	**3,454**	**48%**	

The analysis shows that on average approximately 48% of the estimated transit demand potential within 1km of route 44 boarded the bus. This is reasonable since there are several other routes that serve transit demand within the catchment area, providing north-south connections to major attractions including the downtown.

Segment 2 shows many more boardings on route 44 compared to the estimated potential transit demand. This can be the result of passenger transfers from other routes which would not be included in the trips / capita estimate (including transfers from the A-Line along Upper James Street), and/or passengers attracted to the route from beyond the 1 km catchment area.

It is anticipated that in the future, improved east-west transit connections and intensification outside of the downtown will result in a higher share of transit demand potential travelling east-west on the S-line. This is discussed further in **Section 4.1**.

3.0 Forecasted Growth

This section of the report presents the future population growth within the 1km catchment area of the corridor. This catchment area is used to determine the future transit potential and transit demand growth along each segment of the corridor.

3.1 Population Growth

The future population density is estimated for 2031, 2041, and 2051 under No Urban Boundary Expansion and Urban Boundary Expansion (UBE) Scenarios. Growth projections and a preferred option are informed by the City's GRIDS2 process. The UBE scenario has four phasing options:

1. "East to West" – assumes Elfrida, Twenty Road East and Twenty Road West / Garner will be added to the urban boundary, progressing easterly from Elfrida –not including Whitechurch
2. "Non-Prime Agricultural Lands Priority" – assumes lands not identified as Prime Agricultural will be developed in the first phase – not including Whitechurch
3. "West to East" – assumes Twenty Road West / Garner, Twenty Road East and Elfrida will be added to urban boundary, progressing westerly – not including Whitechurch
4. "Distributed Development – assumes portions of Elfrida, Twenty Road East, Twenty Road West / Garner and Whitechurch will be developed in the first phase, with portion of the remaining land developed in the second phase

The 10, 20, and 30 year horizon populations were provided by the City of Hamilton for the UBE scenarios. For the No UBE scenario, the 2031 and 2041 values were interpolated because only the 2021 and 2051 population values were provided. The forecast population for each Scenario is presented in **Table 9.**

Table 9: Population Forecast (within 1km of the S-Line Corridor)

Within 1km	Existing (2021)	2021 Pop Density	Future (2031)	Future (2041)	Future (2051)	2051 Pop Density	Total Growth
No UBE	88,607	14.4	-	-	126,896	20.7	43%
Scenario 1			106,650	132,450	158,252	25.8	79%
Scenario 2			104,050	127,300	161,644	26.3	82%
Scenario 3			110,150	147,200	160,219	26.1	81%
Scenario 5b			101,550	119,050	139,667	22.7	58%

A total of between 43% and 82% growth in population is anticipated within 1 km of the future S-Line which can have implications on the infrastructure and transit service that may be required. At a minimum it would be expected that transit demand would grow proportionally to growth in population. Additionally, increases in transit mode shares would result in even higher growth in transit demand.

3.2 Future Transit Ridership Potential

It was previously determined that the City achieves an existing transit trip per capita of between 40 and 45 trips / year, with the study area achieving rates closer to 24 trips per capita. Existing Ward transit trip rates were applied to population forecasts to estimate baseline growth in transit demand. Increases in transit shares are not included under this baseline condition. The baseline transit demand would grow at a similar rate as population growth as noted in the Tables below.

Table 10: 2051 Annual Transit Trips (Existing Transit Trip Rate)

Segment	Existing Annual Transit Trip Rate	Existing Annual Transit Trips	No UBE	Scenario 1	Scenario 2	Scenario 3	Scenario 5b
Segment 1	6.7	178,586	342,400	324,600	324,575	324,600	324,600
Segment 2	21.9	104,746	118,700	104,100	104,075	104,100	104,100
Segment 3	38.3	1,021,043	1,143,200	1,071,700	1,071,700	1,071,700	1,071,700
Segment 4	25.2	409,373	432,750	669,050	663,675	666,400	521,500
Segment 5	25.6	336,681	484,300	583,250	566,500	577,150	566,250
Segment 6	39.3	126,886	187,600	1,102,450	1,274,175	1,190,700	544,200
TOTAL		**2,177,316**	**2,708,950**	**3,855,150**	**4,004,700**	**3,934,650**	**3,132,350**
% Growth		**-**	**24%**	**77%**	**84%**	**81%**	**44%**

Table 11: 2051 Peak Period Transit Trips (Existing Transit Trip Rate)

Segment	Existing Peak Period Transit Trip Rate	Existing Peak Period Transit Trips	No UBE	Scenario 1	Scenario 2	Scenario 3	Scenario 5b
Segment 1	0.005	124	250	200	225	200	200
Segment 2	0.017	80	100	100	75	100	100
Segment 3	0.031	836	950	900	875	900	900
Segment 4	0.018	299	300	500	500	500	400
Segment 5	0.021	271	400	450	425	450	450
Segment 6	0.037	119	200	1,050	1,225	1,150	500
TOTAL		**1,728**	**2,200**	**3,200**	**3,325**	**3,300**	**2,550**
		-	**27%**	**85%**	**92%**	**91%**	**48%**

Increases in transit mode shares will result in increases to the overall city-wide rates but will have more significant impacts in developing areas where existing transit demand is limited. A city wide mode share target of 12% would suggest that the downtown would achieve higher rates, and developing areas would have less transit use. It was assumed that Ward 4 would be a reasonable and realistic proxy for estimating future transit demand potential along the S-Line. This is due to the fact that S-Line should be able to achieve the following with planned service improvement and population densities:

- Represents a transit mode share of 11%,
- Represents population densities along the future S-Line,
- Results in an increase in transit demand for all segments along the S-Line, and
- A 63.6 trips/capita/year is in line with peer group Cities with populations between 400,000 and 2,000,000, as indicated **Table 2**.

Ward 4 include an annual transit trip rate of 63.6 trips per year which is used in subsequent analysis.

The results for each scenario based on the forecast population and increased transit shares are shown in **Table 12** and **Table 13.** Assuming a higher modal split and trip rates similar to those currently being achieved in Ward 4, it was determined that up to 318% growth in peak period transit demand can be expected compared to existing transit demand within the corridor.

Table 12: 2051 Annual Transit Trips (Increased Transit Trip Rate)

	Existing Annual Transit Trips	Increased Annual Transit Trip Rate	No UBE	Scenario 1	Scenario 2	Scenario 3	Scenario 5b
Segment 1	178,586	63.6	3,232,900	3,064,800	3,064,800	3,064,800	3,064,800
Segment 2	104,746	63.6	344,450	231,600	231,600	231,600	231,600
Segment 3	1,021,043	63.6	1,900,050	1,781,500	1,781,500	1,781,500	1,781,500
Segment 4	409,373	63.6	1,093,050	1,609,500	1,603,250	1,611,250	1,412,500
Segment 5	336,681	63.6	1,202,100	1,568,100	1,506,275	1,545,700	1,505,400
Segment 6	126,886	63.6	303,450	1,816,100	2,100,025	1,962,000	893,050
TOTAL	**2,177,316**		**8,076,000**	**10,071,600**	**10,287,450**	**10,196,850**	**8,888,850**
	-		**271%**	**363%**	**372%**	**368%**	**308%**

Table 13: 2051 Peak Period Transit Trips (Increased Transit Trip Rate)

	Existing Peak Period Transit Trips	Increased Peak Period Transit Trip Rate	No UBE	Scenario 1	Scenario 2	Scenario 3	Scenario 5b
Segment 1	124	0.045	2,250	2,150	2,150	2,150	2,150
Segment 2	80	0.045	250	150	175	150	150
Segment 3	836	0.045	1,350	1,250	1,250	1,250	1,250
Segment 4	299	0.045	750	1,150	1,125	1,150	1,000
Segment 5	271	0.045	850	1,100	1,050	1,100	1,050
Segment 6	119	0.045	200	1,300	1,475	1,400	650
TOTAL	**1,728**		**5,650**	**7,100**	**7,225**	**7,200**	**6,250**
	-		**227%**	**311%**	**318%**	**317%**	**262%**

As shown in **Table 14**, trip rates for interim 2031 and 2041 years were established based on linear growth from existing trip rates for each Ward.

Table 14: Annual Trip Rates for Interim 2031 and 2041 Years Established Based on Linear Growth from Existing Rates (Within Study Area)

Increase Transit Trip Rate (Trips / capita / year)	2021 (Existing)	2031	2041	2051
Ward 6	38	46	55	64
Ward 7	41	49	56	64
Ward 8	46	52	58	64
Ward 9	17	33	48	64
Ward 11	6	25	45	64
Ward 12	7	26	45	64
Ward 14		21	42	64

Table 15: Peak Period Trip Rates for Interim 2031 and 2041 Years Established Based on Linear Growth from Existing Rates (Within Study Area)

Increase Transit Trip Rate (Trips/capita/period)	2021 (Existing)	2031	2041	2051
Ward 6	0.030	0.035	0.040	0.045
Ward 7	0.037	0.039	0.042	0.045
Ward 8	0.035	0.038	0.041	0.045
Ward 9	0.010	0.021	0.033	0.045
Ward 11	0.005	0.018	0.032	0.045
Ward 12	0.005	0.018	0.031	0.045
Ward 14		0.015	0.030	0.045

"Existing Transit Trip Rate" applies existing Ward Trip Rates to individual TTS Zones within each Segment to achieve the baseline transit trip rates of segments (Table 16), the forecasted growth of transit demand is 84% in total.

"Increased Transit Trip Rate" uses rates more in line with future population density retrieved from Ward 4 to achieve the sustainable annual trip rates of segments (Table 17). Note that some areas anticipate larger growth than other areas.

The forecast transit demand for each Scenario horizon year and segment is included in Appendix A.

4.0 Approaches to Estimate Ridership

This section presents the approaches used to estimate ridership along the corridor. The existing baseline data and forecast growth presented above was used to determine total transit demand along the S-Line and peak period riders on the future facility. The three approaches include:

- Top Down Approach: Distribute estimated transit demand based on Transit Trips per capita along the future S-Line. Approach is based on assumed transit demand captured, directionality, and peak hour ridership conversion factors;
- Bottom Up Approach: Grow existing transit station activity on Route 44 based on forecast growth in transit demand; and
- Review Transportation Model

These approaches are further expanded upon below.

4.1 Top-Down Approach: Transit Trips per Capita

The Top-Down Approach uses the total transit trips per capita and population within a 1km radius to estimate the total transit demand potential within each catchment area. As shown in **Section 3.2,** an increased transit trip rate of 63.4 annual trips per capita would result in up to 318% growth in transit demand.

The total estimated potential transit boarding's were determined for each segment. The following assumptions were applied to distribute the estimated transit demand along the s-Line corridor:

- Peak Period = 25% of daily total
- Peak Hour = 50% of Peak Period
- 75% of transit demand assigned to S-Line (increase from 48% demand captured by route 44). This is an optimistic assumption to demonstrate whether the facility would be meet minimum ridership thresholds under an approximate upset limit of ridership potential.
- Distribution of transit demand per direction as shown in **Table 16.**

Table 16: Distribution of Segment Boardings per Direction

Segment	Eastbound	Westbound
Segment 1	85%	15%
Segment 2	65%	35%
Segment 3	50%	50%
Segment 4	50%	50%
Segment 5	35%	65%
Segment 6	15%	85%

This approach is demonstrated in in **Table 12** for the "No UBE" Scenario. The peak hour peak direction transit boarding results for all the scenarios in 2051 are presented in **Table 13.** Interim year results for 2031 and 2041 are included in Appendix B.

Table 17: Distribution of Forecast Demand (no UBE in 2051)

No UBE	Peak Period Transit Demand	Peak Hour Transit Demand (50% of Peak Period)	Peak Hour S-Line Boardings (75% of Demand)	Peak Hour S-Line Peak Distribution	Peak Hour Boardings per Direction
Segment 1	2,273	1,137	852	85%	725
Segment 2	242	121	91	65%	59
Segment 3	1,336	668	501	50%	251
Segment 4	769	384	288	50%	144
Segment 5	845	423	317	65%	206
Segment 6	213	107	80	85%	68
TOTAL	**5,679**				

Table 18: Peak Hour Peak Direction Boardings (All Scenarios in 2051)

Segment	No UBE	Scenario 1	Scenario 2	Scenario 3	Scenario 5b
Segment 1	725	687	687	687	687
Segment 2	59	40	40	40	40
Segment 3	251	235	235	235	235
Segment 4	144	212	212	212	186
Segment 5	206	269	269	265	258
Segment 6	68	407	407	440	200

This approach does not include:

- Planned employment growth. The analysis is focused on population growth and AM peak trip origins not AM peak trip destinations. It is possible that trips will be attracted to the corridor that originate from elsewhere in the network including transfers from other routes / areas of the city (overall network demand growth).
- Accumulation of passengers through corridor. The analysis identifies the number of potential transit boardings within each segment of the corridor. It does not consider where the passengers will be alighting. Passengers that may use the route for short trips may board and alight within a single segment and therefore may not significantly contribute to increases in peak passenger volumes on the bus. Contrarily, passengers that use the route for long trips can result in accumulation of riders and therefore higher volumes of passengers on the bus at peak points.

4.2 Bottom Up Approach: Transit Station Activity

The Bottom Up Approach uses the existing HSR Route 44 station activity and peak point for each direction as well as the forecast transit growth to estimate future ridership. Three different growth rate options were explored to understand the potential demand implications:

- Baseline 0.5% Annual growth in transit demand (15% growth over 30 years from 2021 to 2051)
- Population growth within 1km of corridor (43% to 82% growth)
- Population growth and enhanced trip rate (227% to 318% growth)

4.2.1 Baseline

- 0.5% Annual growth in transit demand 30 years from 2021 to 2051
- Growth in Daily Boardings = Growth in Peak Point
- Does not include planned intensification or increased transit uptake
- 15% increase in peak point passenger volumes was applied and is presented in **Table 19.**

Table 19: Baseline (15% Growth) Peak Hour Peak Point Passengers per Direction

Direction	Eastbound				Westbound			
Year	2021 EQ	2031	2041	2051	2021 EQ	2031	2041	2051
Segment 1	40	43	45	48	50	53	56	58
Segment 2	55	59	61	65	66	69	73	77
Segment 3	56	59	63	65	68	71	75	79
Segment 4	50	53	55	59	61	64	67	71
Segment 5	53	56	59	63	64	67	71	74
Segment 6	17	19	20	21	20	21	23	24

A peak hour peak direction passenger volume of less than 100) Peak Hour Peak Point Passengers is estimated throughout the corridor.

4.2.2 Population Growth within 1 km of Corridor

While several scenarios were considered for future population growth within the corridor, the scenario with the most growth (Scenario 2) was used to assess the need for transit priority measures as it would likely show the most justification. The following was included in the estimate:

- Population growth of between 38,300 (no UBE) and 73,000 (UBE Scenario 2);
- Growth in Daily Boardings = Growth in Peak Point;
- While interim year population forecasts were provided for each scenario, a high level estimate was conducted using interpolated 2031 & 2041 passenger volumes; and
- While this approach includes planned intensification, it does not include increased transit uptake.

The 82% growth in population associated with UBE Scenario 2 was applied to peak point passenger volumes and is presented in **Table 20.**

Table 20: Transit Demand Growth based on Population Growth within 1km of Corridor

Direction	Eastbound				Westbound			
Year	2021 EQ	2031	2041	2051	2021 EQ	2031	2041	2051
Segment 1	40	51	62	73	50	64	78	91
Segment 2	55	70	85	100	66	84	102	120
Segment 3	56	71	86	102	68	87	105	124
Segment 4	50	63	77	91	61	78	94	111
Segment 5	53	67	82	96	64	81	99	116
Segment 6	17	22	27	32	20	26	32	37

A peak hour peak direction passenger volume of approximately 100 to 150 Peak Hour Peak Point Passengers is estimated in Segments 2, 3, 4, and 5.

4.2.3 Population Growth and Enhanced Trip Rate

The scenario with the most population growth (Scenario 2) was used to assess the need for transit priority measures as it would likely show the most justification, particularly with the increased transit trip rates representative of improved mode shares adjacent to the future S-Line. The following was included in the estimate:

- 82% population growth (over 30 years)
- 2.59 x Increase in transit trip rates from 24.6 to 63.6 trips / capita = 319% increase in transit demand (from Top-Down Approach)
- While interim year population forecasts were provided for each scenario; a high level estimate was conducted using interpolated 2031 & 2041 passenger volumes

A 319% increase in peak point passenger volumes was applied and is presented in **Table 21.**

Table 21: Transit Demand Growth based on Population Growth and Enhanced Trip Rate

Direction	Eastbound				Westbound			
Year	2021 EQ	2031	2041	2051	2021 EQ	2031	2041	2051
Segment 1	40	83	126	169	50	104	157	211
Segment 2	55	114	172	231	66	136	207	277
Segment 3	56	115	175	234	68	140	213	285
Segment 4	50	103	156	209	61	126	191	256
Segment 5	53	109	165	221	64	132	200	268
Segment 6	17	36	54	73	20	42	64	85

A peak hour peak direction passenger volume of between 200 and 300 Peak Hour Peak Point Passengers is estimated in all Segments except for Segment 6 by 2051.

It was noted previously in Section 4.1 that a future S-Line with high frequency service, and good route connections will attract a higher share of potential transit riders to the corridor instead of them using adjacent or other overlapping routes. It was estimated that approximately 48% of existing transit demand potential is currently being attracted to Route 44. This capture rate is likely to improve and a 75% capture rate was applied to achieve an escalated estimate of transit corridor demand potential. The increase from 48% to 75% suggests a 70% increase in corridor demand which is presented in **Table 22.**

Table 22: Transit Demand Growth based on Population Growth, Enhanced Trip Rate, & Increased Capture rate of future S-Line

Direction	Eastbound				Westbound			
Year	2021 EQ	2031	2041	2051	2021 EQ	2031	2041	2051
Segment 1	40	104	189	287	50	130	236	358
Segment 2	55	142	258	393	66	170	310	471
Segment 3	56	144	262	398	68	175	319	484
Segment 4	50	128	233	354	61	157	286	435
Segment 5	53	136	248	376	64	165	300	455
Segment 6	17	45	81	123	20	53	96	145

A peak hour peak direction passenger volume of between 350 and 500 pphpd is estimated in all Segments except for Segment 6 by 2051.

4.3 Review of City of Hamilton Transportation Model Approach

A review of the City of Hamilton's Transportation Demand Model was completed to verify the analysis results. The model, maintained by the City's Transportation planning group, provides data for AM Peak Period transit passenger demand on all local HSR transit routes for the 2031 planning horizon.

Minor changes to some transit routes have been introduced, which are not reflected in the model such as route extension to new developments or the addition of stops along routes.

Table 23: City of Hamilton Transportation Demand Model: 2031 Peak Period Transit Passengers

Road	Study Area Segment	Peak Period Transit Passenger Volume
Garner Road	Segment 1	571 – 635 ppppd[a] (<300 pphpd[b])
Rymal Road	Segment 2, 3 & 4	440 – 625 ppppd (<300 pphpd)
Centennial	Segment 5 & 6	472 – 660 ppppd (<300 pphpd)

Modelled transit demand is estimated to be similar to the two approaches applied to estimate future ridership.

[a] Passengers per Period Per Direction (ppppd)
[b] Passengers Per Hour Per Direction (pphpd)

5.0 Evaluation of Transit Priority Measures

The objective of this study is to forecast transit ridership for the S-Line corridor in order to assess the need and justification for dedicated transit facilities within the corridor. Several criteria have been identified to support the evaluation. The goal is to determine which of the following levels of transit priority should be further considered as part of future planning studies:

- No transit measures required;
- Priority bus corridor:
  - Transit signal priority and/or physical intersection measures (such as queue jump lanes); and/or
  - Managed lane for transit and high occupancy vehicles;
- Exclusive transit lane
  - Not separated from general traffic; or
  - Physically separated from traffic.

The following two criteria were established to evaluate the need and/or level of transit priority:

1. Number of transit passengers at peak points on each segment
   - Continuous Transit Priority (TP), or exclusive facilities, should be considered when there are **more than 700 passengers per hour** per direction (based on the approximate equivalent person capacity of a standard vehicle lane)
   - Isolated Transit Priority measures should be considered when there is **between 300 and 700 pphpd**
2. Number of bus routes and combined headway within corridor
   - Transit Priority should be considered where there are frequent buses (frequent defined as a bus arriving almost every signal cycle – estimated as **30 buses per signal cycle** assuming a 120 second cycle.

These two criteria will help determine if minimum thresholds have been met to further consider Transit Priority. It is noted that these metrics are based strictly on transit passenger demand and do not factor the potential impacts to other vehicle operations including the resulting service reliability when vehicle lanes are congested, nor does it consider whether transit priority measures can be physically accommodated within the space available. It is therefore suggested that additional metrics be evaluated as part of future EAs to confirm and refine the design recommendations as follows:

- Ability for Transit Priority to increase average transit operating speeds / improved reliability
  - Excessive vehicle congestion impacting transit in mixed traffic (ability to adhere to schedules)
- Ability and availability to designate space for Transit Priority
  - Ability to take lanes from vehicles, based on vehicle operations within corridor
  - Required property and construction costs for widening.

5.1 Recommended Transit Priority Measures Based on Estimated Number of Peak Transit Passengers

As a reminder, Continuous Transit Priority (TP) should be considered when there are **more than 700 passengers per hour** per direction (based on the approximate equivalent person capacity of a standard vehicle lane) and Isolated TP should be considered when there is **between 300 and 700 pphpd.**

Table 24 presents a summary of peak hour peak direction transit demand that was estimated for 2051 based on both the Top-Down and the Bottom-Up methods. Details pertaining to passenger forecasts for the 2031 and 2041 horizons are provided in **Appendix A.** The table also indicates if the identified transit passenger thresholds have been met for transit priority measures for each study segment.

Table 24: Summary of Recommended Transit Priority Measures Based on Peak Hour Peak Direction Transit Passenger Forecast for 2051

	Top-Down	Bottom-Up	City of Hamilton Transportation Model Estimates[c]	Recommended 2051 Facility Type
Segment 1	687 – 725[d]	279 – 356	285-317	Isolated Transit Priority Measures
Segment 2	40 – 59	369 – 470	220-312	Isolated Transit Priority Measures
Segment 3	235 – 251	380 – 484		Isolated Transit Priority Measures
Segment 4	144 – 212	341 – 434		Isolated Transit Priority Measures
Segment 5	206 – 269	358 – 456	235-330	Isolated Transit Priority Measures
Segment 6	68 - 471	112 - 152		No transit measures required
	Potential boardings within each segment; does not carry boardings to adjacent segments	Grow existing route demand; does not consider changes in loading profiles through corridor	-	

It is suggested that Transit Priority be considered through the majority of the S-Line corridor, however it is recommended to be in the form of isolated measures and not as a dedicated exclusive facility based on estimated transit passenger volumes.

[c] Converted from Passengers per Period Per Direction using the rule of them that 50% of trips occur during the peak hour.

[d] While the Top-Down ridership for Segment 1 would appear to indicate that dedicated facilities are required, the upper limit is just beyond the conservative 700 pphpd target used as part of this analysis. Criteria used to identify the need for exclusive facilities often sit closer to a 1000 Passengers per Hour per Direction threshold.

5.2 Recommended Transit Priority Measures Based on the Combined Route Headways Approach

Applying this approach, Transit Priority should be considered where there are frequent buses (frequent defined as a bus arriving almost every signal cycle). Where a combined headway results in a <2 minute between buses, (more than 30 per an hour) then measures should be considered to prioritize transit operations.

The existing route map was used to identify locations where several routes operate within the S-Line corridor. The information is summarized in **Table 9**.

Figure 9: Existing Overlapping Routes

	Routes (other than Route 44)	Existing route frequency
Segment 1	16	4 / hr
Segment 2	34, 35	4 / hr
Segment 3	24, 26, 22	10 / hr
Segment 4	-	-
Segment 5	58	6 / hr
Segment 6	56	2 / hr

In 2051 it was assumed that a 3-4 minute service headway would be required for the S-Line (18 buses / hr based on 725 peak hour peak direction transit passengers on 40 passenger capacity buses). By 2041 approximately 5 minute service headways would be required.

A typical service standard for BRT corridors is to ensure that local routes operate no less than double the BRT headway to provide good transfer connections. (i.e. a 5 minute BRT service would have local routes connecting with 10 minute service headways). It was assumed that routes that already operate with these frequencies would be further improved with 50% more service.

Figure 10: Forecasted Transit Headways in 2051

	S-Line Frequency	Other Route Frequency	Total	Recommended 2051 Facility Type
Segment 1	12 buses / hr	6 buses / hr	18 buses / hr	None
Segment 2	12 buses / hr	6 buses / hr	18 buses / hr	None
Segment 3	12 buses / hr	15 buses / hr	27 buses / hr	Transit Priority measures nearly justified
Segment 4	12 buses / hr		12 buses / hr	None
Segment 5	12 buses / hr	9 buses / hr	21 buses / hr	None
Segment 6	12 buses / hr	6 buses / hr	18 buses / hr	None

The analysis suggests that Segment 3 should be considered for transit priority due to the bus routing and the combined route headways on Rymal Road.

6.0 Conclusions

Based on the results presented, this section discusses the transit measures that would be appropriate for each section of the study corridor during the future time frames. Note that additional analysis is required to determine feasibility of implementing these changes based on such considerations as available property, impact on vehicular traffic, etc. The levels of transit measures that were considered include:

- No transit measures required;
- Priority bus corridor:
  - Transit signal priority and/or physical intersection measures (such as queue jump lanes); and/or
  - Managed lane for transit and high occupancy vehicles;
- Exclusive transit lane
  - Not separated from general traffic; or
  - Physically separated from traffic.

Applying four methods to estimate future ridership and transit vehicle frequency, it was identified that **Isolated Transit Priority Measures should be considered for all segments of the S-Line corridor** by the 2051 planning horizon. Interim measures, aligning with the nearer term 2031 and 2041 planning horizons and based on the Top Down and Bottom Up approaches to estimating ridership growth (the most aggressive methods), are presented in **Table 25**.

Table 25: Summary of Recommended Transit Priority Measures Based on Peak Hour Peak Direction (PHPD) Transit Passenger Forecast for 2031/2041[e].

Segment	2031 PHPD		Recommended 2031 Transit Priority Measures	2041 PHPD		Recommended 2041 Transit Priority Measures
	Top-Down	Bottom-Up		Top-Down	Bottom - Up	
1	195	60-108	None	441	73-228	None
2	24	79-143	None	30	96-301	None
3	174	82-147	None	197	99-310	None
4	81-97	73-132	None	111-165	88-278	None
5	110-116	77-139	None	164-194	93-292	None
6	64-163	24-43	None	74-421	29-91	None

[e] Ranges are the result of consideration of No UBE and UBE Scenarios.

APPENDIX A

INTERIM DEMAND AND RIDERSHIP VOLUMES

Forecast Annual Transit Demand

REF - No UBE	2021	2031	2041	2051	Growth
Segment 1	178,586	-	-	3,232,906	1710%
Segment 2	104,746	-	-	344,441	229%
Segment 3	1,021,043	-	-	1,900,030	86%
Segment 4	409,373	-	-	1,093,067	167%
Segment 5	336,681	-	-	1,202,120	257%
Segment 6	126,886	-	-	303,442	139%
TOTAL	2,177,316	-	-	8,076,005	271%
Scenario 1	**2021**	**2031**	**2041**	**2051**	**Growth**
Segment 1	178,586	873,865	1,971,150	3,064,805	1616%
Segment 2	104,746	136,687	170,967	231,589	121%
Segment 3	1,021,043	1,212,356	1,440,835	1,781,494	74%
Segment 4	409,373	606,590	838,664	1,609,504	293%
Segment 5	336,681	607,291	994,702	1,568,117	366%
Segment 6	126,886	553,845	1,256,744	1,816,079	1331%
TOTAL	2,177,316	3,990,634	6,673,062	10,071,588	363%
Scenario 2	**2021**	**2031**	**2041**	**2051**	**Growth**
Segment 1	178,586	873,865	1,971,150	3,064,805	1616%
Segment 2	104,746	136,687	170,967	231,589	121%
Segment 3	1,021,043	1,212,356	1,440,835	1,781,494	74%
Segment 4	409,373	717,259	1,238,071	1,603,262	292%
Segment 5	336,681	635,200	1,114,999	1,506,284	347%
Segment 6	126,886	268,955	417,270	2,100,025	1555%
TOTAL	2,177,316	3,844,323	6,353,292	10,287,458	372%
Scenario 3	**2021**	**2031**	**2041**	**2051**	**Growth**
Segment 1	178,586	873,865	1,971,150	3,064,805	1616%
Segment 2	104,746	136,687	170,967	231,589	121%
Segment 3	1,021,043	1,212,356	1,440,835	1,781,494	74%
Segment 4	409,373	714,942	1,228,114	1,611,233	294%
Segment 5	336,681	599,153	940,087	1,545,680	359%
Segment 6	126,886	608,892	1,734,910	1,961,986	1446%
TOTAL	2,177,316	4,145,895	7,486,064	10,196,787	368%
Scenario 5b	**2021**	**2031**	**2041**	**2051**	**Growth**
Segment 1	178,586	873,865	1,971,150	3,064,805	1616%
Segment 2	104,746	136,687	170,967	231,589	121%
Segment 3	1,021,043	1,212,356	1,440,835	1,781,494	74%
Segment 4	409,373	637,461	942,548	1,412,517	245%
Segment 5	336,681	621,878	1,068,776	1,505,376	347%
Segment 6	126,886	238,410	304,992	893,034	604%
TOTAL	2,177,316	3,720,657	5,899,268	8,888,815	308%

Forecast Peak Period Transit Demand

REF - No UBE	2021	2031	2041	2051	Growth
Segment 1	124	-	-	2,273	1738%
Segment 2	80	-	-	242	204%
Segment 3	836	-	-	1,336	60%
Segment 4	299	-	-	769	157%
Segment 5	271	-	-	845	212%
Segment 6	119	-	-	213	79%
TOTAL	1,728	-	-	5,679	229%
Scenario 1	**2021**	**2031**	**2041**	**2051**	**Growth**
Segment 1	124	613	1,385	2,155	1642%
Segment 2	80	100	122	163	105%
Segment 3	836	929	1,052	1,253	50%
Segment 4	299	434	593	1,132	279%
Segment 5	271	458	712	1,103	307%
Segment 6	119	465	958	1,277	972%
TOTAL	1,728	2,998	4,821	7,082	310%
Scenario 2	**2021**	**2031**	**2041**	**2051**	**Growth**
Segment 1	124	613	1,385	2,155	1642%
Segment 2	80	100	122	163	105%
Segment 3	836	929	1,052	1,253	50%
Segment 4	299	516	880	1,127	277%
Segment 5	271	476	794	1,059	291%
Segment 6	119	225	318	1,477	1140%
TOTAL	1,728	2,858	4,551	7,234	319%
Scenario 3	**2021**	**2031**	**2041**	**2051**	**Growth**
Segment 1	124	613	1,385	2,155	1642%
Segment 2	80	100	122	163	105%
Segment 3	836	929	1,052	1,253	50%
Segment 4	299	514	873	1,133	279%
Segment 5	271	452	674	1,087	302%
Segment 6	119	512	1,322	1,380	1058%
TOTAL	1,728	3,120	5,428	7,170	315%
Scenario 5b	**2021**	**2031**	**2041**	**2051**	**Growth**
Segment 1	124	613	1,385	2,155	1642%
Segment 2	80	100	122	163	105%
Segment 3	836	929	1,052	1,253	50%
Segment 4	299	455	666	993	233%
Segment 5	271	467	763	1,059	291%
Segment 6	119	200	232	628	427%
TOTAL	1,728	2,764	4,219	6,250	262%

Forecast Peak Hour Peak Direction Transit Boardings (Top-Down Approach)

Peak Hour, Peak Point, Peak Direction Demand				
REF - No UBE	2021	2031	2041	2051
Segment 1	38	-	-	725
Segment 2	51	-	-	59
Segment 3	78	-	-	251
Segment 4	27	-	-	144
Segment 5	86	-	-	206
Segment 6	44	-	-	68
Scenario 1	2021	2031	2041	2051
Segment 1	38	195	441	687
Segment 2	51	24	30	40
Segment 3	78	174	197	235
Segment 4	27	81	111	212
Segment 5	86	112	173	269
Segment 6	44	148	305	407
Scenario 2	2021	2031	2041	2051
Segment 1	38	195	441	687
Segment 2	51	24.36	30	40
Segment 3	78	174	197	235
Segment 4	27	97	165	211
Segment 5	86	116	194	258
Segment 6	44	72	101	471
Scenario 3	2021	2031	2041	2051
Segment 1	38	195	441	687
Segment 2	51	24.36	30	40
Segment 3	78	174	197	235
Segment 4	27	96	164	212
Segment 5	86	110	164	265
Segment 6	44	163	421	440
Scenario 5b	2021	2031	2041	2051
Segment 1	38	195	441	687
Segment 2	51	24.36	30	40
Segment 3	78	174	197	235
Segment 4	27	85	125	186
Segment 5	86	114	186	258
Segment 6	44	64	74	200

Forecast Peak Hour Peak Direction Transit Boardings (Bottom-Up Approach)

Peak Hour, Peak Point, Peak Direction Demand				
REF - No UBE	2021	2031	2041	2051
Segment 1	50	60	73	279
Segment 2	66	79	96	369
Segment 3	68	82	99	380
Segment 4	61	73	88	341
Segment 5	64	77	93	358
Segment 6	20	24	29	112
Scenario 1	2021	2031	2041	2051
Segment 1	50	104	202	348
Segment 2	66	137	267	460
Segment 3	68	142	275	474
Segment 4	61	127	247	425
Segment 5	64	133	259	446
Segment 6	20	42	81	139
Scenario 2	2021	2031	2041	2051
Segment 1	50	99	191	356
Segment 2	66	131	252	470
Segment 3	68	135	260	484
Segment 4	61	121	233	434
Segment 5	64	127	244	456
Segment 6	20	40	76	142
Scenario 3	2021	2031	2041	2051
Segment 1	50	108	228	353
Segment 2	66	143	301	466
Segment 3	68	147	310	480
Segment 4	61	132	278	430
Segment 5	64	139	292	452
Segment 6	20	43	91	141
Scenario 5b	2021	2031	2041	2051
Segment 1	50	96	177	308
Segment 2	66	127	234	406
Segment 3	68	131	241	418
Segment 4	61	117	216	375
Segment 5	64	123	227	394
Segment 6	20	38	71	123

Corridor Ridership Forecasted by City of Hamilton Model on Eastbound Garner Road (ppppd)

Corridor Ridership Forecasted by City of Hamilton Model on Westbound Garner Road (ppppd)

Corridor Ridership Forecasted by City of Hamilton Model on Eastbound Rymal Road (ppppd)

Corridor Ridership Forecasted by City of Hamilton Model on Westbound Rymal Road (ppppd)

Corridor Ridership Forecasted by City of Hamilton Model on Northbound Centennial Road (ppppd)

Corridor Ridership Forecasted by City of Hamilton Model on Southbound Centennial Road (ppppd)