

30 RIDGE VALLEY ROAD TRAFFIC IMPACT STUDY

DRAFT REPORT



PREPARED FOR:
UNIVERSAL REALTY GROUP

SEPTEMBER 2023

Project No. CA0011828.3205





TABLE OF CONTENTS

1	INTRODUCTION.....	1
2	STUDY AREA DESCRIPTIONS.....	2
3	BACKGROUND TRAFFIC	4
4	ACTIVE TRANSPORTATION AND TRANSIT.....	5
5	TRIP GENERATION, DISTRIBUTION, AND ASSIGNMENT.....	7
6	OPERATIONAL ANALYSIS	8
6.1	Analysis Scenarios	10
6.2	Int #1: Cowie Hill Road at Ridge Valley Road.....	11
6.3	Int #2: Herring Cove Road at Cowie Hill Road.....	12
7	SUMMARY & CONCLUSIONS	13
7.1	Summary	13
7.2	Conclusions	14

APPENDICES

- A** TRAFFIC VOLUME DATA
- B** WARRANT ANALYSIS
- C** INTERSECTION PERFORMANCE ANALYSIS

PREPARED BY: BRIANNA RIETZEL, EIT
 PATRICK HATTON, P.ENG.

1 INTRODUCTION

Background

Since the existing building on the 4.2 acre 30 Ridge Valley Road site only occupies 7% of the site, *Universal Realty Group* is preparing plans to construct two additional buildings which will add a total of 298 apartment units. The development location is shown in Figure 1. Buildout of the development is expected by 2027. The Halifax Regional Municipality (HRM) has requested that a Traffic Impact Study (TIS) be completed to review the impacts to the adjacent transportation network and WSP Canada Inc. has been retained to complete this TIS.

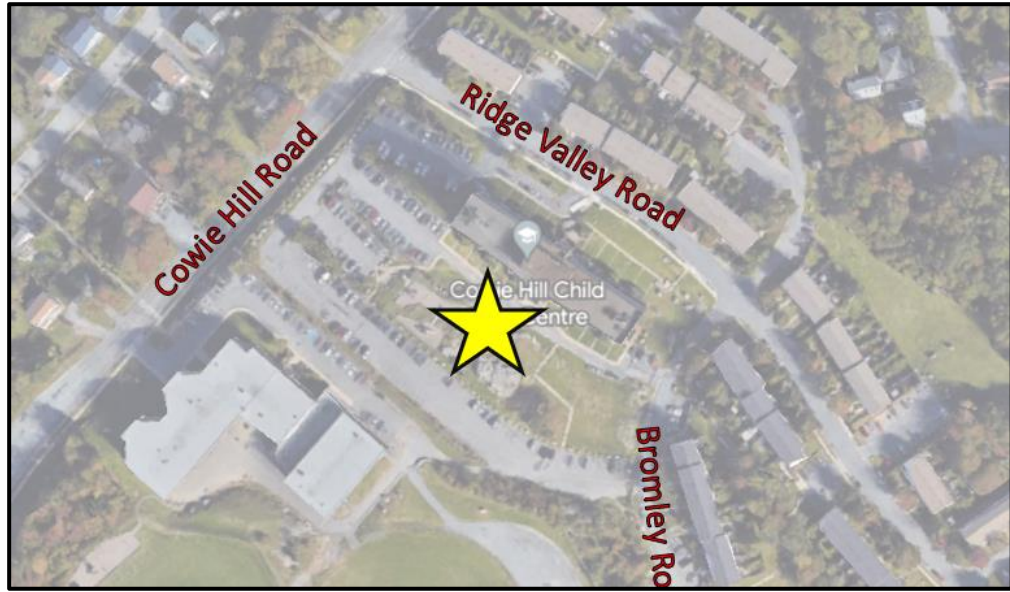


Figure 1 – Proposed Development Location

A Traffic Impact Study Usually Considers Four Questions

A TIS usually consists of determining answers to the following questions:

1. **What is the existing transportation situation** adjacent to the study site? How have volumes changed historically?
2. **What transportation changes are expected** at key Study Area locations? How many vehicle trips are expected to be generated by the proposed development during weekday peak hours? What routes are the trips expected to use to travel within and through the Study Area?
3. **What transportation impacts will occur** on Study Area roads, sidewalks, and intersections?
4. **What transportation improvements are required** to mitigate project impacts on Study Area travel? Are there transportation modifications that should be made to improve the travel experience for all users?

Study Objectives

The objectives of the traffic impact study are to:

1. Develop projected 2027 background weekday AM and PM peak hourly traffic volumes for Study Intersections.
2. Estimate the number of weekday AM and PM peak hour vehicle trips that will be generated by the proposed development.
3. Distribute and assign site generated trips to Study Intersections to project 2027 peak hourly volumes that include site generated trips.
4. Evaluate impacts of site generated traffic on the performance of Study Intersections.
5. Complete warrant analyses, as necessary, for Study Intersections and recommend improvements that may be needed at Study Intersections to mitigate the impacts of site development.

2 STUDY AREA DESCRIPTIONS

Description of Existing Development

The existing site at 30 Ridge Valley Road contains a 12-storey residential building and abuts Chebucto Heights Elementary School.

Description of Proposed Development

The proposed development is planned to add 298 new high-rise residential units. The study will consider the build out development scenario with a study horizon year of 2027.

A concept of the proposed development is shown in Figure 2. Vehicular access will be at or near existing driveways on Ridge Valley Road and Bromley Road and sufficient sight distance is available at each driveway.

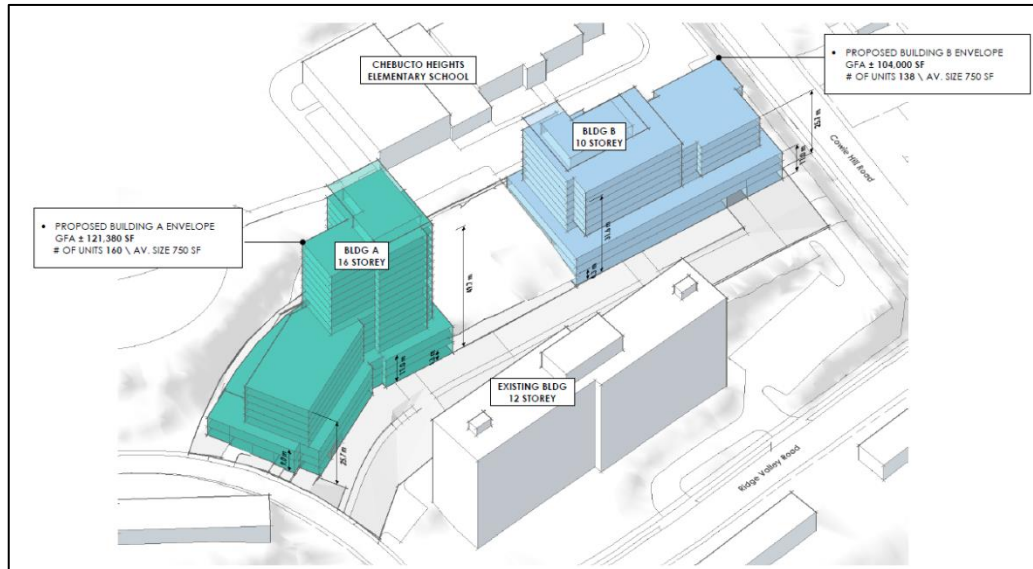


Figure 2 - Site Concept

Existing Study Road Descriptions

Ridge Valley Road is a local street with a sidewalk on the west side adjacent to the site. Parking is permitted on the west side of the street.

Bromley Road is a narrow one-way eastbound local street without sidewalks. Limited on-street parking is permitted on the north side of the street.

Cowie Hill Road is a wide collector street with a sidewalk on the south side fronting the site. Visibility is very good on both approaches to the Ridge Valley Road intersection.

Herring Cove Road is an arterial road with a sidewalk on both sides south of Cowie Hill Road and on the west side north of Cowie Hill Road.

Existing Study Intersection Descriptions

The traffic study includes review of several intersections around the site. Traffic and pedestrian volumes were counted at the study intersections shown in Figure 3 and a description of each intersection is provided below.

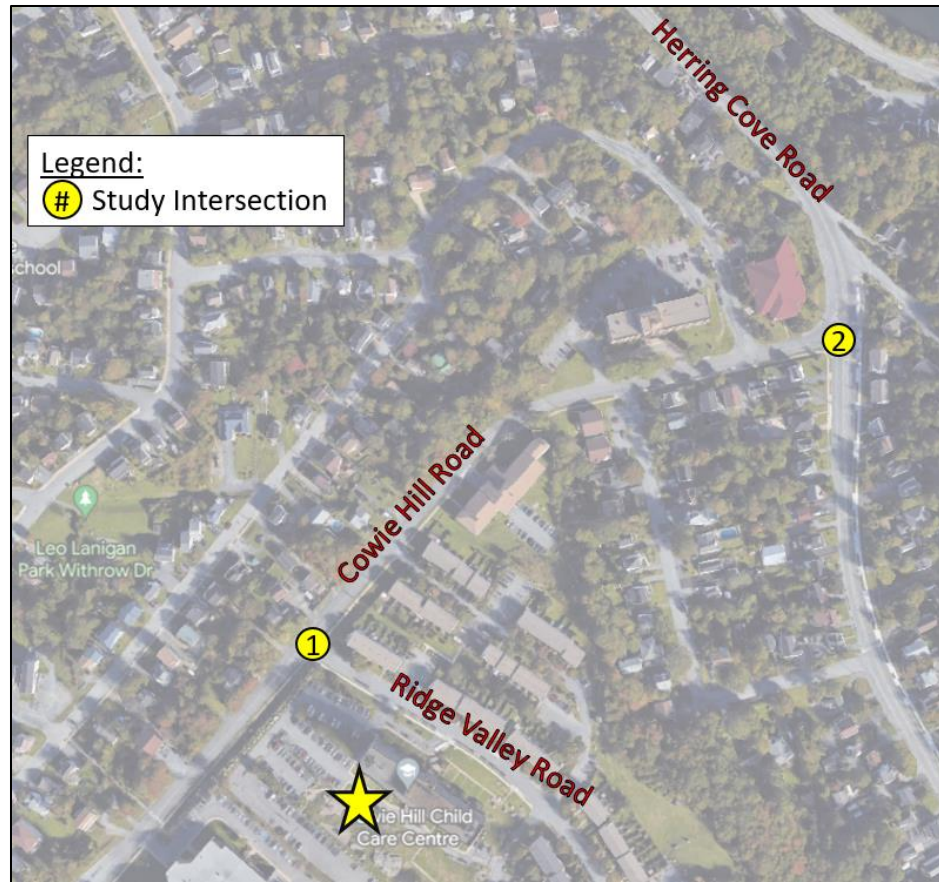


Figure 3 - Study Intersections

Intersection #1 – Cowie Hill Road at Ridge Valley Road is a 3-leg intersection with STOP control northbound on Ridge Valley Road. Each approach has shared lanes and there is a marked pedestrian crossing on Ridge Valley Road.

Intersection #2 –Herring Cove Road at Cowie Hill Road is a 3-leg signalized intersection with. The northbound approach on Herring Cove Road has a left-turn lane and a through lane and the southbound approach on Herring Cove Road has a right-turn channelized lane and a through lane. Cowie Hill Road has a single lane approach. There are marked pedestrian crossings at each leg of the intersection and sidewalk on both roads.



3 BACKGROUND TRAFFIC

Turning Movement Counts

Turning movement counts were collected for the two study intersections discussed in Section 2 on the following dates and times:

Intersection:	Count Date / Times:
1. Cowie Hill Road at Ridge Valley Road	7-9AM and 4-6PM, Wednesday, September 20, 2023
2. Herring Cove Road at Cowie Hill Road	7-9AM and 4-6PM, Wednesday, May 17, 2023

Intersection counts have been tabulated in 15-minute intervals with peak hours indicated by shaded areas. Pedestrian volumes are summarized in hourly increments. Turning movement counts are summarized in Tables A-1 to A-2, Appendix A, and illustrated in Figure A-1, Appendix A.

Traffic Growth Rate

An annual growth rate of 1.0% was applied to project the 2027 background volumes (see Figure A-2, Appendix A) for this Traffic Impact Study. This is expected to account for additional vehicle trips generated by population increases in the area and is conservative compared to the HRM 0.5% annual traffic growth target.

Background Development Trips

In addition to the applied 1% background growth rate (noted above), estimated trips generated by the nearby development at 41 Cowie Hill Road based on the TIS completed in May 2023. The trip generation from that TIS is extracted and shown in Table 1 below.

Table 1 – Trip Generation Estimates for the Background Development at 41 Cowie Hill Road (Extracted from that development’s TIS, DesignPoint, 2023)

Land Use	Code	Units	Variable	Trip Generation Rates ¹						Trips Generated			
				AM Peak			PM Peak			AM Peak		PM Peak	
				Rate	In	Out	Rate	In	Out	In	Out	In	Out
Multifamily Housing (Mid-Rise)	221	58	Dwellings	0.24	23%	77%	0.40	61%	39%	3	11	14	9
Multifamily Housing (High-Rise)	222	122	Dwellings	0.37	26%	74%	0.45	62%	38%	12	34	34	21
Estimated Site Generated Trips										15	45	48	30
Mode Share Reduction (20% Transit, 7% Active Transportation)										4	12	13	8
Total Estimated Site Generated Trips										11	32	35	22
Notes:		1. Trip generation rates from ITE <i>Trip Generation Manual</i> , 11th Edition, fitted line equations. 2. Mode share rates from HRM Mode Share app, 2016 Census data for census tract.											

Background Traffic Volumes

The trips generated by the 41 Cowie Hill Road background development and the 1% annual growth rate have been applied to the 2023 traffic counts to estimate the 2027 background traffic volumes within site generated trips (See Figure A-2, Appendix A).

4 ACTIVE TRANSPORTATION AND TRANSIT

Active Transportation

Sidewalk facilities are available along Herring Cove Road, Cowie Hill Road, and Ridge Valley Road in this area and there are existing walkways and multi-use paths and trails near the site (See Figure 4).

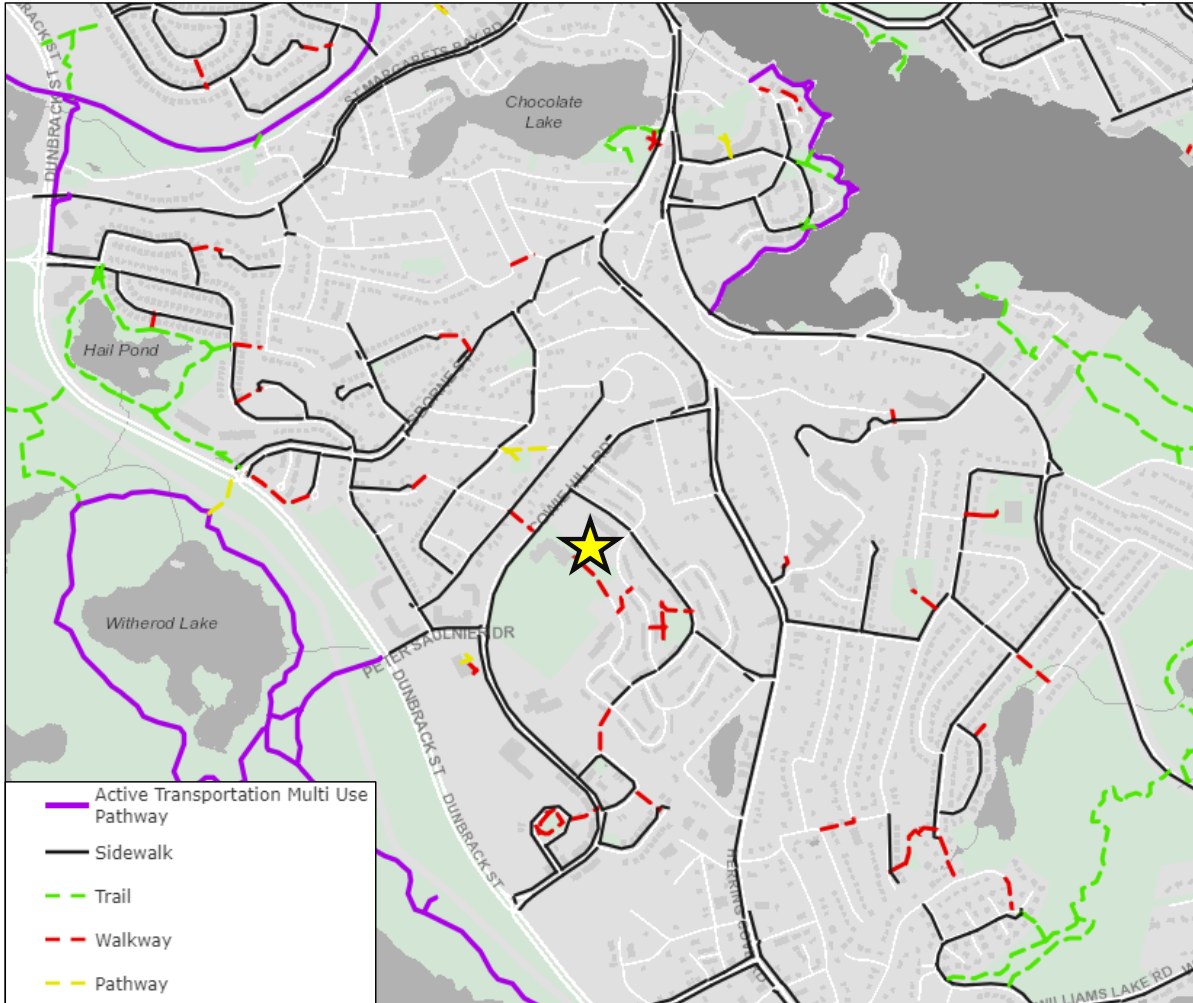


Figure 4 – Existing AT Network (Explore HRM)

Transit

The site is in close proximity to several nearby transit stops including #6517 and #6515 on Cowie Hill Road, #6856 and #6906 along Herring Cove Road, as well as #8167 and #8168 fronting the site on Ridge Valley Road. Each of these stops are within 500m of the site. The Cowie Hill Road and Ridge Valley Road stops are serviced by Halifax Transit routes #24 and #127 and by Route #9+ servicing the Herring Cove Road stops. Transit routes are shown in Figure 5.

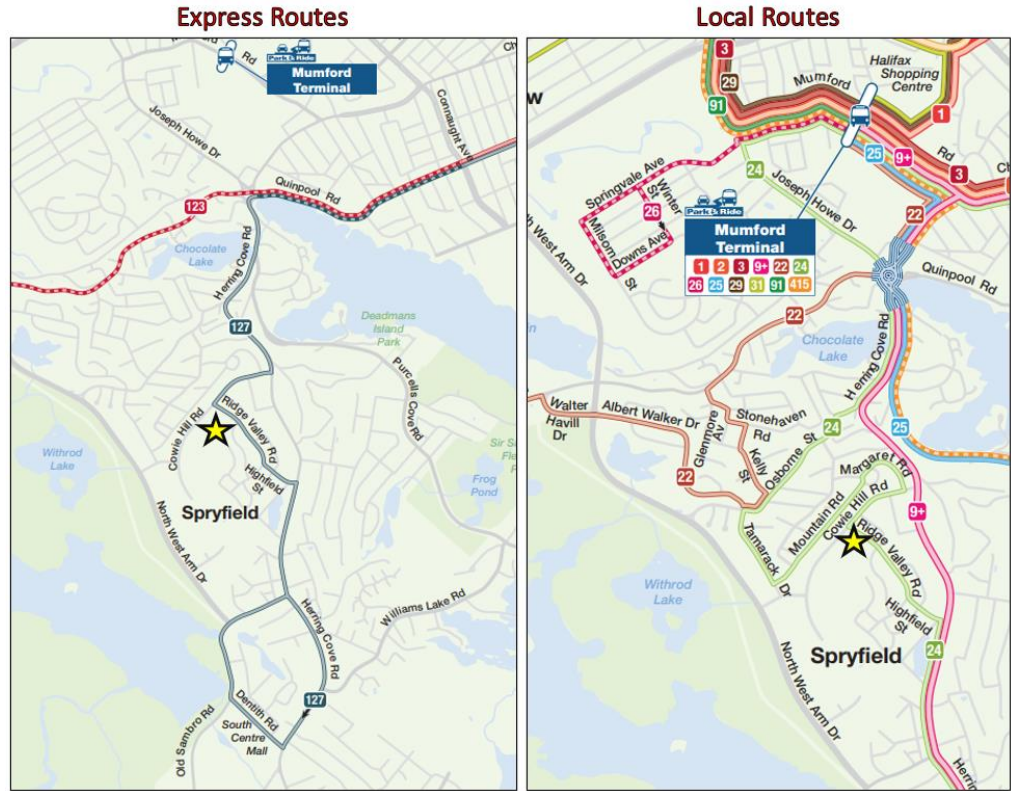


Figure 5 - Transit Routes from Ridge Valley Road

Planned AT and Transit Modifications

Herring Cove Road in this area is a candidate bike route (Brown Line, Figure 6), leading into a future greenway (green shading, Figure 6).

Herring Cove Road in this area has been identified in the Rapid Transit Study as a network corridor (Yellow line, See Figure 7).

HRM has completed the preliminary design and is currently undertaking a project for the detailed design of transit and active transportation modifications along Herring Cove Road north of Cowie Hill Road that would see improvements to these non-auto modes in this area.



Figure 7 - Vision for a Regional Greenway Network (Source: Making Connections: 2014-19 AT Plan)



Figure 6 - Proposed HRM Rapid Transit Network (Source: Rapid Transit Study, HRM)



5 TRIP GENERATION, DISTRIBUTION, AND ASSIGNMENT

Prepared Trip Generation Estimates

When using the published trip generation rates in the Trip Generation Manual, the transportation engineer’s objective should be to provide a realistic estimate of the number of trips that will be generated by the proposed development.

Existing & Proposed Redevelopment

The proposed development is expected to include 298 high-rise residential units. The site currently includes a 12-storey residential building.

Anticipated Land Use for the Proposed Development

Trips generated by High-Rise Multifamily Housing (Land Use 222) are estimated for the AM and PM peak hours by the number of dwelling units. Trip generation estimates for the proposed development were prepared using published rates and equations from *Trip Generation Manual, 11th Edition* (Institute of Transportation Engineers, Washington, 2021).

Trips Generated by the Proposed Development

Trip generation estimates for the proposed development are summarized in Table 2. It is estimated that the development will generate:

- 73 two-way trips (25 entering and 48 exiting) during the AM peak hour; and,
- 85 two-way trips (48 entering and 37 exiting) during the PM peak hour.

Table 2 – Trip Generation Estimates for the Proposed Developments

Land Use ¹	Units ²	Trip Generation Rates ³	Trip Generation Estimates ³			
			AM Peak		PM Peak	
			In	Out	In	Out
Multifamily Housing (High-Rise) Land Use 222	298	(AM) T = 0.22(X) + 18.85 (34% in / 66% out) (PM) T = 0.26(X) + 23.12 (56% in / 44% out)	29	56	56	44
15% Reduction for non-auto Trips ⁴			4	8	8	7
Primary Vehicle Trip Estimate for the Proposed Development			25	48	48	37

NOTES: 1. Rates and equations are from *Trip Generation, 11th Edition*, Institute of Transportation Engineers, 2021.
 2. Number of residential units.
 3. Rates are 'vehicles per hour per unit'; trips generated are 'vehicles per hour for peak hours'.
 4. The HRM Integrated Mobility plan has a target for 26% non-auto trips within the Inner Suburban Region. While a recent TIS completed for the nearby background development used a 27% non-auto reduction (see Table 1), this TIS has used a more conservative 15% reduction for non-auto trips and is considered appropriate for apartment units in this area.

Trip Distribution and Assignment

The proposed development generated trips were distributed to the Study Intersections based on counted volumes and review of travel origin and destinations around the site, specifically employment and retail densities in the area. The estimated directional distributions are provided below.

Direction	Split
West on Cowie Hill Road	20%
North on Herring Cove Road	60%
South on Herring Cove Road	20%

Volume Figures

Weekday AM and PM peak hourly estimated site generated vehicle volumes were distributed and assigned to external streets and intersections in the study area using the above assumptions. Assigned AM and PM peak hourly site generated volumes are illustrated diagrammatically in Figure A-3, Appendix A. Assigned site development trips were added to background volumes (Figure A-2, Appendix A) to provide estimates of the AM and PM peak hour volumes at study area intersections for development build-out which are illustrated diagrammatically on Figure A-4, Appendix A.

6 OPERATIONAL ANALYSIS

Intersection Level of Service (LOS) Analysis was completed to estimate how intersections may be expected to operate into the future without and with site generated trips. This section of the report addresses how provisions for active modes as well as left-turn lane warrants and traffic signal warrants were conducted and how each intersection was evaluated. The following subsections identify each study intersection and summarize the results of the operational analysis.

Active Transportation

There is sidewalk along the south (site) side of Cowie Hill Road, and in segments along the north side of Cowie Hill Road but missing between 41 Cowie Hill Road and Peter Saulnier Drive (See Figure 4). This creates discontinuity for pedestrians on the north side of Cowie Hill Road. The development at 68 Mountain Road provides pedestrian access to Cowie Hill Road with no crosswalk to the south side of the road or pedestrian space to continue on the north side (See Photo 1). While this northside sidewalk is not expected to be used by significant development trips, HRM should consider installing a sidewalk on the north side of Cowie Hill Road between 41 Cowie Hill Road and Peter Saulnier Drive.



Photo 1: Pedestrian Walkway Discontinuity at 68 Mountain Road



Photo 2: Missing sidewalk connectivity to Halifax Transit bus stop #6517

Transit

The lack of sidewalk along the north side of Cowie Hill Road in this area is missing connectivity for transit users using transit stop #6517 just east of Limerick Drive (See Photo 2). The addition of sidewalk along the north side of Cowie Hill Road identified above would improve this connectivity for transit users in this area. Figure 8 shows the area of missing sidewalk.



Figure 8: Recommended sidewalk to improve pedestrian and transit operations along Cowie Hill Road



Left-Turn Lane Warrant Analysis

Left-turn movements on a two-lane street may cause both operational and safety problems. Operational problems result as a vehicle stopped waiting for an opportunity to turn across ‘heavy’ opposing traffic causes a queue of stopped vehicles to form. Safety problems result from rear end collisions when a stopped left-turning vehicle is struck by an advancing vehicle, or from head-on or right-angle collisions when a left-turning vehicle is struck by an opposing vehicle.

The Geometric Design Standards for Ontario Highways Manual contains nomographs for left-turn lane analysis for two lane streets at unsignalized intersections. The analysis method, which is normally used by WSP Atlantic to evaluate the warrant for left-turn lanes, uses a series of nomographs that consider speed, advancing volumes, left-turns as a percentage of advancing volumes, and opposing volumes. A point, based on ‘opposing’ and ‘advancing’ volumes, plotted to the right of the ‘warrant line’ of the appropriate ‘% left-turns’ and ‘approach speed’ nomograph, indicates that a left-turn lane is warranted for the conditions used in the analysis. Similarly, a point that is plotted to the left of the warrant line indicates that a left-turn lane is not warranted.

Left-turn lane analyses have been completed for the study intersections using projected 2027 peak hourly volumes that include site generated trips (Figure A-4) and 2027 future background volumes (Figure A-2). A left-turn lane **is not warranted** at the Cowie Hill Road and Ridge Valley Road intersection without and with site generated trips. Left turn lane warrant analysis is provided in Appendix B.

Traffic Signal Warrant Analysis

A signal warrant analysis is completed to determine if the installation of traffic signals at an intersection will provide a positive impact on total intersection operation. That is, the benefits in time saved and improved safety that will accrue to vehicles entering from a side street will exceed the impact that signals will have in time lost and potential additional collisions for vehicles approaching the intersection on the main street.

The *Canadian Traffic Signal Warrant Matrix Analysis (Transportation Association of Canada (TAC), 2005)* considers 100 warrant points as an indication that traffic signals will provide a positive impact. Signal warrant analysis uses vehicular and pedestrian volumes, and intersection, roadway and study area characteristics to calculate a warrant point value.

Evaluation of a traffic signal warrant was completed for the appropriate intersection using 2027 traffic volumes with the proposed development and **traffic signals are not warranted** at the unsignalized study intersection (Cowie Hill Road at Ridge Valley Road).

All-Way Stop (AWS) Warrant Analysis

An All-Way Stop (AWS) is best suited for situations where the traffic volumes are balanced evenly, with 50% of the traffic is approaching on the major street and 50 % of the traffic is approaching on the minor street. On the lower end, an AWS should not have more than around 70% of its total approach volume on any one street.

Evaluation of traffic an AWS warrant was completed for appropriate intersection using 2027 traffic volumes with the proposed development and **an AWS is not warranted** at the unsignalized study intersection (Cowie Hill Road at Ridge Valley Road), despite following the approach volume split guide for the installation of an AWS (65%/35%).



Intersection Capacity Analysis Results

Synchro 11 software has been used for performance evaluation of the two study intersections. Summaries of the results are provided in the following sub-sections and detailed results of the analyses are included in Appendix C.

Intersection Level of Service Analysis

The level or quality of performance of an intersection in terms of traffic movement is determined by a level of service (LOS) analysis. LOS for intersections is defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and increased travel time.

LOS criteria, as shown in Table 3, are stated in terms of average control delay per vehicle which includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.

Table 3 – Level of Service Criteria

Signalized Intersections Control Delay (Seconds per Vehicle)	LOS Description	Roundabouts and Two Way Stop Controlled (TWSC) Intersections Control Delay (Seconds per Vehicle)
Less than 10.0	Very low delay; most vehicles do not stop (Excellent)	Less than 10.0
Between 10.0 and 20.0	Higher delay; most vehicles stop (Very Good)	Between 10.0 and 15.0
Between 20.0 and 35.0	Higher level of congestion; number of vehicles stopping is significant, although many still pass through intersection without stopping (Good)	Between 15.0 and 25.0
Between 35.0 and 55.0	Congestion becomes noticeable; vehicles must sometimes wait through more than one red light; many vehicles stop (Satisfactory)	Between 25.0 and 35.0
Between 55.0 and 80.0	Vehicles must often wait through more than one red light; considered by many agencies to be the limit of acceptable delay	Between 35.0 and 50.0
Greater than 80.0	This level is considered to be unacceptable to most drivers; occurs when arrival flow rates exceed the capacity of the intersection (Unacceptable)	Greater than 50.0

6.1 ANALYSIS SCENARIOS

Summary Analysis Scenarios Considered

Scenario 1 - Future 2027 without Site: Represents future 2027 traffic volumes without site generated trips on the existing road network, including the existing traffic control and lane configurations of the Study Intersections.

Scenario 2 - Future 2027 with Site: Represents future 2027 traffic volumes on the existing road network, including the existing traffic control and lane configurations of the Study Intersections with buildout of the proposed development.

Scenario 3 - Future 2027 with Site and Potential Modifications: Represents future 2027 traffic volumes on the existing road network, including the modified traffic control and lane configurations of the Study Intersections with buildout of the proposed development.

6.2 INT #1: COWIE HILL ROAD AT RIDGE VALLEY ROAD

Operational performance results for this intersection are provided in Table 4 for both the AM and PM peak hours.

The intersection is expected to operate within HRM acceptable limits during the AM and PM peak hours without and with site generated trips. The maximum v/c ratio is projected to be 0.34 with LOS B or better. Small changes in the operational performance of this intersection are expected with the addition of the proposed development.

Scenario 3 shows the performance of the intersection with all-way stop control. With this configuration, the intersection is expected to operate within HRM acceptable limits during the AM and PM peak hours without and with site generated trips. With an overall increase to delay at the intersection (as well as along Cowie Hill Road) with All-Way STOP control, maintaining the existing STOP control on Ridge Valley Road only (Scenario 2) is recommended for this intersection.

Table 4 - Intersection Capacity Analysis: Cowie Hill Road at Ridge Valley Road

LOS Criteria	Control Delay (sec/veh), Level of Service (LOS), v/c Ratio, and 95 th %ile Queue (m) by Intersection Movement			Overall Intersection	Control
	Cowie Hill Road		Ridge Valley Road		
	EB-TR	WB-LT	NB-LR	Delay	
Scenario 1 - 2027 Future without Site AM Peak Hour (Page C-1)					
Delay	0.0	5.8	10.8	5.7	
LOS	A	A	B		
v/c	0.09	0.10	0.21		
Queue	0.0	2.8	6.3		
Scenario 2 - 2027 Future with Site AM Peak Hour (Page C-5)					
Delay	0.0	6.1	11.6	6.5	
LOS	A	A	B		
v/c	0.09	0.12	0.28		
Queue	0.0	3.3	9.3		
Scenario 3 - 2027 Future with Site AM Peak Hour - AWS (Page C-9)					
Delay	9.0	8.6	9.9	9.2	
LOS	A	A	A		
v/c	0.27	0.20	0.30		
Queue	1.1	0.7	1.3		
Scenario 1 - 2027 Future without Site PM Peak Hour (Page C-3)					
Delay	0.0	5.1	11.8	4.9	
LOS	A	A	B		
v/c	0.16	0.06	0.26		
Queue	0.0	1.5	8.4		
Scenario 2 - 2027 Future with Site PM Peak Hour (Page C-7)					
Delay	0.0	6.0	13.0	5.9	
LOS	A	A	B		
v/c	0.16	0.09	0.34		
Queue	0.0	2.4	11.9		
Scenario 3 - 2027 Future with Site PM Peak Hour - AWS (Page C-10)					
Delay	9.5	9.7	9.4	9.6	
LOS	A	A	A		
v/c	0.29	0.34	0.23		
Queue	1.2	1.5	0.9		

6.3 INT #2: HERRING COVE ROAD AT COWIE HILL ROAD

Operational performance results for this intersection are provided in Table 5 for both the AM and PM peak hours.

The analysis shows no existing operational concerns with the intersection’s operation in isolation. However, Herring Cove Road does experience heavy congestion, especially during the AM peak in the northbound direction. The Armdale Roundabout is a bottleneck for the corridor and can create extensive queueing. Small changes in the operational performance of this intersection are expected with the addition of the proposed development.

Table 5 - Intersection Capacity Analysis: Herring Cove Road at Cowie Hill Road

LOS Criteria	Control Delay (sec/veh), Level of Service (LOS), v/c Ratio, and 95th %ile Queue (m) by Intersection Movement					Overall Intersection Delay	Control
	Cowie Hill Road		Herring Cove Road				
	EB-LR	NB-L	NB-T	SB-T	SB-R		
Scenario 1 - 2027 Future without Site AM Peak Hour (Page C-2)							
Delay	15.3	4.9	7.0	5.5	2.0	7.3	
LOS	B	A	A	A	A		
v/c	0.44	0.05	0.45	0.28	0.05		
Queue	18.4	4.2	48.8	26.3	3.4		
Scenario 2 - 2027 Future with Site AM Peak Hour (Page C-6)							
Delay	15.7	5.5	7.9	6.2	2.1	8.3	
LOS	B	A	A	A	A		
v/c	0.50	0.06	0.47	0.29	0.07		
Queue	23.2	5.1	53.9	29.2	4.1		
Scenario 1 - 2027 Future without Site PM Peak Hour (Page C-4)							
Delay	20.8	7.2	5.4	9.9	2.0	8.8	
LOS	C	A	A	A	A		
v/c	0.51	0.26	0.41	0.68	0.10		
Queue	24.0	10.6	48.5	130.4	6.1		
Scenario 2 - 2027 Future with Site PM Peak Hour (Page C-8)							
Delay	23.1	11.0	6.5	12.6	2.2	11.0	
LOS	C	B	A	B	A		
v/c	0.57	0.37	0.45	0.74	0.13		
Queue	30.0	15.6	53.9	161.4	7.8		

7 SUMMARY & CONCLUSIONS

7.1 SUMMARY

Background	1. Plans are being prepared for a residential development in Halifax, Nova Scotia. The development is proposed to be located on the existing lot at 30 Ridge Valley Road.
Description of Existing Development	2. The development site currently includes a 12-storey residential building and surface parking.
Description of Proposed Development	3. The proposed development is expected to include 298 new high-rise residential units with underground parking.
Proposed Site Access	4. The proposed development is expected to use the existing site accesses on Ridge Valley Road and Bromley Road.
Study Area Roads	5. The study considers Herring Cove Road, Cowie Hill Road, Ridge Valley Road, and their corresponding intersections.
Turning Movement Counts	6. Turning movement counts were collected on Wednesday, September 20, 2023, at the Cowie Hill Road and Ridge Valley Road intersection and on Wednesday, May 17, 2023 at the Herring Cove Road at Cowie Hill Road intersection.
Background Traffic Volumes	7. Projected 2027 peak hour future background volumes include an annual growth of 1.0% between 2023 and 2027 and also includes trips generated by the background development at 41 Cowie Hill Road.
Estimation of Existing & Proposed Development Trips	8. Trip generation estimates for the proposed development were prepared using rates published in <i>Trip Generation, 11th Edition</i> (Institute of Transportation Engineers, Washington, 2021). 9. It is estimated that the development will generate: <ul style="list-style-type: none"> • 73 two-way vehicle trips (25 entering and 48 exiting) during the AM peak hour; and, • 85 two-way vehicle trips (48 entering and 37 exiting) during the PM peak hour.
Trip Distribution and Assignment	10. Proposed development generated trips were distributed to the Study Intersections based on counted volumes considering major trip origins and destinations in the region.
Warrant Analysis Summary	11. Warrant reviews were completed for traffic signals with the projected traffic volumes. 12. It was determined that a left turning lane and traffic signals are not warranted at the Cowie Hill Road and Ridge Valley Road intersection.

**Summary –
Intersection
Capacity
Analysis**

13. Intersection performance analysis was completed using *Synchro 11* at the Study Intersections.
14. The **Cowie Hill Road at Ridge Valley Road intersection** is expected to operate well and within HRM acceptable limits during the AM and PM peak periods.
15. The **Herring Cove Road at Cowie Hill Road intersection** is shown to operate well and within HRM guidelines during both the AM and PM peak periods. While the analysis shows no existing operational concerns with the intersection’s operation in isolation, Herring Cove Road does experience heavy congestion as the Armdale Roundabout is a bottleneck for the corridor. Negligible changes in the operational performance of this intersection are expected with the addition of the proposed development.

7.2 CONCLUSIONS

Conclusions

16. HRM should consider installing sidewalk on the north side of Cowie Hill Road to improve pedestrian connectivity and to connect to the existing bus stop (#6517) to the east of Limerick Road. This will improve access to the transit stop for riders from the new development at 41 Cowie Hill Road as well as existing developments in the area.
-

APPENDIX

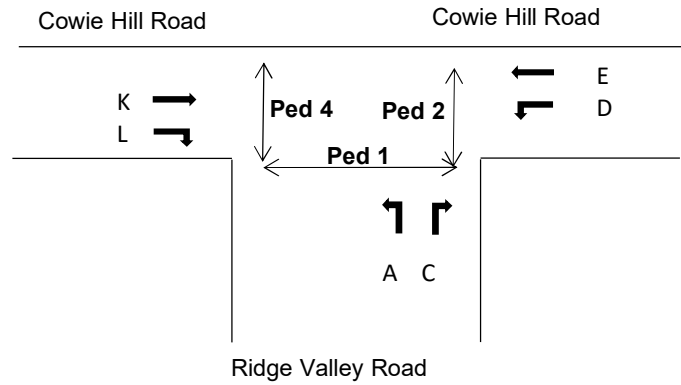
A

TRAFFIC VOLUME DATA



Table A-1
Cowie Hill Road
@
Ridge Valley Road

Halifax, NS
Wednesday, September 20, 2023

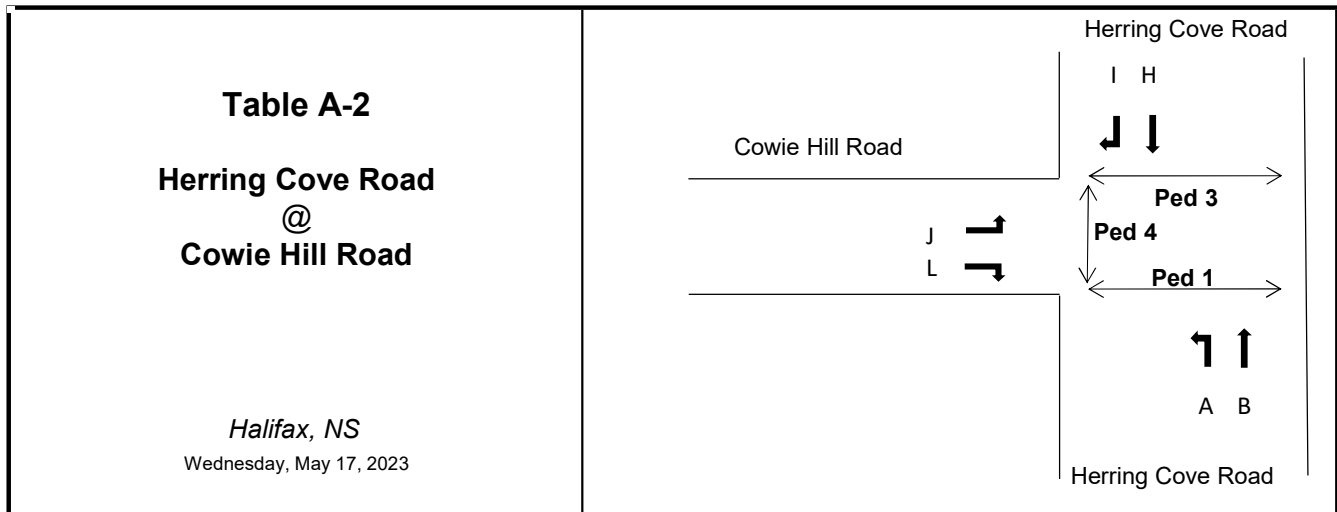


AM Peak Period Volume Data

Time	Ridge Valley Road Northbound Approach		Cowie Hill Road Westbound Approach		Cowie Hill Road Eastbound Approach		Total Vehicles
	A	C	D	E	K	L	
07:00 - 07:15	5	20	17	20	10	8	80
07:15 - 07:30	5	5	44	25	8	13	100
07:30 - 07:45	2	17	32	12	13	5	81
07:45 - 08:00	7	38	26	6	22	11	110
08:00 - 08:15	7	27	37	15	24	5	115
08:15 - 08:30	2	28	36	7	12	12	97
08:30 - 08:45	10	25	25	9	17	7	93
08:45 - 09:00	9	37	34	14	35	17	146
AM Peak Hour	28	117	132	45	88	41	451
07:00 - 08:00	19	80	119	63	53	37	371
08:00 - 09:00	28	117	132	45	88	41	451
	Ped 1		Ped 2		Ped 4		Total Peds
07:00 - 08:00	5		0		0		5
08:00 - 09:00	24		0		1		25

PM Peak Period Volume Data

Time	Ridge Valley Road Northbound Approach		Cowie Hill Road Westbound Approach		Cowie Hill Road Eastbound Approach		Total Vehicles
	A	C	D	E	K	L	
16:00 - 16:15	15	28	15	7	30	28	123
16:15 - 16:30	18	26	9	12	36	18	119
16:30 - 16:45	10	21	17	7	39	25	119
16:45 - 17:00	18	24	11	9	40	26	128
17:00 - 17:15	12	30	15	7	27	25	116
17:15 - 17:30	16	28	18	10	33	22	127
17:30 - 17:45	9	31	22	10	25	32	129
17:45 - 18:00	16	28	14	8	20	22	108
PM Peak Hour	55	113	66	36	125	105	500
16:00 - 17:00	61	99	52	35	145	97	489
17:00 - 18:00	53	117	69	35	105	101	480
	Ped 1		Ped 2		Ped 4		Total Peds
16:00 - 17:00	10		5		0		15
17:00 - 18:00	11		0		0		11



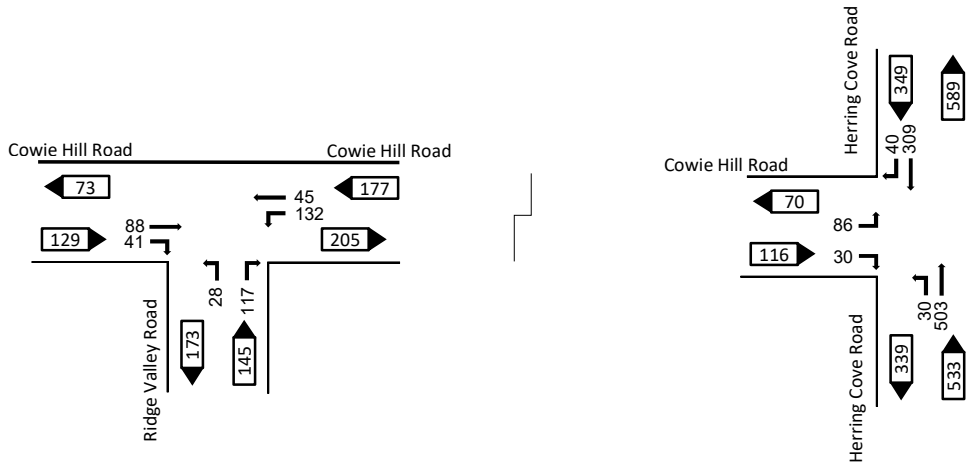
AM Peak Period Volume Data

Time		Herring Cove Road Northbound Approach		Herring Cove Road Southbound Approach		Cowie Hill Road Eastbound Approach		Total Vehicles
		A	B	H	I	J	L	
07:00	07:15	10	219	77	6	24	7	343
07:15	07:30	7	175	65	12	28	4	291
07:30	07:45	6	58	75	15	22	10	186
07:45	08:00	7	51	92	7	12	9	178
08:00	08:15	4	51	57	12	11	3	138
08:15	08:30	3	26	81	18	17	15	160
08:30	08:45	6	44	99	11	14	7	181
08:45	09:00	5	60	104	18	23	24	234
AM Peak Hour		30	503	309	40	86	30	998
07:00	08:00	30	503	309	40	86	30	998
08:00	09:00	18	181	341	59	65	49	713
		Ped 1		Ped 3		Ped 4		Total Peds
07:00	08:00	2		7		1		10
08:00	09:00	7		8		3		18

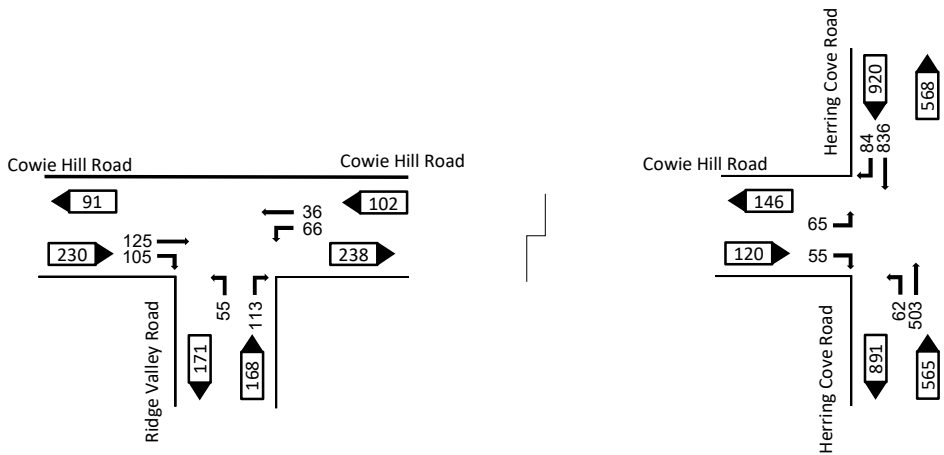
PM Peak Period Volume Data

Time		Herring Cove Road Northbound Approach		Herring Cove Road Southbound Approach		Cowie Hill Road Eastbound Approach		Total Vehicles
		A	B	H	I	J	L	
16:00	16:15	21	129	193	24	36	17	420
16:15	16:30	14	85	162	22	29	10	322
16:30	16:45	14	114	216	17	13	17	391
16:45	17:00	10	118	209	27	17	17	398
17:00	17:15	17	134	208	21	18	14	412
17:15	17:30	21	137	203	19	17	7	404
17:30	17:45	15	121	179	22	28	16	381
17:45	18:00	9	133	189	19	25	11	386
PM Peak Hour		62	503	836	84	65	55	1605
16:00	17:00	59	446	780	90	95	61	1531
17:00	18:00	62	525	779	81	88	48	1583
		Ped 1		Ped 3		Ped 4		Total Peds
16:00	17:00	4		5		4		13
17:00	18:00	2		3		4		9

Weekday AM Peak Hour
2023 Existing Traffic Volumes



Weekday PM Peak Hour
2023 Existing Traffic Volumes



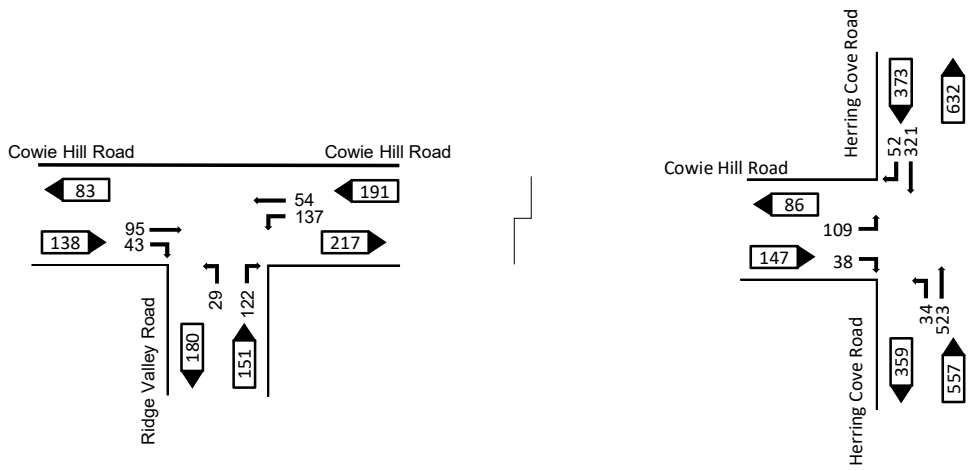
30 Ridge Valley Road TIS
Halifax, NS

Figure A-1

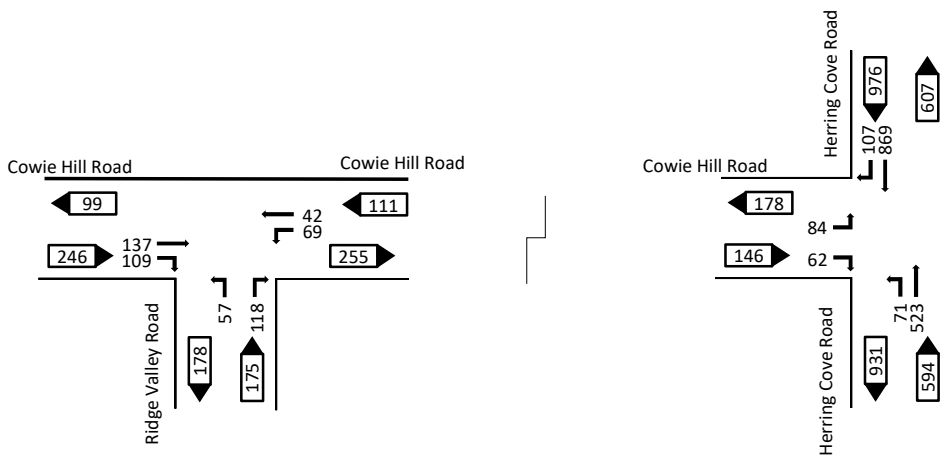
Weekday AM and PM Peak Hour
2023 Existing Traffic Volumes

September 2023

Weekday AM Peak Hour
2027 Future Background Traffic Volumes



Weekday PM Peak Hour
2027 Future Background Traffic Volumes



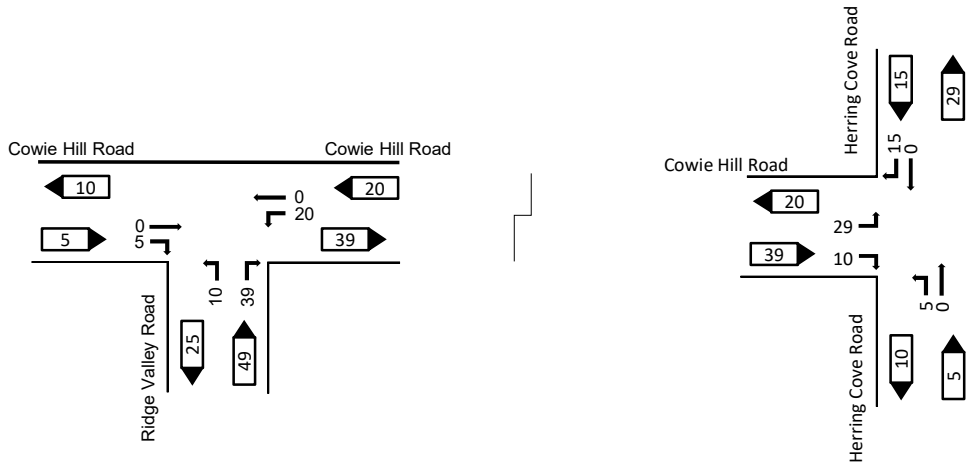
30 Ridge Valley Road TIS
Halifax, NS

Figure A-2

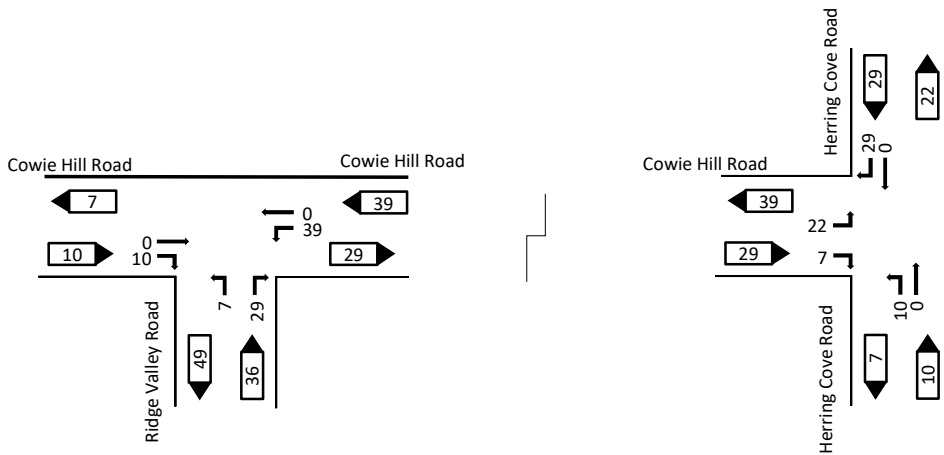
Weekday AM and PM Peak Hour
2027 Future Background Traffic Volumes

September 2023

Weekday AM Peak Hour
Trip Assignment Volumes



Weekday PM Peak Hour
Trip Assignment Volumes



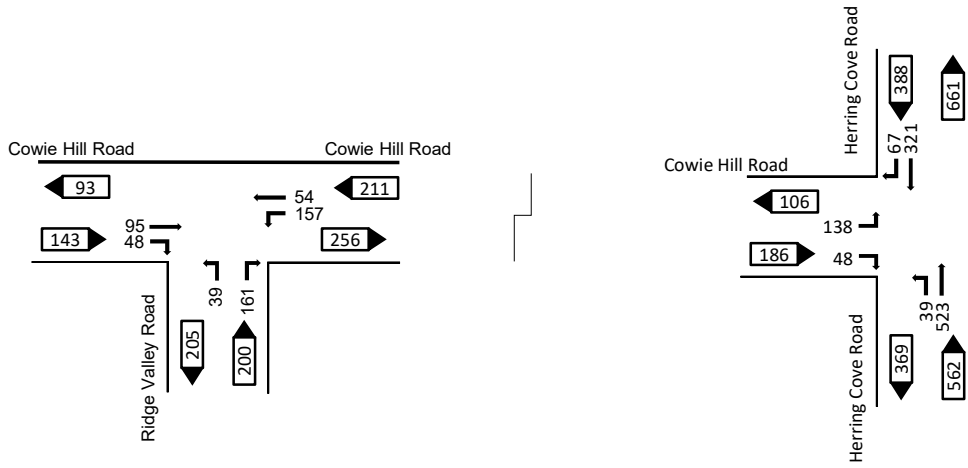
30 Ridge Valley Road TIS
Halifax, NS

Figure A-3

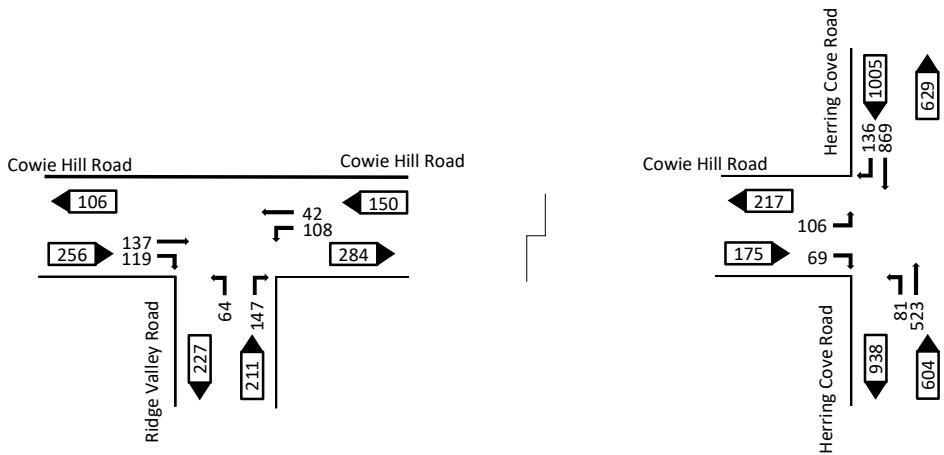
Weekday AM and PM Peak Hour
Trip Assignment

September 2023

Weekday AM Peak Hour
2027 Future Background and Site Generated Trips



Weekday PM Peak Hour
2027 Future Background and Site Generated Trips



30 Ridge Valley Road TIS
Halifax, NS

Figure A-4

Weekday AM and PM Peak Hour
2027 Total Traffic with Site Generated Trips

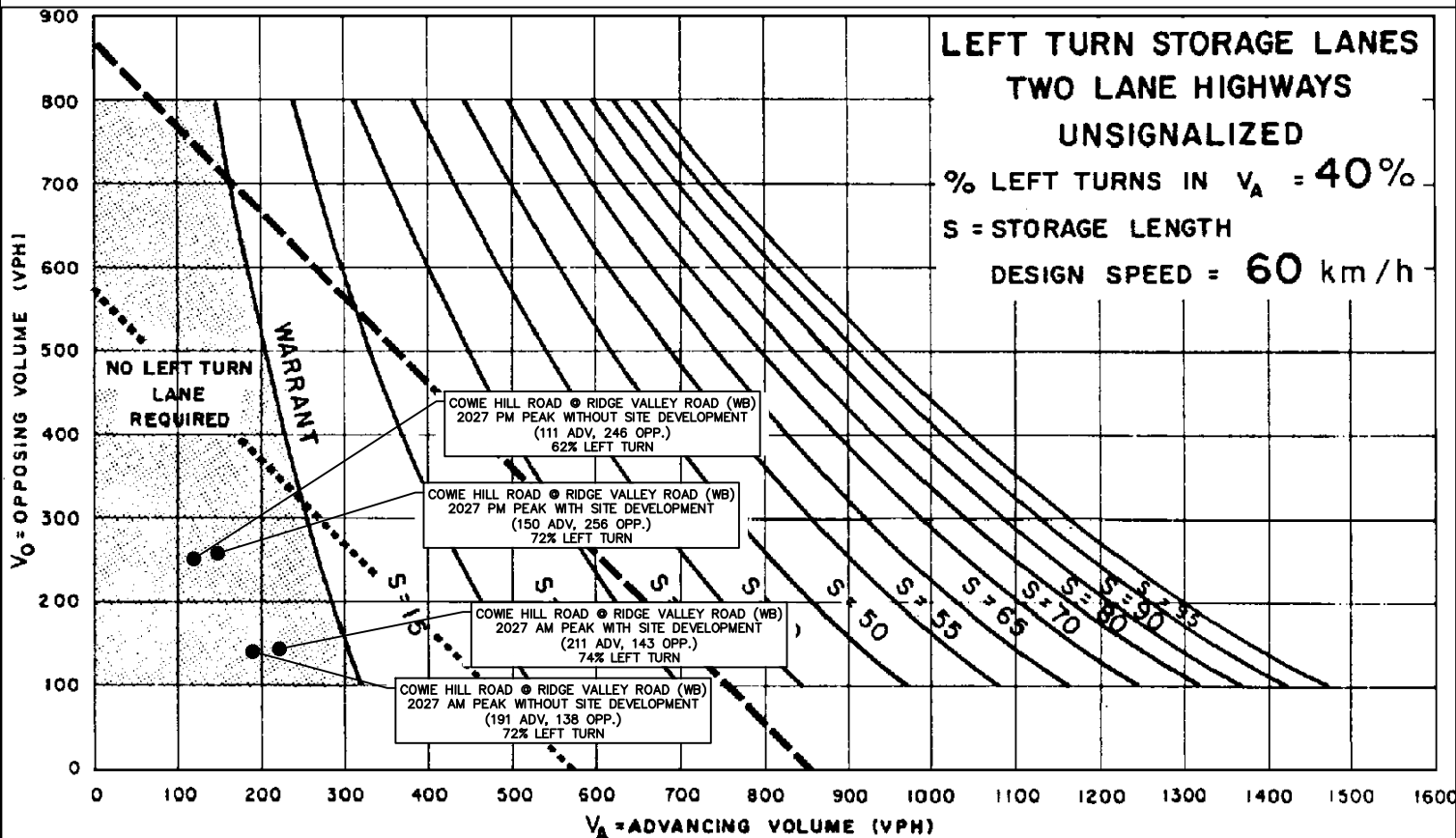
September 2023

APPENDIX

B

WARRANT ANALYSIS





2005 Canadian Traffic Signal Warrant Matrix Analysis

Table: B-1 - Cowie Hill Road @ Ridge Valley Road
2027 Future Background with Site Trips

Main Street (name)	Cowie Hill Road	Direction (EW or NS)	EW	Date:	Septmeber 2023
Side Street (name)	Ridge Valley Road	Direction (EW or NS)	NS	City:	Halifax, NS

Lane Configuration		Excl LT	Th & LT	Through or Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Cowie Hill Road	WB			1				1
Cowie Hill Road	EB			1				1
Ridge Valley Road	NB			1				
	SB							

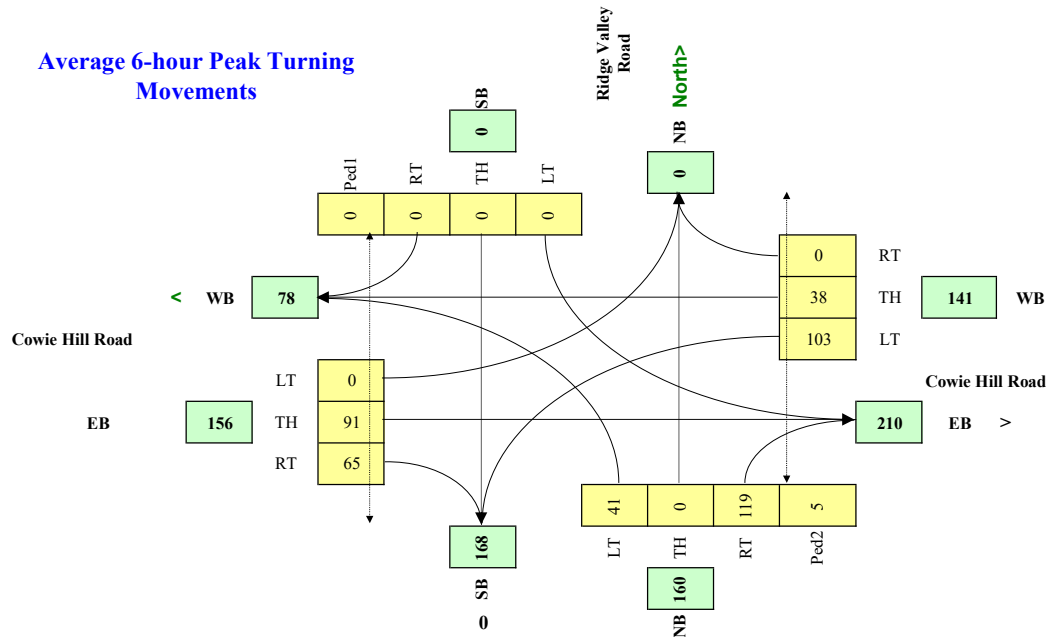
Other input		Speed (Km/h)	Trucks %	Bus Rt (y/n)	Median (m)
Cowie Hill Road	EW	50	2.0%	y	0.0
Ridge Valley Road	NS	50	2.0%	y	

	Ped1 NS W Side	Ped2 NS E Side	Ped3 EW N Side	Ped4 EW S side
7:00 - 8:00		5		30
8:00 - 9:00		5		30
11:30 - 12:30		5		30
12:30 - 13:30		5		30
15:30 - 16:30		5		15
16:30 - 17:30		5		15
Total (6-hour peak)	0	30	0	150
Average (6-hour peak)	0	5	0	25

Demographics		
Elementary School	(y/n)	y
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	400,000
Central Business District	(y/n)	n

Traffic Input	NB			SB			WB			EB		
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT
7:00 - 8:00	40	0	160	0	0	0	155	55	0	0	95	50
8:00 - 9:00	35	0	135	0	0	0	135	45	0	0	80	40
11:30 - 12:30	25	0	75	0	0	0	65	25	0	0	60	40
12:30 - 13:30	25	0	75	0	0	0	65	25	0	0	60	40
15:30 - 16:30	55	0	125	0	0	0	90	35	0	0	115	100
16:30 - 17:30	65	0	145	0	0	0	110	40	0	0	135	120
Total (6-hour peak)	245	0	715	0	0	0	620	225	0	0	545	390
Average (6-hour peak)	41	0	119	0	0	0	103	38	0	0	91	65

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v,v}) / K_1 + (F(X_{v,p}) L) / K_2] \times C_i$$

W =	19	17	2
		Veh	Ped
NOT Warranted			

Table B-2 All Way Stop Analysis - 2027 Future Background + Site Generated Trips

City / Town: **Halifax, NS**
 Major Street: **Cowie Hill Road**
 Major Street Direction (NS or EW): **EW**
 Minor Street: **Ridge Valley Road**
 Date: **Septmeber 2023**

INPUT DATA:

Major Street

	D WBL	E WBT	F WBR	J EBL	K EBT	L EBR	Total	Crossing Peds
7:00 - 8:00	155	55	0	0	95	50	355	0
8:00 - 9:00	135	45	0	0	80	40	300	0
11:30 - 12:30	65	25	0	0	60	40	190	0
12:30 - 13:30	65	25	0	0	60	40	190	0
15:30 - 16:30	90	35	0	0	115	100	340	0
16:30 - 17:30	110	40	0	0	135	120	405	0
Average of 6 Hours	103	38	0	0	91	65	297	0

Minor Street

	A NBL	B NBT	C NBR	G SBL	H SBT	I SBR	Total
07:00 to 08:00	40	0	160	0	0	0	200
08:00 to 09:00	35	0	135	0	0	0	170
11:00 to 12:00	25	0	75	0	0	0	100
12:00 to 13:00	25	0	75	0	0	0	100
16:00 to 17:00	55	0	125	0	0	0	180
17:00 to 18:00	65	0	145	0	0	0	210
Average of 6 Hours	41	0	119	0	0	0	160

Minor Street Delay During Peak Hour seconds
 Signal Warrant Priority Points
 Average Collisions per Year that Could be Prevented by an All-Way Stop

ANALYSIS RESULTS:

A guide that indicates whether an All-Way Stop Control is appropriate is the volume split between the major and minor streets. An All-Way Stop is best suited for situations where the volumes are balanced evenly between the major and minor streets. That is 50% of the traffic is approaching on the major street and 50 % of the traffic is approaching on the minor street. A guide on volume splits that has been used is that an All-Way Stop should not have more that 70% of its total approach volume on any one street.

This intersection has **65%** of the traffic approaching on the major street and **35%** approaching on the minor.

This intersection **FOLLOWS** the approach volume split guide for installation of an All-Way Stop.

All-Way Stop Warrants B and C are based on 8-hours of Traffic Volume on an average day. Since this Warrant uses 6-Hours of data, actually using 8 hours of data would give lower results.

Warrant A	Signals Warranted?	Warrant A Not Met
Warrant B	Collision Warrant	NO INFORMATION
Warrant C C1	Average Major Street Volume >300 vph	Not Warranted
C2	Average Minor Street Volume >200 vph	Condition C2 Not Met
C3	Average Delay to Minor Street >30 seconds during the peak hour	Not Warranted
	Conditions C1, C2, and C3 must be met to meet Warrant C	Warrant C Not Met

An All-Way Stop **IS NOT** Warranted at this Location










APPENDIX

C

INTERSECTION PERFORMANCE ANALYSIS



Appendix C - Intersection Operational Analysis
1: Ridge Valley Road & Cowie Hill Road

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	95	43	137	54	29	122
Future Volume (Veh/h)	95	43	137	54	29	122
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	103	47	149	59	32	133
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			150			484
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			150			484
tC, single (s)			4.1			6.2
tC, 2 stage (s)						
tF (s)			2.2			3.3
p0 queue free %			90			86
cM capacity (veh/h)			1431			924
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	150	208	165			
Volume Left	0	149	32			
Volume Right	47	0	133			
cSH	1700	1431	786			
Volume to Capacity	0.09	0.10	0.21			
Queue Length 95th (m)	0.0	2.8	6.3			
Control Delay (s)	0.0	5.8	10.8			
Lane LOS			A			B
Approach Delay (s)	0.0	5.8	10.8			
Approach LOS			B			
Intersection Summary						
Average Delay			5.7			
Intersection Capacity Utilization			37.2%	ICU Level of Service	A	
Analysis Period (min)	15					

Appendix C - Intersection Operational Analysis
 2: Herring Cove Road & Cowie Hill Road

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	109	38	34	523	321	52
Future Volume (vph)	109	38	34	523	321	52
Satd. Flow (prot)	1733	0	1770	1863	1863	1583
Flt Permitted	0.964		0.552			
Satd. Flow (perm)	1733	0	1028	1863	1863	1583
Satd. Flow (RTOR)	40					57
Lane Group Flow (vph)	159	0	37	568	349	57
Turn Type	Prot		Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases			2			6
Total Split (s)	23.0		27.0	27.0	27.0	27.0
Total Lost Time (s)	4.5		4.5	4.5	4.5	4.5
Act Effect Green (s)	8.5		29.7	29.7	29.7	29.7
Actuated g/C Ratio	0.19		0.67	0.67	0.67	0.67
v/c Ratio	0.44		0.05	0.45	0.28	0.05
Control Delay	15.3		4.9	7.0	5.5	2.0
Queue Delay	0.0		0.0	0.0	0.0	0.0
Total Delay	15.3		4.9	7.0	5.5	2.0
LOS	B		A	A	A	A
Approach Delay	15.3			6.8	5.0	
Approach LOS	B			A	A	
Queue Length 50th (m)	8.4		1.0	20.5	10.8	0.0
Queue Length 95th (m)	18.4		4.2	48.8	26.3	3.4
Internal Link Dist (m)	169.4			112.5	118.2	
Turn Bay Length (m)						30.0
Base Capacity (vph)	753		691	1252	1252	1083
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.21		0.05	0.45	0.28	0.05

Intersection Summary

Cycle Length: 50

Actuated Cycle Length: 44.2

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.45

Intersection Signal Delay: 7.3

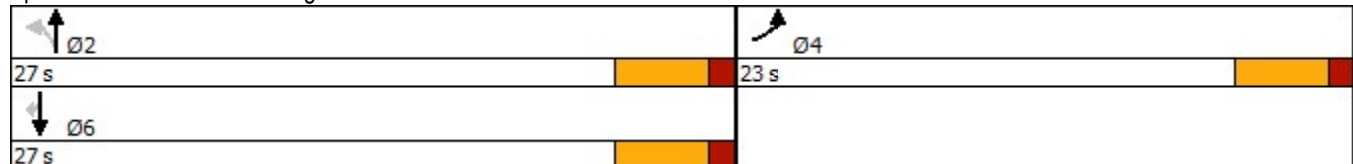
Intersection Capacity Utilization 43.4%

Analysis Period (min) 15










Intersection LOS: A

ICU Level of Service A












Splits and Phases: 2: Herring Cove Road & Cowie Hill Road



Appendix C - Intersection Operational Analysis
1: Ridge Valley Road & Cowie Hill Road

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	137	109	69	42	57	118
Future Volume (Veh/h)	137	109	69	42	57	118
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	149	118	75	46	62	128
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			267		404	208
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			267		404	208
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			94		89	85
cM capacity (veh/h)			1297		568	832
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	267	121	190			
Volume Left	0	75	62			
Volume Right	118	0	128			
cSH	1700	1297	722			
Volume to Capacity	0.16	0.06	0.26			
Queue Length 95th (m)	0.0	1.5	8.4			
Control Delay (s)	0.0	5.1	11.8			
Lane LOS		A	B			
Approach Delay (s)	0.0	5.1	11.8			
Approach LOS			B			
Intersection Summary						
Average Delay			4.9			
Intersection Capacity Utilization			40.3%	ICU Level of Service		A
Analysis Period (min)			15			

Appendix C - Intersection Operational Analysis
 2: Herring Cove Road & Cowie Hill Road

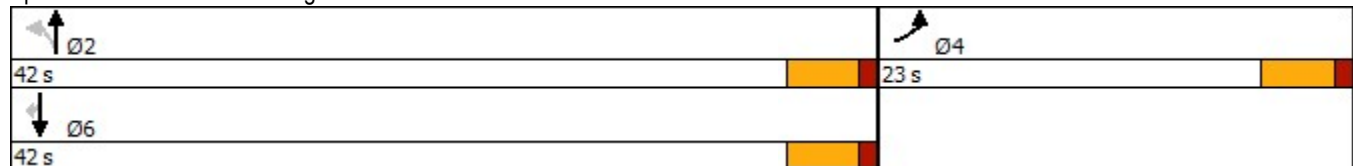
						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	84	62	71	523	869	107
Future Volume (vph)	84	62	71	523	869	107
Satd. Flow (prot)	1707	0	1770	1863	1863	1583
Flt Permitted	0.972		0.214			
Satd. Flow (perm)	1707	0	399	1863	1863	1583
Satd. Flow (RTOR)	57					76
Lane Group Flow (vph)	158	0	77	568	945	116
Turn Type	Prot		Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases			2			6
Total Split (s)	23.0		42.0	42.0	42.0	42.0
Total Lost Time (s)	4.5		4.5	4.5	4.5	4.5
Act Effect Green (s)	9.1		44.6	44.6	44.6	44.6
Actuated g/C Ratio	0.15		0.75	0.75	0.75	0.75
v/c Ratio	0.51		0.26	0.41	0.68	0.10
Control Delay	20.8		7.2	5.4	9.9	2.0
Queue Delay	0.0		0.0	0.0	0.0	0.0
Total Delay	20.8		7.2	5.4	9.9	2.0
LOS	C		A	A	A	A
Approach Delay	20.8			5.6	9.0	
Approach LOS	C			A	A	
Queue Length 50th (m)	10.6		2.5	21.7	50.9	1.1
Queue Length 95th (m)	24.0		10.6	48.5	#130.4	6.1
Internal Link Dist (m)	169.4			112.5	118.2	
Turn Bay Length (m)						30.0
Base Capacity (vph)	569		298	1393	1393	1202
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.28		0.26	0.41	0.68	0.10

Intersection Summary










Cycle Length: 65
 Actuated Cycle Length: 59.7
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.68
 Intersection Signal Delay: 8.8
 Intersection Capacity Utilization 69.6%
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Intersection LOS: A
 ICU Level of Service C

Splits and Phases: 2: Herring Cove Road & Cowie Hill Road



Appendix C - Intersection Operational Analysis
1: Ridge Valley Road & Cowie Hill Road

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	95	48	157	54	39	161
Future Volume (Veh/h)	95	48	157	54	39	161
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	103	52	171	59	42	175
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			155		530	129
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			155		530	129
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			88		91	81
cM capacity (veh/h)			1425		448	921
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	155	230	217			
Volume Left	0	171	42			
Volume Right	52	0	175			
cSH	1700	1425	765			
Volume to Capacity	0.09	0.12	0.28			
Queue Length 95th (m)	0.0	3.3	9.3			
Control Delay (s)	0.0	6.1	11.6			
Lane LOS		A	B			
Approach Delay (s)	0.0	6.1	11.6			
Approach LOS			B			
Intersection Summary						
Average Delay			6.5			
Intersection Capacity Utilization			41.5%	ICU Level of Service		A
Analysis Period (min)			15			

Appendix C - Intersection Operational Analysis
2: Herring Cove Road & Cowie Hill Road

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	138	48	39	523	321	67
Future Volume (vph)	138	48	39	523	321	67
Satd. Flow (prot)	1733	0	1770	1863	1863	1583
Flt Permitted	0.964		0.552			
Satd. Flow (perm)	1733	0	1028	1863	1863	1583
Satd. Flow (RTOR)	40					73
Lane Group Flow (vph)	202	0	42	568	349	73
Turn Type	Prot		Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases			2			6
Total Split (s)	23.0		27.0	27.0	27.0	27.0
Total Lost Time (s)	4.5		4.5	4.5	4.5	4.5
Act Effect Green (s)	9.3		27.9	27.9	27.9	27.9
Actuated g/C Ratio	0.22		0.65	0.65	0.65	0.65
v/c Ratio	0.50		0.06	0.47	0.29	0.07
Control Delay	15.7		5.5	7.9	6.2	2.1
Queue Delay	0.0		0.0	0.0	0.0	0.0
Total Delay	15.7		5.5	7.9	6.2	2.1
LOS	B		A	A	A	A
Approach Delay	15.7			7.7	5.5	
Approach LOS	B			A	A	
Queue Length 50th (m)	10.4		1.2	22.0	11.6	0.0
Queue Length 95th (m)	23.2		5.1	53.9	29.2	4.1
Internal Link Dist (m)	169.4			112.5	118.2	
Turn Bay Length (m)						30.0
Base Capacity (vph)	766		663	1201	1201	1047
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.26		0.06	0.47	0.29	0.07

Intersection Summary

Cycle Length: 50

Actuated Cycle Length: 43.2

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.50

Intersection Signal Delay: 8.3

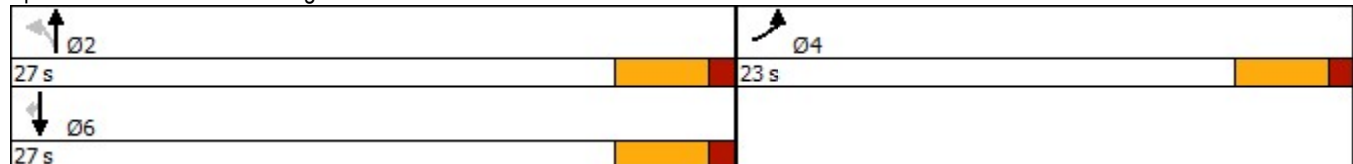
Intersection Capacity Utilization 45.6%

Analysis Period (min) 15










Intersection LOS: A

ICU Level of Service A

Splits and Phases: 2: Herring Cove Road & Cowie Hill Road



Appendix C - Intersection Operational Analysis
 1: Ridge Valley Road & Cowie Hill Road

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	137	119	108	42	64	147
Future Volume (Veh/h)	137	119	108	42	64	147
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	149	129	117	46	70	160
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			278		494	214
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			278		494	214
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			91		86	81
cM capacity (veh/h)			1285		486	827
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	278	163	230			
Volume Left	0	117	70			
Volume Right	129	0	160			
cSH	1700	1285	681			
Volume to Capacity	0.16	0.09	0.34			
Queue Length 95th (m)	0.0	2.4	11.9			
Control Delay (s)	0.0	6.0	13.0			
Lane LOS		A	B			
Approach Delay (s)	0.0	6.0	13.0			
Approach LOS			B			
Intersection Summary						
Average Delay			5.9			
Intersection Capacity Utilization			45.3%	ICU Level of Service		A
Analysis Period (min)			15			

Appendix C - Intersection Operational Analysis
2: Herring Cove Road & Cowie Hill Road

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	106	69	81	523	869	136
Future Volume (vph)	106	69	81	523	869	136
Satd. Flow (prot)	1713	0	1770	1863	1863	1583
Flt Permitted	0.971		0.189			
Satd. Flow (perm)	1713	0	352	1863	1863	1583
Satd. Flow (RTOR)	50					97
Lane Group Flow (vph)	190	0	88	568	945	148
Turn Type	Prot		Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases			2			6
Total Split (s)	23.0		42.0	42.0	42.0	42.0
Total Lost Time (s)	4.5		4.5	4.5	4.5	4.5
Act Effect Green (s)	10.4		42.0	42.0	42.0	42.0
Actuated g/C Ratio	0.17		0.68	0.68	0.68	0.68
v/c Ratio	0.57		0.37	0.45	0.74	0.13
Control Delay	23.1		11.0	6.5	12.6	2.2
Queue Delay	0.0		0.0	0.0	0.0	0.0
Total Delay	23.1		11.0	6.5	12.6	2.2
LOS	C		B	A	B	A
Approach Delay	23.1			7.1	11.2	
Approach LOS	C			A	B	
Queue Length 50th (m)	14.2		3.4	23.8	56.0	1.5
Queue Length 95th (m)	30.0		15.6	53.9	#161.4	7.8
Internal Link Dist (m)	169.4			112.5	118.2	
Turn Bay Length (m)						30.0
Base Capacity (vph)	552		240	1273	1273	1113
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.34		0.37	0.45	0.74	0.13

Intersection Summary

Cycle Length: 65

Actuated Cycle Length: 61.4

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.74

Intersection Signal Delay: 11.0

Intersection LOS: B

Intersection Capacity Utilization 71.6%

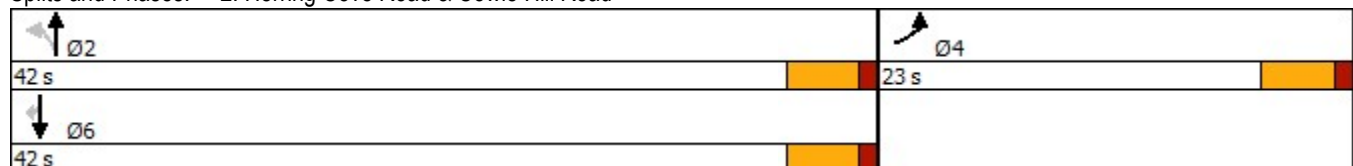
ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2: Herring Cove Road & Cowie Hill Road



Appendix C - Intersection Operational Analysis
1: Ridge Valley Road & Cowie Hill Road

Intersection	
Intersection Delay, s/veh	9.2
Intersection LOS	A

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	➔			⬆	⬆	
Traffic Vol, veh/h	95	48	157	54	39	161
Future Vol, veh/h	95	48	157	54	39	161
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	103	52	171	59	42	175
Number of Lanes	1	0	0	1	1	0
Approach	EB		WB		NB	
Opposing Approach	WB		EB			
Opposing Lanes	1		1		0	
Conflicting Approach Left			NB		EB	
Conflicting Lanes Left	0		1		1	
Conflicting Approach Right	NB				WB	
Conflicting Lanes Right	1		0		1	
HCM Control Delay	8.6		9.9		9	
HCM LOS	A		A		A	

Lane	NBLn1	EBLn1	WBLn1
Vol Left, %	20%	0%	74%
Vol Thru, %	0%	66%	26%
Vol Right, %	81%	34%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	200	143	211
LT Vol	39	0	157
Through Vol	0	95	54
RT Vol	161	48	0
Lane Flow Rate	217	155	229
Geometry Grp	1	1	1
Degree of Util (X)	0.265	0.194	0.303
Departure Headway (Hd)	4.383	4.499	4.752
Convergence, Y/N	Yes	Yes	Yes
Cap	817	796	755
Service Time	2.417	2.54	2.79
HCM Lane V/C Ratio	0.266	0.195	0.303
HCM Control Delay	9	8.6	9.9
HCM Lane LOS	A	A	A
HCM 95th-tile Q	1.1	0.7	1.3

Appendix C - Intersection Operational Analysis
1: Ridge Valley Road & Cowie Hill Road

Intersection	
Intersection Delay, s/veh	9.6
Intersection LOS	A

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	137	119	108	42	64	147
Future Vol, veh/h	137	119	108	42	64	147
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	149	129	117	46	70	160
Number of Lanes	1	0	0	1	1	0
Approach	EB		WB		NB	
Opposing Approach	WB		EB			
Opposing Lanes	1		1		0	
Conflicting Approach Left			NB		EB	
Conflicting Lanes Left	0		1		1	
Conflicting Approach Right	NB				WB	
Conflicting Lanes Right	1		0		1	
HCM Control Delay	9.7		9.4		9.5	
HCM LOS	A		A		A	

Lane	NBLn1	EBLn1	WBLn1
Vol Left, %	30%	0%	72%
Vol Thru, %	0%	54%	28%
Vol Right, %	70%	46%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	211	256	150
LT Vol	64	0	108
Through Vol	0	137	42
RT Vol	147	119	0
Lane Flow Rate	229	278	163
Geometry Grp	1	1	1
Degree of Util (X)	0.292	0.34	0.223
Departure Headway (Hd)	4.576	4.398	4.93
Convergence, Y/N	Yes	Yes	Yes
Cap	782	815	726
Service Time	2.622	2.442	2.981
HCM Lane V/C Ratio	0.293	0.341	0.225
HCM Control Delay	9.5	9.7	9.4
HCM Lane LOS	A	A	A
HCM 95th-tile Q	1.2	1.5	0.9