



MEMO

TO: Mike Evers, MCIP, RPP, BES

FROM: Stephen Keen, P.Eng.

DATE: June 6, 2018

SUBJECT: Haldimand County
Caledonia East-West Road Planning to the Southern Urban Boundary

1. INTRODUCTION

CIMA was retained by Haldimand County to review potential options for an east-west connector at the south end of Caledonia. There are a number of subdivision plans moving forward just within the urban boundary including the McKenzie Subdivision which is draft approved and the Beattie Estates Subdivision at the east end which has a current layout under consideration. The proposed connector will serve the proposed developments within the urban boundary and provide access to downtown via McKenzie Road and Argyle Street. However, the main role of this road is to provide a good east-west connection to Highway 6 thereby encouraging commuters to by-pass the centre of Caledonia.

2. ALTERNATIVE ROUTES

Two main options for the east-west connector were examined:

- A new collector (Route A) that is contained within the Mackenzie and Beattie Estates subdivisions
- A new arterial road (Route B) extending eastwards from Argyle Street along the southern boundary of the Beattie Estates subdivision and urban boundary.

Within the Route A option, 3 collector road sub-options have been developed:

- Collector Road Alternative A1
- Collector Road Alternative A2
- Collector Road Alternative A3

The alternative routes are provided in Appendix A.

3027 Harvester Road, Suite 400
Burlington ON L7N 3G7
CANADA

Phone: 289-288-0287
Fax: 289-288-0285
www.cima.ca

3. ASSESSMENT CRITERIA

The connector road alternatives were assessed and evaluated based on the following criteria:

Transportation

- Traffic Operations at Intersections and Level of Service
- Travel Time Savings from Beattie Subdivision to Argyle Street and Highway 6 (via Highway 6 rather than via Argyle Street)
- Number of Driveways Along Route
- Number of Intersections Along Route
- Network Connectivity

Natural and Social Environment

- Natural Environment
- Impacts on Existing Properties

Engineering

- Cost and Cost Sharing

Development

- Compatibility with Urban Boundary
- Compatibility with Subdivision Plans
- Ability to Serve Intended Purpose

4. ASSESSMENT OF ALTERNATIVE ROUTES

4.1 TRANSPORTATION ASSESSMENT METHODOLOGY

4.1.1 INTERSECTION CONFIGURATION

A traffic operations review was conducted for each alternative using Synchro to evaluate intersection operations (Appendix B). Under future conditions, the intersections of the new road with Argyle Street and McKenzie Road were modelled as signalized.

Based on our assessment, the intersection of the new road with McKenzie Road operates well as a two-way stop controlled intersection, a roundabout or signalized (LOS A). If signalized, the intersection would operate similarly to the stop-controlled configuration with a slight improvement in delay for vehicles attempting to turn left onto McKenzie Road.

Although the two-way stop control intersection operates at an acceptable level, this intersection configuration may encourage westbound drivers coming from the Beattie Estates subdivision to turn right (northbound) as it is easier and presents less delay than waiting for gaps in traffic to proceed westbound through the McKenzie subdivision. In order

to encourage drivers to continue west rather than north, a roundabout or traffic signal may be more suitable to minimize westbound delay.

Given the lack of a need to provide a traffic signal based on traffic operations, this intersection presents a paradoxical situation. The life-cycle costs of a traffic signal would be cheaper however the upfront capital costs are greater for a roundabout. Generally, a roundabout is favoured in order to reduce delay at the intersection given the choice of these two options. The type of intersection will be confirmed during the EA planning for this new road.

4.1.2 TRAVEL TIME

The travel time from a consistent point within Beattie Estates subdivision to the intersection of Argyle Street and Highway 6 was also considered as a factor in the evaluation. The travel time to the intersection of Argyle Street and Highway 6 was assessed via two different routes (Figure 1):

- Route 1: Via Argyle Street
- Route 2: Via Highway 6 (Caledonia Bypass)

A travel time assessment was conducted for both routes based on distance, travel speed and intersection delay. The analysis was conducted in the following steps:

- Travel corridor was selected from Beattie Estates to the intersection of Argyle Street and Highway 6.
- Operating speed was assumed to be 60 km/h on collector roads, 80 km/h on the arterial road and 40km/h on the collector road through the development areas adjacent to residential driveways.
- Travel speed was adjusted based on the number of driveways¹ (where applicable);
- Intersection delay was analyzed by Synchro, and applied to the total travel time.

1 Transportation Research Board NCHRP Report 420: Impacts of Access Management Techniques, Table 34 Access point density adjustment factors. Retrieved from <https://books.google.ca/books?id=z64qi86p2kcC&pg=PA41&lpg=PA41&dq=effect+of+multiple+driveways+on+travel+speed&source=bl&ots=cRMeUiChkJ&sig=cSwvgrSqKZOUWMxo5lANXeEKfjM&hl=en&sa=X&ved=0ahUKewjvusbx5rTaAhUSPN8KHfQgBowQ6AEIJzAA#v=onepage&q=effect%20of%20multiple%20driveways%20on%20travel%20speed&f=false>

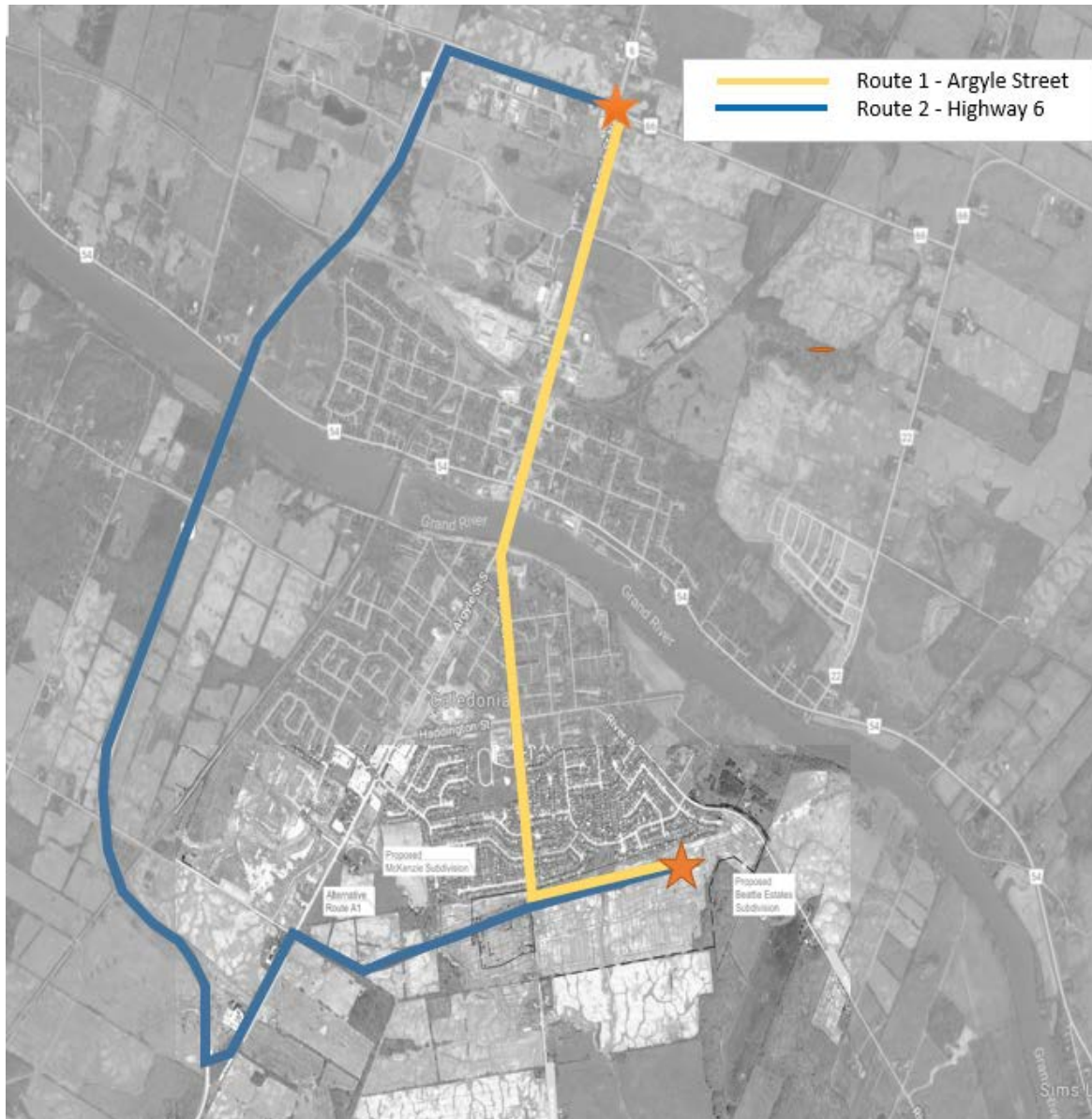


Figure 1: Travel Time Routes

It was assumed that in development areas with frequent access control and intersections, travel speed would be reduced due to the delay waiting for vehicles to complete their movements.

The travel time comparison between Route 1 Argyle Street and Route 2 Highway 6 for each alternative is summarized in the following tables.

Table 1: Alternative A1 Travel Time

Route 1 – Via Argyle Street			
AM		PM	
NB	SB	NB	SB
12:15	11:18	12:02	11:44
Route 2 – Via Highway 6			
AM		PM	
NB	SB	NB	SB
12:09	11:14	11:58	10:58

(minutes: seconds)

Table 2: Alternative A2 Travel Time

Route 1 – Via Argyle Street			
AM		PM	
NB	SB	NB	SB
11:31	10:33	11:07	10:52
Route 2 – Via Highway 6			
AM		PM	
NB	SB	NB	SB
10:33	9:50	10:14	9:20

(minutes: seconds)

Table 3: Alternative A3 Travel Time

Route 1 – Via Argyle Street			
AM		PM	
NB	SB	NB	SB
12:02	11:08	11:48	11:35
Route 2 – Via Highway 6			
AM		PM	
NB	SB	NB	SB
11:11	10:39	11:02	10:10

(minutes: seconds)

Table 4: Alternative B Travel Time

Route 1 – Via Argyle Street			
AM		PM	
NB	SB	NB	SB
11:04	10:06	10:28	10:07
Route 2 – Via Highway 6			
AM		PM	
NB	SB	NB	SB
9:44	8:55	9:22	8:28

(minutes: seconds)

Based on the assessment, it can be concluded that travel time from Beattie Estates to the intersection of Argyle Street and Highway 6 is shorter via the Highway 6 bypass for all alternatives.

As noted above, travel time was adjusted based on the number of driveways accesses along the route. The travel time analysis assumed 30 driveways within Beattie Estates. If the developer were to increase the number of driveway accesses within Beattie Estates along the route to (for example) 50, travel time for each option would increase as summarized in the following tables (typically 10 – 20 seconds).

Table 5: Alternative A1 Travel Time with Increase in Driveways

Route 1 – Via Argyle Street			
AM		PM	
NB	SB	NB	SB
12:23	11:36	12:20	12:02
Route 2 – Via Highway 6			
AM		PM	
NB	SB	NB	SB
12:21	11:33	12:17	11:12

(minutes: seconds)

Table 6: Alternative A2 Travel Time with Increase in Driveways

Route 1 – Via Argyle Street			
AM		PM	
NB	SB	NB	SB
11:37	10:39	11:13	10:58
Route 2 – Via Highway 6			
AM		PM	
NB	SB	NB	SB
10:39	9:56	10:20	9:26

(minutes: seconds)

Table 7: Alternative A3 Travel Time with Increase in Driveways

Route 1 – Via Argyle Street			
AM		PM	
NB	SB	NB	SB
12:20	11:26	12:06	11:53
Route 2 – Via Highway 6			
AM		PM	
NB	SB	NB	SB
11:29	10:57	11:20	10:28

(minutes: seconds)

Table 8: Alternative B Travel Time with Increase in Driveways

Route 1 – Via Argyle Street			
AM		PM	
NB	SB	NB	SB
11:04	10:06	10:28	10:07
Route 2 – Via Highway 6			
AM		PM	
NB	SB	NB	SB
9:44	8:55	9:22	8:28

(minutes: seconds)

Although overall travel time increases for all collector road options with an increase in the number of driveways along the route, Alternative A2 still presents higher travel time savings by utilizing the Highway 6 route (rather than via Argyle Street) compared to Alternative A1 or A3. As such, if the number of driveways were increased, Alternative A2 would remain the recommended option.

4.2 NATURAL AND SOCIAL ENVIRONMENT

Where applicable, impacts to the natural and social environment reduced the preference for an alternative. Weight was placed on impact to the natural environment, as vegetation clearing is required for some alternatives, however this natural area is not designated by the County as a Core Natural Area therefore impacts are not anticipated to be significant.

A significant weight was placed on impact to adjacent properties. There are four existing residential units adjacent to McKenzie Road directly south of the proposed subdivisions. Preference was given to options that do not impact the residential properties or where impacts had the potential to be mitigated. The alternative that directly impacts the units (Option B) was scored lower.

4.3 ENGINEERING

Given that in some alternatives a portion of the roadway passes directly through the subdivisions, cost sharing was considered in the evaluation. Preference was given to options that would be constructed simultaneously with the subdivision and therefore be directly funded by the developer. Less preference was assigned to options that require funding through development charges and potentially tax revenue.

4.4 DEVELOPMENT

The proposed subdivisions are planned at the southern end of Caledonia just north of the southern border of the Urban Boundary for the County. In keeping with planning policy, preference was given to alternatives that remain within the Urban Boundary, thereby not encouraging an expansion of the Urban Boundary.

As mentioned above, the McKenzie Subdivision is currently draft approved and the Beattie Estates Subdivision has a current layout under consideration. Given the state of the development plans, the alternatives that do not require modifications to the current subdivision plans are preferred. In some cases, minor modifications to the Beattie Estates plans are required which were scored moderately as these plans are not yet final and are flexible to changes.

Although Alternative A routes are designated as collector roads, it is anticipated that traffic calming may be required to moderate speeds where the routes pass through the subdivision with frequent driveway access. As such, in these areas the roads are likely to serve as a residential road rather than a collector road. Less preference was assigned to these options as the road is no longer able to serve its intended purpose and travel time and safety concerns may increase. In fact, such road sections are likely to face pressure to be traffic calmed moving forward.

An evaluation matrix was developed based on the criteria discussed above. The evaluation is provided in Appendix C.

5. PREFERRED ALTERNATIVE

Based on the assessment and evaluation of the alternative east-west routes, Alternative A2 was selected as the preferred alternative. Alternatives A1, A3, and B were not selected as the preferred based on the following factors:

Alternative A1

- Longest travel time between Beattie Estates subdivision and the intersection of Argyle Street and Highway 6 (via both routes)
- Minimal reduction in travel time between Beattie Subdivision and the intersection of Argyle Street and Highway 6 via Highway 6 (Caledonia Bypass) rather than via Argyle Street
- High frequency of driveways and intersections along the route
- May result in the need for traffic calming through the McKenzie subdivision and serve as a residential road rather than a collector

Alternative A3

- Moderate frequency of driveways and intersections along the route
- Access to the Beattie Estates subdivision is discontinuous from Argyle Street
- May result in the need for traffic calming unless the Beattie Estates subdivision is redesigned to accommodate collector role (e.g. minimize intersections and driveways).

Alternative B

- Requires complete property acquisition of the property on the east side of McKenzie Road at the intersection with 6th Line
- Full length of new road (3km) constructed outside of subdivision (DC funded)
- New road extends south and east of the urban boundary

Alternative A2 was selected as the preferred alternative based on the following:

- Similar or better travel time between Beattie Estates subdivision and the intersection of Argyle Street and Highway 6 compared to Alternative A1 and A3
- Reduces travel time from Beattie Subdivision to the intersection of Argyle Street and Highway 6 by utilizing Highway 6 (Caledonia Bypass) rather than Argyle Street
- Minimal private driveways adjacent to the road
- Intersections with the new road can be reduced with a minor design of the Beattie Estates subdivision plan

- 10 -

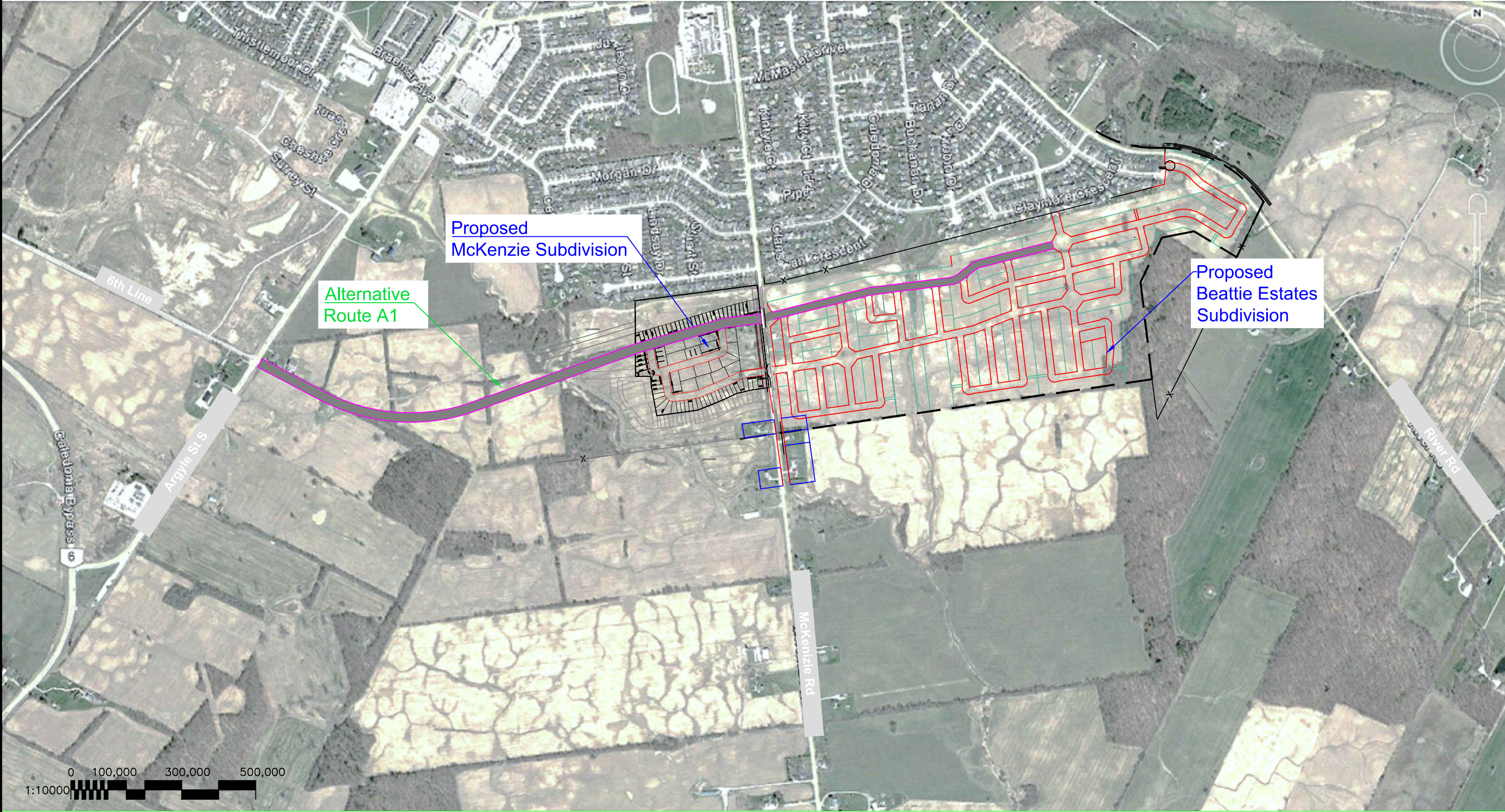
- Does not require modification to the McKenzie Estates subdivision
- Impacts to natural environment are minimal
- 0.8 km of the road will be constructed as part of the Beattie Estates subdivision
- New road is within the Urban Boundary limits
- Impacts to existing properties/houses can likely be mitigated



APPENDIX A

3027 Harvester Road, Suite 400
Burlington ON L7N 3G7
CANADA

Phone: 289-288-0287
Fax: 289-288-0285
www.cima.ca



Partners in excellence

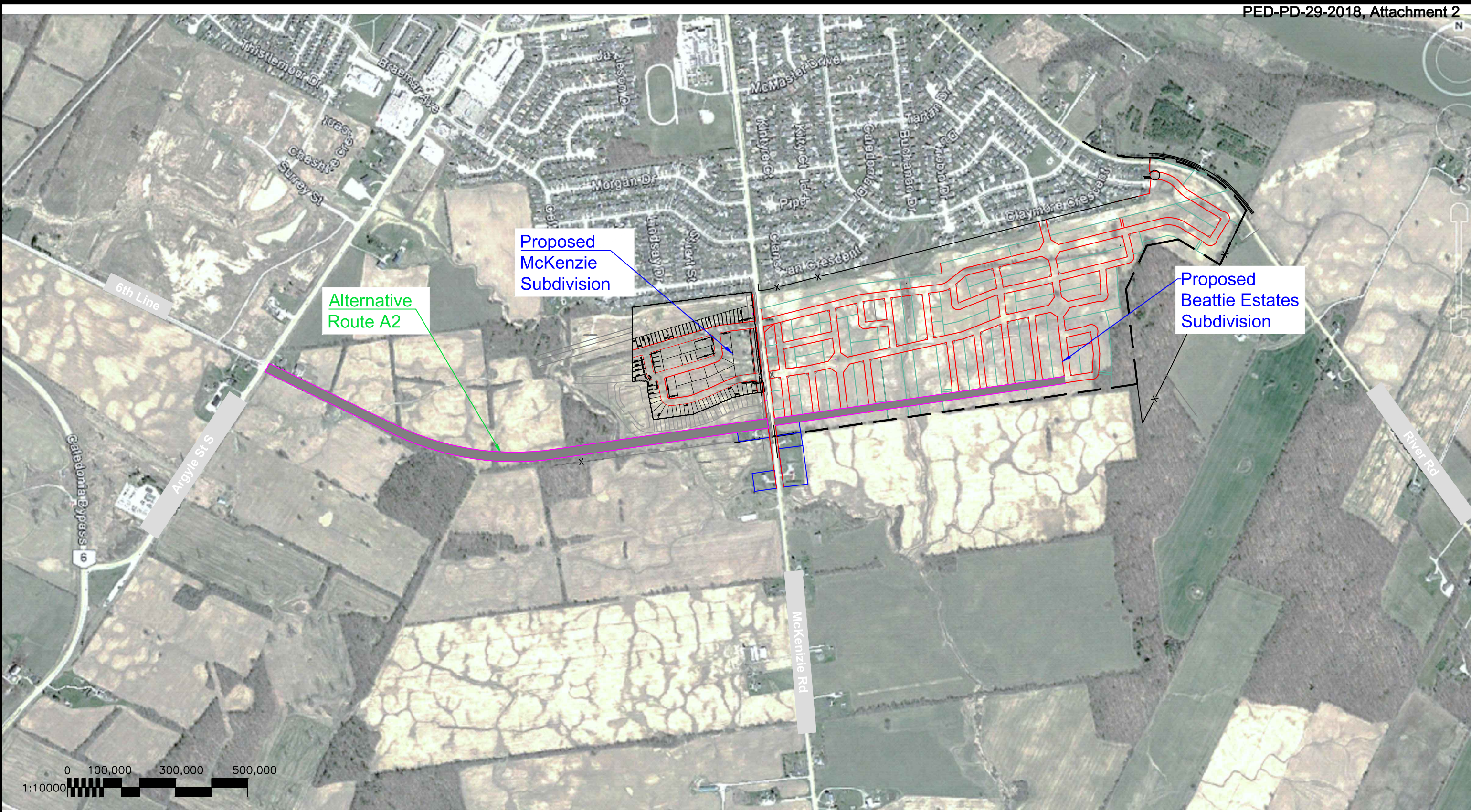
Collector Road Alternative - A1

B000900

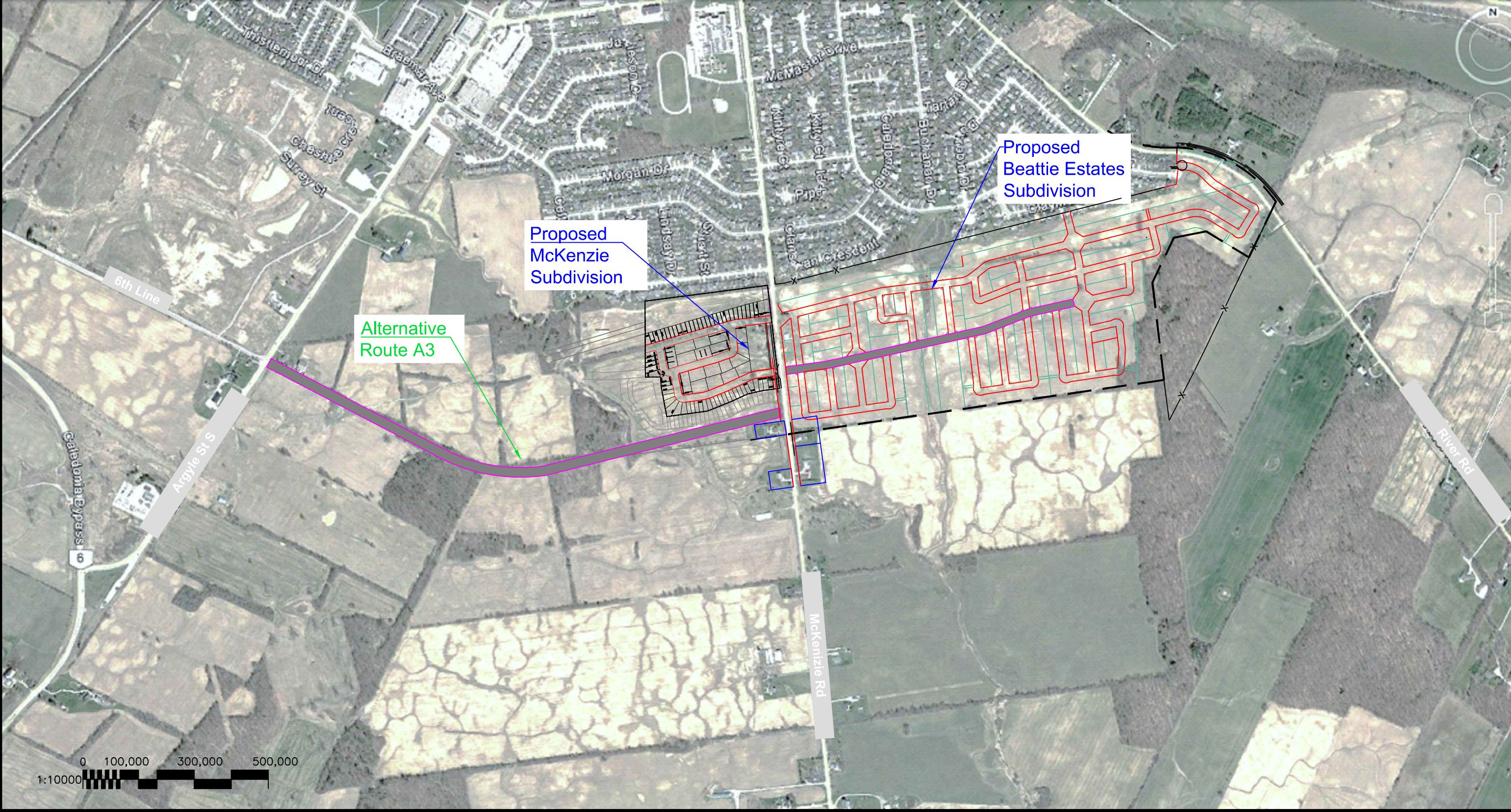
Caledonia E-W Road LINK

Drawing NO.
001

Date
May 23, 2018

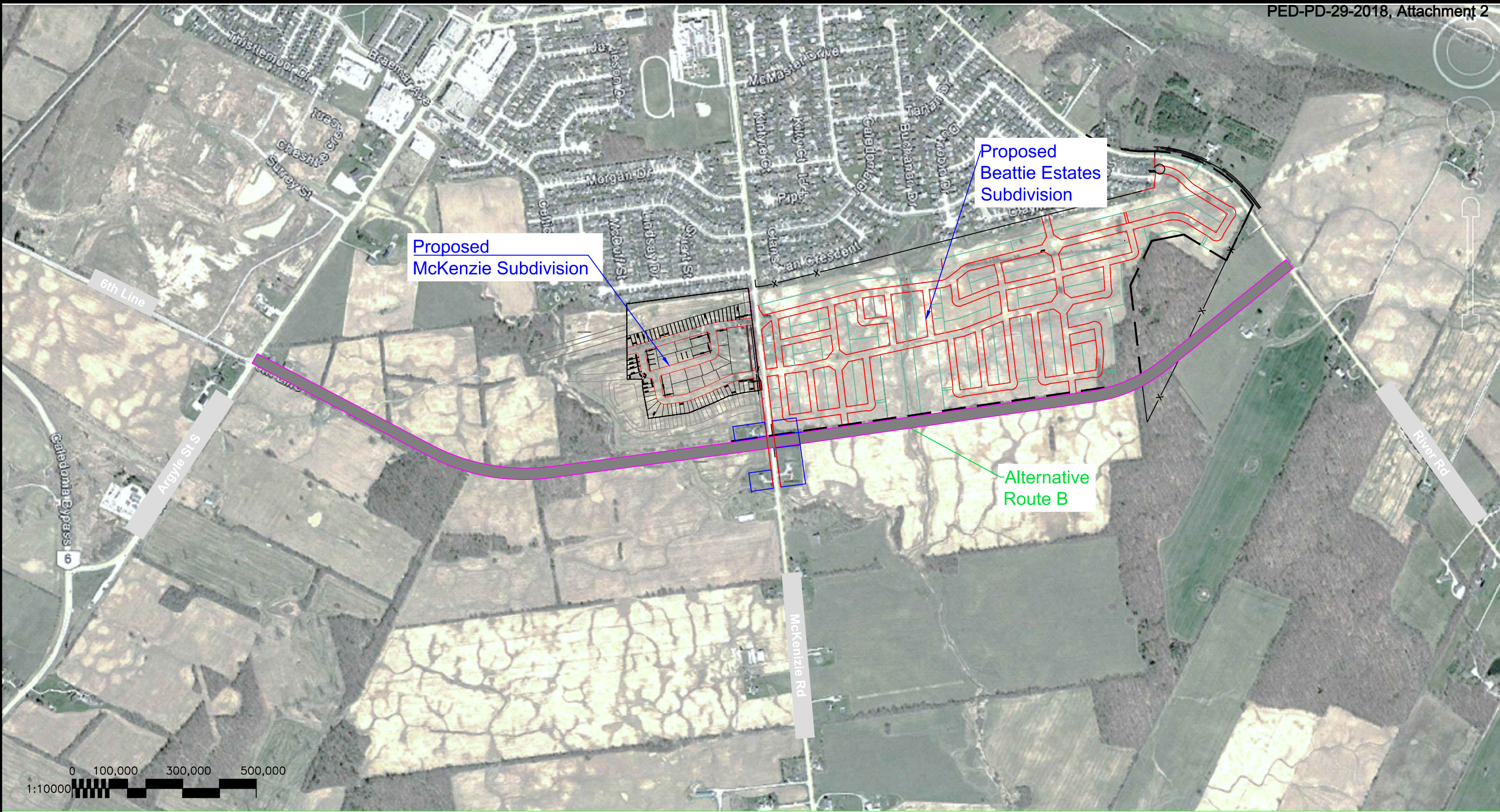


 Partners in excellence	Collector Road Alternative - A2	B000900	
		Caledonia E-W Road LINK	
		Drawing No. 002	Date May 23, 2018



Collector Road Alternative - A3

B000900	
Caledonia E-W Road LINK	
Drawing No.	Date
003	May 23, 2018



Arterial Road Alternative - B

B000900	
Caledonia E-W Road LINK	
Drawing No. 004	Date March 21, 2018



APPENDIX B

3027 Harvester Road, Suite 400
Burlington ON L7N 3G7
CANADA

Phone: 289-288-0287
Fax: 289-288-0285
www.cima.ca

HCM Signalized Intersection Capacity Analysis
22: Argyle Street & Hwy 6 By-Pass

Collector Road Alternative A1

Timing Plan: AM Peak

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	53	256	297	211	156	39
Future Volume (vph)	118	273	359	334	301	252
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.55	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1021	1863	1863	1583
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	137	317	417	388	350	293
RTOR Reduction (vph)	0	269	0	0	0	81
Lane Group Flow (vph)	137	48	417	388	350	212
Turn Type	Perm	Perm	Perm	NA	NA	Perm
Protected Phases				2	6	
Permitted Phases	4	4	2			6
Actuated Green, G (s)	10.8	10.8	51.6	51.6	51.6	51.6
Effective Green, g (s)	10.8	10.8	51.6	51.6	51.6	51.6
Actuated g/C Ratio	0.15	0.15	0.72	0.72	0.72	0.72
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	267	239	737	1346	1346	1144
v/s Ratio Prot				0.21	0.19	
v/s Ratio Perm	c0.08	0.03	c0.41			0.13
v/c Ratio	0.51	0.20	0.57	0.29	0.26	0.19
Uniform Delay, d1	27.9	26.5	4.6	3.5	3.4	3.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.7	0.4	3.1	0.5	0.1	0.1
Delay (s)	29.5	26.9	7.8	4.0	3.5	3.2
Level of Service	C	C	A	A	A	A
Approach Delay (s)	27.7			6.0	3.4	
Approach LOS	C			A	A	
Intersection Summary						
HCM 2000 Control Delay			10.3		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.56			
Actuated Cycle Length (s)			71.4		Sum of lost time (s)	9.0
Intersection Capacity Utilization			40.1%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
80: Argyle Street

Collector Road Alternative A1

Timing Plan: AM Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	0	264	0	0	195
Future Volume (vph)	213	0	313	139	0	340
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			1.00
Frt	1.00		0.96			1.00
Flt Protected	0.95		1.00			1.00
Satd. Flow (prot)	1770		1785			1863
Flt Permitted	0.95		1.00			1.00
Satd. Flow (perm)	1770		1785			1863
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	248	0	364	162	0	395
RTOR Reduction (vph)	0	0	12	0	0	0
Lane Group Flow (vph)	248	0	514	0	0	395
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases					6	
Actuated Green, G (s)	17.2		60.3			60.3
Effective Green, g (s)	17.2		60.3			60.3
Actuated g/C Ratio	0.20		0.70			0.70
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	351		1244			1298
v/s Ratio Prot	c0.14		c0.29			0.21
v/s Ratio Perm						
v/c Ratio	0.71		0.41			0.30
Uniform Delay, d1	32.3		5.6			5.0
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	6.4		1.0			0.6
Delay (s)	38.7		6.6			5.6
Level of Service	D		A			A
Approach Delay (s)	38.7		6.6			5.6
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			13.1		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.48			
Actuated Cycle Length (s)			86.5		Sum of lost time (s)	9.0
Intersection Capacity Utilization			17.6%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
111: McKenzie Road & Beattie Estates Driveway 3

Collector Road Alternative A1

Timing Plan: AM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Future Volume (vph)	25	61	76	28	76	75	80	75	9	25	25	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.94			0.94			0.99			0.98	
Flt Protected		0.99			0.99			0.98			0.98	
Satd. Flow (prot)		1732			1744			1805			1793	
Flt Permitted		0.99			0.99			0.98			0.98	
Satd. Flow (perm)		1732			1744			1805			1793	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	29	71	88	33	88	87	93	87	10	29	29	8
RTOR Reduction (vph)	0	40	0	0	33	0	0	2	0	0	5	0
Lane Group Flow (vph)	0	148	0	0	175	0	0	188	0	0	61	0
Turn Type		NA			NA			NA			NA	
Protected Phases		4		8	8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)		10.6			11.5			26.8			26.8	
Effective Green, g (s)		10.6			11.5			26.8			26.8	
Actuated g/C Ratio		0.17			0.18			0.43			0.43	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		294			321			775			770	
v/s Ratio Prot		c0.09			c0.10			c0.10			0.03	
v/s Ratio Perm												
v/c Ratio		0.50			0.55			0.24			0.08	
Uniform Delay, d1		23.5			23.1			11.3			10.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.4			1.9			0.7			0.2	
Delay (s)		24.9			25.0			12.1			10.7	
Level of Service		C			C			B			B	
Approach Delay (s)		24.9			25.0			12.1			10.7	
Approach LOS		C			C			B			B	
Intersection Summary												
HCM 2000 Control Delay			19.7			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.37									
Actuated Cycle Length (s)			62.4			Sum of lost time (s)				13.5		
Intersection Capacity Utilization			0.0%			ICU Level of Service				A		
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

22: Hwy 6 By-Pass & Argyle Street

Timing Plan: PM Peak

05/24/2018



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	56	282	287	220	192	49
Future Volume (vph)	56	282	287	245	251	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.59	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1102	1863	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	61	307	312	266	273	53
RTOR Reduction (vph)	0	234	0	0	0	28
Lane Group Flow (vph)	61	73	312	266	273	25
Turn Type	Perm	Perm	custom	NA	NA	Perm
Protected Phases					6	
Permitted Phases	4	4	2	2		6
Actuated Green, G (s)	7.3	7.3	14.6	14.6	14.6	14.6
Effective Green, g (s)	7.3	7.3	14.6	14.6	14.6	14.6
Actuated g/C Ratio	0.24	0.24	0.47	0.47	0.47	0.47
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	418	373	520	880	880	747
v/s Ratio Prot					0.15	
v/s Ratio Perm	0.03	c0.05	c0.28	0.14		0.02
v/c Ratio	0.15	0.19	0.60	0.30	0.31	0.03
Uniform Delay, d1	9.3	9.4	6.0	5.0	5.0	4.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.3	1.9	0.2	0.2	0.0
Delay (s)	9.5	9.7	7.9	5.2	5.2	4.4
Level of Service	A	A	A	A	A	A
Approach Delay (s)	9.7			6.6	5.1	
Approach LOS	A			A	A	
Intersection Summary						
HCM 2000 Control Delay			7.1		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.46			
Actuated Cycle Length (s)			30.9		Sum of lost time (s)	9.0
Intersection Capacity Utilization			41.4%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
80: 6th Line & Argyle Street

Timing Plan: PM Peak
05/24/2018

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W	W	T	T	T	T
Traffic Volume (vph)	0	0	276	0	0	241
Future Volume (vph)	141	0	465	254	0	325
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			1.00
Frt	1.00		0.95			1.00
Flt Protected	0.95		1.00			1.00
Satd. Flow (prot)	1770		1770			1863
Flt Permitted	0.95		1.00			1.00
Satd. Flow (perm)	1770		1770			1863
Peak-hour factor, PHF	0.86	0.86	0.92	0.86	0.86	0.92
Adj. Flow (vph)	164	0	505	295	0	353
RTOR Reduction (vph)	0	0	18	0	0	0
Lane Group Flow (vph)	164	0	782	0	0	353
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases					6	
Actuated Green, G (s)	14.2		78.4			78.4
Effective Green, g (s)	14.2		78.4			78.4
Actuated g/C Ratio	0.14		0.77			0.77
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	247		1365			1437
v/s Ratio Prot	c0.09		c0.44			0.19
v/s Ratio Perm						
v/c Ratio	0.66		0.57			0.25
Uniform Delay, d1	41.4		4.7			3.3
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	6.6		1.8			0.4
Delay (s)	48.0		6.5			3.7
Level of Service	D		A			A
Approach Delay (s)	48.0		6.5			3.7
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			10.9		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.59			
Actuated Cycle Length (s)			101.6		Sum of lost time (s)	9.0
Intersection Capacity Utilization			18.3%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
111: McKenzie Road & Beattie Estates Driveway 3

Timing Plan: PM Peak
05/24/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Future Volume (vph)	15	95	95	34	53	34	78	34	57	58	58	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.94			0.96			0.95			0.97	
Flt Protected		1.00			0.99			0.98			0.98	
Satd. Flow (prot)		1740			1767			1738			1774	
Flt Permitted		1.00			0.99			0.98			0.98	
Satd. Flow (perm)		1740			1767			1738			1774	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	17	110	110	40	62	40	91	40	66	67	67	37
RTOR Reduction (vph)	0	39	0	0	18	0	0	16	0	0	9	0
Lane Group Flow (vph)	0	198	0	0	124	0	0	181	0	0	162	0
Turn Type		NA			NA			NA			NA	
Protected Phases		4		8	8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)		12.3			8.2			29.3			29.3	
Effective Green, g (s)		12.3			8.2			29.3			29.3	
Actuated g/C Ratio		0.19			0.13			0.46			0.46	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		338			228			804			821	
v/s Ratio Prot		c0.11			c0.07			c0.10			0.09	
v/s Ratio Perm												
v/c Ratio		0.58			0.54			0.23			0.20	
Uniform Delay, d1		23.2			25.8			10.2			10.1	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		2.6			2.6			0.7			0.5	
Delay (s)		25.7			28.4			10.8			10.6	
Level of Service		C			C			B			B	
Approach Delay (s)		25.7			28.4			10.8			10.6	
Approach LOS		C			C			B			B	
Intersection Summary												
HCM 2000 Control Delay		18.9			HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio		0.37										
Actuated Cycle Length (s)		63.3			Sum of lost time (s)			13.5				
Intersection Capacity Utilization		0.0%			ICU Level of Service			A				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
22: Argyle Street & Hwy 6 By-Pass

Collector Road Alternative A2

Timing Plan: AM Peak



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	53	256	297	211	156	39
Future Volume (vph)	130	261	316	278	357	295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.50	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	938	1863	1863	1583
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	151	303	367	323	415	343
RTOR Reduction (vph)	0	258	0	0	0	89
Lane Group Flow (vph)	151	45	367	323	415	254
Turn Type	Perm	Perm	Perm	NA	NA	Perm
Protected Phases				2	6	
Permitted Phases	4	4	2			6
Actuated Green, G (s)	12.2	12.2	60.6	60.6	60.6	60.6
Effective Green, g (s)	12.2	12.2	60.6	60.6	60.6	60.6
Actuated g/C Ratio	0.15	0.15	0.74	0.74	0.74	0.74
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	263	236	694	1380	1380	1172
v/s Ratio Prot				0.17	0.22	
v/s Ratio Perm	c0.09	0.03	c0.39			0.16
v/c Ratio	0.57	0.19	0.53	0.23	0.30	0.22
Uniform Delay, d1	32.4	30.5	4.5	3.3	3.5	3.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.0	0.4	2.9	0.4	0.1	0.1
Delay (s)	35.4	30.9	7.4	3.7	3.7	3.4
Level of Service	D	C	A	A	A	A
Approach Delay (s)	32.4			5.7	3.5	
Approach LOS	C			A	A	
Intersection Summary						
HCM 2000 Control Delay			11.2		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.54			
Actuated Cycle Length (s)			81.8		Sum of lost time (s)	9.0
Intersection Capacity Utilization			40.1%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
80: 6th Line & Argyle Street

Collector Road Alternative A2

Timing Plan: AM Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	0	264	0	0	195
Future Volume (vph)	312	0	313	95	0	340
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			1.00
Frt	1.00		0.97			1.00
Flt Protected	0.95		1.00			1.00
Satd. Flow (prot)	1770		1804			1863
Flt Permitted	0.95		1.00			1.00
Satd. Flow (perm)	1770		1804			1863
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	363	0	364	110	0	395
RTOR Reduction (vph)	0	0	8	0	0	0
Lane Group Flow (vph)	363	0	466	0	0	395
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases					6	
Actuated Green, G (s)	21.6		50.7			50.7
Effective Green, g (s)	21.6		50.7			50.7
Actuated g/C Ratio	0.27		0.62			0.62
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	470		1125			1161
v/s Ratio Prot	c0.21		c0.26			0.21
v/s Ratio Perm						
v/c Ratio	0.77		0.41			0.34
Uniform Delay, d1	27.6		7.8			7.3
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	7.7		1.1			0.8
Delay (s)	35.3		8.9			8.1
Level of Service	D		A			A
Approach Delay (s)	35.3		8.9			8.1
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			16.4		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.52			
Actuated Cycle Length (s)			81.3		Sum of lost time (s)	9.0
Intersection Capacity Utilization			17.6%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
116: McKenzie Road & 6th Line/Beattie Driveway

Collector Road Alternative A2

Timing Plan: AM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Future Volume (vph)	50	45	0	28	147	75	0	28	9	25	28	165
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.96			0.97			0.90	
Flt Protected		0.97			0.99			1.00			0.99	
Satd. Flow (prot)		1815			1777			1804			1663	
Flt Permitted		0.97			0.99			1.00			0.99	
Satd. Flow (perm)		1815			1777			1804			1663	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	58	52	0	33	171	87	0	33	10	29	33	192
RTOR Reduction (vph)	0	0	0	0	19	0	0	6	0	0	99	0
Lane Group Flow (vph)	0	110	0	0	272	0	0	37	0	0	155	0
Turn Type		NA			NA			NA			NA	
Protected Phases	4	4			8			2			6	
Permitted Phases				8			2			6		
Actuated Green, G (s)		7.7			14.9			28.5			28.5	
Effective Green, g (s)		7.7			14.9			28.5			28.5	
Actuated g/C Ratio		0.12			0.23			0.44			0.44	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		216			409			795			733	
v/s Ratio Prot		c0.06			c0.15			0.02			c0.09	
v/s Ratio Perm												
v/c Ratio		0.51			0.66			0.05			0.21	
Uniform Delay, d1		26.7			22.6			10.3			11.1	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.9			4.0			0.1			0.7	
Delay (s)		28.6			26.6			10.4			11.8	
Level of Service		C			C			B			B	
Approach Delay (s)		28.6			26.6			10.4			11.8	
Approach LOS		C			C			B			B	
Intersection Summary												
HCM 2000 Control Delay			20.5			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.39									
Actuated Cycle Length (s)			64.6			Sum of lost time (s)			13.5			
Intersection Capacity Utilization			0.0%			ICU Level of Service			A			
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
22: Hwy 6 By-Pass & Argyle Street

Collector Road Alternative A2

Timing Plan: PM Peak



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	56	282	287	220	192	49
Future Volume (vph)	56	282	287	245	251	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.59	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1102	1863	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	61	307	312	266	273	53
RTOR Reduction (vph)	0	234	0	0	0	28
Lane Group Flow (vph)	61	73	312	266	273	25
Turn Type	Perm	Perm	custom	NA	NA	Perm
Protected Phases					6	
Permitted Phases	4	4	2	2		6
Actuated Green, G (s)	7.3	7.3	14.6	14.6	14.6	14.6
Effective Green, g (s)	7.3	7.3	14.6	14.6	14.6	14.6
Actuated g/C Ratio	0.24	0.24	0.47	0.47	0.47	0.47
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	418	373	520	880	880	747
v/s Ratio Prot					0.15	
v/s Ratio Perm	0.03	c0.05	c0.28	0.14		0.02
v/c Ratio	0.15	0.19	0.60	0.30	0.31	0.03
Uniform Delay, d1	9.3	9.4	6.0	5.0	5.0	4.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.3	1.9	0.2	0.2	0.0
Delay (s)	9.5	9.7	7.9	5.2	5.2	4.4
Level of Service	A	A	A	A	A	A
Approach Delay (s)	9.7			6.6	5.1	
Approach LOS	A			A	A	
Intersection Summary						
HCM 2000 Control Delay			7.1		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.46			
Actuated Cycle Length (s)			30.9		Sum of lost time (s)	9.0
Intersection Capacity Utilization			41.4%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
80: 6th Line & Argyle Street

Collector Road Alternative A2

Timing Plan: PM Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	0	276	0	0	241
Future Volume (vph)	141	0	465	254	0	325
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			1.00
Frt	1.00		0.95			1.00
Flt Protected	0.95		1.00			1.00
Satd. Flow (prot)	1770		1770			1863
Flt Permitted	0.95		1.00			1.00
Satd. Flow (perm)	1770		1770			1863
Peak-hour factor, PHF	0.86	0.86	0.92	0.86	0.86	0.92
Adj. Flow (vph)	164	0	505	295	0	353
RTOR Reduction (vph)	0	0	18	0	0	0
Lane Group Flow (vph)	164	0	782	0	0	353
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases					6	
Actuated Green, G (s)	14.2		78.4			78.4
Effective Green, g (s)	14.2		78.4			78.4
Actuated g/C Ratio	0.14		0.77			0.77
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	247		1365			1437
v/s Ratio Prot	c0.09		c0.44			0.19
v/s Ratio Perm						
v/c Ratio	0.66		0.57			0.25
Uniform Delay, d1	41.4		4.7			3.3
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	6.6		1.8			0.4
Delay (s)	48.0		6.5			3.7
Level of Service	D		A			A
Approach Delay (s)	48.0		6.5			3.7
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			10.9		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.59			
Actuated Cycle Length (s)			101.6		Sum of lost time (s)	9.0
Intersection Capacity Utilization			18.3%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
120: McKenzie Road & 6th Line/Beattie Driveway

Collector Road Alternative A2

Timing Plan: PM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Future Volume (vph)	159	95	0	34	53	34	0	57	57	58	34	88
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.96			0.93			0.93	
Flt Protected		0.97			0.99			1.00			0.98	
Satd. Flow (prot)		1806			1767			1737			1713	
Flt Permitted		0.97			0.99			1.00			0.98	
Satd. Flow (perm)		1806			1767			1737			1713	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	185	110	0	40	62	40	0	66	66	67	40	102
RTOR Reduction (vph)	0	0	0	0	23	0	0	26	0	0	25	0
Lane Group Flow (vph)	0	295	0	0	119	0	0	106	0	0	184	0
Turn Type		NA			NA			NA			NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		14.9			14.9			36.7			36.7	
Effective Green, g (s)		14.9			14.9			36.7			36.7	
Actuated g/C Ratio		0.25			0.25			0.61			0.61	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		444			434			1051			1037	
v/s Ratio Prot		c0.16			0.07			0.06			c0.11	
v/s Ratio Perm												
v/c Ratio		0.66			0.27			0.10			0.18	
Uniform Delay, d1		20.6			18.5			5.0			5.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		3.7			0.3			0.2			0.4	
Delay (s)		24.3			18.8			5.2			5.7	
Level of Service		C			B			A			A	
Approach Delay (s)		24.3			18.8			5.2			5.7	
Approach LOS		C			B			A			A	
Intersection Summary												
HCM 2000 Control Delay			15.1			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.32									
Actuated Cycle Length (s)			60.6			Sum of lost time (s)				9.0		
Intersection Capacity Utilization			0.0%			ICU Level of Service				A		
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
22: Argyle Street & Hwy 6 By-Pass

Collector Road Alternative A3

Timing Plan: AM Peak



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	53	256	297	211	156	39
Future Volume (vph)	118	273	359	278	357	252
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.50	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	940	1863	1863	1583
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	137	317	417	323	415	293
RTOR Reduction (vph)	0	269	0	0	0	81
Lane Group Flow (vph)	137	48	417	323	415	212
Turn Type	Perm	Perm	Perm	NA	NA	Perm
Protected Phases				2	6	
Permitted Phases	4	4	2			6
Actuated Green, G (s)	10.8	10.8	51.6	51.6	51.6	51.6
Effective Green, g (s)	10.8	10.8	51.6	51.6	51.6	51.6
Actuated g/C Ratio	0.15	0.15	0.72	0.72	0.72	0.72
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	267	239	679	1346	1346	1144
v/s Ratio Prot				0.17	0.22	
v/s Ratio Perm	c0.08	0.03	c0.44			0.13
v/c Ratio	0.51	0.20	0.61	0.24	0.31	0.19
Uniform Delay, d1	27.9	26.5	4.9	3.3	3.5	3.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.7	0.4	4.1	0.4	0.1	0.1
Delay (s)	29.5	26.9	9.1	3.7	3.7	3.2
Level of Service	C	C	A	A	A	A
Approach Delay (s)	27.7			6.7	3.5	
Approach LOS	C			A	A	
Intersection Summary						
HCM 2000 Control Delay			10.5		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.60			
Actuated Cycle Length (s)			71.4		Sum of lost time (s)	9.0
Intersection Capacity Utilization			40.1%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
80: 6th Line & Argyle Street

Collector Road Alternative A3

Timing Plan: AM Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	✕		✕			✕
Traffic Volume (vph)	0	0	264	0	0	195
Future Volume (vph)	269	0	313	83	0	340
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			1.00
Frt	1.00		0.97			1.00
Flt Protected	0.95		1.00			1.00
Satd. Flow (prot)	1770		1810			1863
Flt Permitted	0.95		1.00			1.00
Satd. Flow (perm)	1770		1810			1863
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	313	0	364	97	0	395
RTOR Reduction (vph)	0	0	7	0	0	0
Lane Group Flow (vph)	313	0	454	0	0	395
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases					6	
Actuated Green, G (s)	19.4		53.2			53.2
Effective Green, g (s)	19.4		53.2			53.2
Actuated g/C Ratio	0.24		0.65			0.65
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	420		1180			1214
v/s Ratio Prot	c0.18		c0.25			0.21
v/s Ratio Perm						
v/c Ratio	0.75		0.38			0.33
Uniform Delay, d1	28.8		6.6			6.3
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	7.0		1.0			0.7
Delay (s)	35.9		7.5			7.0
Level of Service	D		A			A
Approach Delay (s)	35.9		7.5			7.0
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			14.9		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.48			
Actuated Cycle Length (s)			81.6		Sum of lost time (s)	9.0
Intersection Capacity Utilization			17.6%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
109: McKenzie Road & Beattie Estates Driveway 4

Collector Road Alternative A3

Timing Plan: AM Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	0	0	0	0	0
Future Volume (Veh/h)	132	75	67	42	25	139
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	153	87	78	49	29	162
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)			166			
pX, platoon unblocked						
vC, conflicting volume	322	102			127	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	322	102			127	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	77	91			98	
cM capacity (veh/h)	658	953			1459	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	240	127	191			
Volume Left	153	0	29			
Volume Right	87	49	0			
cSH	741	1700	1459			
Volume to Capacity	0.32	0.07	0.02			
Queue Length 95th (m)	11.2	0.0	0.5			
Control Delay (s)	12.2	0.0	1.3			
Lane LOS	B		A			
Approach Delay (s)	12.2	0.0	1.3			
Approach LOS	B					
Intersection Summary						
Average Delay		5.7				
Intersection Capacity Utilization		13.3%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Signalized Intersection Capacity Analysis
116: McKenzie Road & 6th Line

Collector Road Alternative A3

Timing Plan: AM Peak

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	0	0	0	0	0	0
Future Volume (vph)	83	0	0	4	0	269
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5			4.5	4.5	
Lane Util. Factor	1.00			1.00	1.00	
Frt	1.00			1.00	0.86	
Flt Protected	0.95			1.00	1.00	
Satd. Flow (prot)	1770			1863	1611	
Flt Permitted	0.95			1.00	1.00	
Satd. Flow (perm)	1770			1863	1611	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	97	0	0	5	0	313
RTOR Reduction (vph)	0	0	0	0	70	0
Lane Group Flow (vph)	97	0	0	5	243	0
Turn Type	Prot			NA	NA	
Protected Phases	4			2	6	
Permitted Phases			2			
Actuated Green, G (s)	8.1			59.5	59.5	
Effective Green, g (s)	8.1			59.5	59.5	
Actuated g/C Ratio	0.11			0.78	0.78	
Clearance Time (s)	4.5			4.5	4.5	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	187			1447	1251	
v/s Ratio Prot	c0.05			0.00	c0.15	
v/s Ratio Perm						
v/c Ratio	0.52			0.00	0.19	
Uniform Delay, d1	32.4			1.9	2.2	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	2.4			0.0	0.3	
Delay (s)	34.8			1.9	2.6	
Level of Service	C			A	A	
Approach Delay (s)	34.8			1.9	2.6	
Approach LOS	C			A	A	
Intersection Summary						
HCM 2000 Control Delay			10.1		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.23			
Actuated Cycle Length (s)			76.6		Sum of lost time (s)	9.0
Intersection Capacity Utilization			0.0%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
22: Hwy 6 By-Pass & Argyle Street

Collector Road Alternative A3

Timing Plan: PM Peak



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	56	282	287	220	192	49
Future Volume (vph)	56	282	287	245	251	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.59	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1102	1863	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	61	307	312	266	273	53
RTOR Reduction (vph)	0	234	0	0	0	28
Lane Group Flow (vph)	61	73	312	266	273	25
Turn Type	Perm	Perm	custom	NA	NA	Perm
Protected Phases					6	
Permitted Phases	4	4	2	2		6
Actuated Green, G (s)	7.3	7.3	14.6	14.6	14.6	14.6
Effective Green, g (s)	7.3	7.3	14.6	14.6	14.6	14.6
Actuated g/C Ratio	0.24	0.24	0.47	0.47	0.47	0.47
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	418	373	520	880	880	747
v/s Ratio Prot					0.15	
v/s Ratio Perm	0.03	c0.05	c0.28	0.14		0.02
v/c Ratio	0.15	0.19	0.60	0.30	0.31	0.03
Uniform Delay, d1	9.3	9.4	6.0	5.0	5.0	4.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.3	1.9	0.2	0.2	0.0
Delay (s)	9.5	9.7	7.9	5.2	5.2	4.4
Level of Service	A	A	A	A	A	A
Approach Delay (s)	9.7			6.6	5.1	
Approach LOS	A			A	A	
Intersection Summary						
HCM 2000 Control Delay			7.1		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.46			
Actuated Cycle Length (s)			30.9		Sum of lost time (s)	9.0
Intersection Capacity Utilization			41.4%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
80: 6th Line & Argyle Street

Collector Road Alternative A3

Timing Plan: PM Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	WT	WT	WT	WT	WT	WT
Traffic Volume (vph)	0	0	276	0	0	241
Future Volume (vph)	141	0	465	254	0	325
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			1.00
Frt	1.00		0.95			1.00
Flt Protected	0.95		1.00			1.00
Satd. Flow (prot)	1770		1770			1863
Flt Permitted	0.95		1.00			1.00
Satd. Flow (perm)	1770		1770			1863
Peak-hour factor, PHF	0.86	0.86	0.92	0.86	0.86	0.92
Adj. Flow (vph)	164	0	505	295	0	353
RTOR Reduction (vph)	0	0	18	0	0	0
Lane Group Flow (vph)	164	0	782	0	0	353
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases					6	
Actuated Green, G (s)	14.2		78.4			78.4
Effective Green, g (s)	14.2		78.4			78.4
Actuated g/C Ratio	0.14		0.77			0.77
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	247		1365			1437
v/s Ratio Prot	c0.09		c0.44			0.19
v/s Ratio Perm						
v/c Ratio	0.66		0.57			0.25
Uniform Delay, d1	41.4		4.7			3.3
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	6.6		1.8			0.4
Delay (s)	48.0		6.5			3.7
Level of Service	D		A			A
Approach Delay (s)	48.0		6.5			3.7
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			10.9		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.59			
Actuated Cycle Length (s)			101.6		Sum of lost time (s)	9.0
Intersection Capacity Utilization			18.3%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
109: McKenzie Road & Beattie Estates Driveway 4

Collector Road Alternative A3

Timing Plan: PM Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	0	0	0	0	0
Future Volume (Veh/h)	87	34	167	152	58	114
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	101	40	194	177	67	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)			191			
pX, platoon unblocked						
vC, conflicting volume	550	282			371	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	550	282			371	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	78	95			94	
cM capacity (veh/h)	468	756			1188	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	141	371	200			
Volume Left	101	0	67			
Volume Right	40	177	0			
cSH	525	1700	1188			
Volume to Capacity	0.27	0.22	0.06			
Queue Length 95th (m)	8.6	0.0	1.4			
Control Delay (s)	14.4	0.0	3.1			
Lane LOS	B		A			
Approach Delay (s)	14.4	0.0	3.1			
Approach LOS	B					
Intersection Summary						
Average Delay		3.7				
Intersection Capacity Utilization		13.3%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Signalized Intersection Capacity Analysis
120: McKenzie Road & 6th Line

Collector Road Alternative A3

Timing Plan: PM Peak



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	0	0	0	0	0	0
Future Volume (vph)	254	0	0	0	0	141
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5				4.5	
Lane Util. Factor	1.00				1.00	
Frt	1.00				0.86	
Flt Protected	0.95				1.00	
Satd. Flow (prot)	1770				1611	
Flt Permitted	0.95				1.00	
Satd. Flow (perm)	1770				1611	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	295	0	0	0	0	164
RTOR Reduction (vph)	0	0	0	0	70	0
Lane Group Flow (vph)	295	0	0	0	94	0
Turn Type	Prot				NA	
Protected Phases	4			2	6	
Permitted Phases			2			
Actuated Green, G (s)	14.1				31.4	
Effective Green, g (s)	14.1				31.4	
Actuated g/C Ratio	0.26				0.58	
Clearance Time (s)	4.5				4.5	
Vehicle Extension (s)	3.0				3.0	
Lane Grp Cap (vph)	457				928	
v/s Ratio Prot	c0.17				c0.06	
v/s Ratio Perm						
v/c Ratio	0.65				0.10	
Uniform Delay, d1	18.0				5.2	
Progression Factor	1.00				1.00	
Incremental Delay, d2	3.1				0.2	
Delay (s)	21.1				5.4	
Level of Service	C				A	
Approach Delay (s)	21.1			0.0	5.4	
Approach LOS	C			A	A	

Intersection Summary

HCM 2000 Control Delay	15.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.27		
Actuated Cycle Length (s)	54.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	0.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

22: Argyle Street & Hwy 6 By-Pass

Arterial Road Alternative B

Timing Plan: AM Peak



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	53	256	297	211	156	39
Future Volume (vph)	118	273	359	279	357	250
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.50	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	940	1863	1863	1583
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	137	317	417	324	415	291
RTOR Reduction (vph)	0	269	0	0	0	81
Lane Group Flow (vph)	137	48	417	324	415	210
Turn Type	Perm	Perm	Perm	NA	NA	Perm
Protected Phases				2	6	
Permitted Phases	4	4	2			6
Actuated Green, G (s)	10.8	10.8	51.6	51.6	51.6	51.6
Effective Green, g (s)	10.8	10.8	51.6	51.6	51.6	51.6
Actuated g/C Ratio	0.15	0.15	0.72	0.72	0.72	0.72
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	267	239	679	1346	1346	1144
v/s Ratio Prot				0.17	0.22	
v/s Ratio Perm	c0.08	0.03	c0.44			0.13
v/c Ratio	0.51	0.20	0.61	0.24	0.31	0.18
Uniform Delay, d1	27.9	26.5	4.9	3.3	3.5	3.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.7	0.4	4.1	0.4	0.1	0.1
Delay (s)	29.5	26.9	9.1	3.7	3.7	3.2
Level of Service	C	C	A	A	A	A
Approach Delay (s)	27.7			6.7	3.5	
Approach LOS	C			A	A	
Intersection Summary						
HCM 2000 Control Delay			10.5		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.60			
Actuated Cycle Length (s)			71.4		Sum of lost time (s)	9.0
Intersection Capacity Utilization			40.1%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
80: 6th Line & Argyle Street

Arterial Road Alternative B

Timing Plan: AM Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	WT	WT	NT	NT	ST	ST
Traffic Volume (vph)	0	0	264	0	0	195
Future Volume (vph)	267	0	313	84	0	340
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			1.00
Frt	1.00		0.97			1.00
Flt Protected	0.95		1.00			1.00
Satd. Flow (prot)	1770		1809			1863
Flt Permitted	0.95		1.00			1.00
Satd. Flow (perm)	1770		1809			1863
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	310	0	364	98	0	395
RTOR Reduction (vph)	0	0	7	0	0	0
Lane Group Flow (vph)	310	0	455	0	0	395
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases					6	
Actuated Green, G (s)	19.2		53.2			53.2
Effective Green, g (s)	19.2		53.2			53.2
Actuated g/C Ratio	0.24		0.65			0.65
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	417		1182			1217
v/s Ratio Prot	c0.18		c0.25			0.21
v/s Ratio Perm						
v/c Ratio	0.74		0.39			0.32
Uniform Delay, d1	28.8		6.5			6.2
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	7.0		1.0			0.7
Delay (s)	35.8		7.5			6.9
Level of Service	D		A			A
Approach Delay (s)	35.8		7.5			6.9
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			14.8		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.48			
Actuated Cycle Length (s)			81.4		Sum of lost time (s)	9.0
Intersection Capacity Utilization			17.6%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis
116: McKenzie Road & 6th Line/Beattie Driveway

Arterial Road Alternative B

Timing Plan: AM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	15	0	0	6	0	0	0	0	0	0	0
Future Volume (vph)	51	48	0	28	110	78	0	14	9	25	28	163
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.95			0.95			0.90	
Flt Protected		0.97			0.99			1.00			0.99	
Satd. Flow (prot)		1816			1760			1766			1664	
Flt Permitted		0.97			0.99			1.00			0.99	
Satd. Flow (perm)		1816			1760			1766			1664	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	59	56	0	33	128	91	0	16	10	29	33	190
RTOR Reduction (vph)	0	0	0	0	25	0	0	5	0	0	96	0
Lane Group Flow (vph)	0	115	0	0	227	0	0	21	0	0	156	0
Turn Type		NA			NA			NA			NA	
Protected Phases	4	4			8			2			6	
Permitted Phases				8			2			6		
Actuated Green, G (s)		7.9			13.4			30.0			30.0	
Effective Green, g (s)		7.9			13.4			30.0			30.0	
Actuated g/C Ratio		0.12			0.21			0.46			0.46	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		221			363			817			770	
v/s Ratio Prot		c0.06			c0.13			0.01			c0.09	
v/s Ratio Perm												
v/c Ratio		0.52			0.62			0.03			0.20	
Uniform Delay, d1		26.7			23.4			9.5			10.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		2.2			3.3			0.1			0.6	
Delay (s)		28.9			26.7			9.5			10.9	
Level of Service		C			C			A			B	
Approach Delay (s)		28.9			26.7			9.5			10.9	
Approach LOS		C			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			20.2			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.36									
Actuated Cycle Length (s)			64.8			Sum of lost time (s)				13.5		
Intersection Capacity Utilization			7.9%			ICU Level of Service				A		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
22: Hwy 6 By-Pass & Argyle Street

Arterial Road Alternative B

Timing Plan: PM Peak



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	56	282	287	220	192	49
Future Volume (vph)	56	282	287	280	333	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.55	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	1016	1863	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	61	307	312	304	362	53
RTOR Reduction (vph)	0	237	0	0	0	26
Lane Group Flow (vph)	61	70	312	304	362	27
Turn Type	Perm	Perm	custom	NA	NA	Perm
Protected Phases					6	
Permitted Phases	4	4	2	2		6
Actuated Green, G (s)	7.6	7.6	16.7	16.7	16.7	16.7
Effective Green, g (s)	7.6	7.6	16.7	16.7	16.7	16.7
Actuated g/C Ratio	0.23	0.23	0.50	0.50	0.50	0.50
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	403	361	509	934	934	793
v/s Ratio Prot					0.19	
v/s Ratio Perm	0.03	c0.04	c0.31	0.16		0.02
v/c Ratio	0.15	0.19	0.61	0.33	0.39	0.03
Uniform Delay, d1	10.3	10.4	6.0	4.9	5.1	4.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.3	2.2	0.2	0.3	0.0
Delay (s)	10.4	10.6	8.2	5.1	5.4	4.2
Level of Service	B	B	A	A	A	A
Approach Delay (s)	10.6			6.7	5.3	
Approach LOS	B			A	A	

Intersection Summary

HCM 2000 Control Delay	7.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	33.3	Sum of lost time (s)	9.0
Intersection Capacity Utilization	41.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
80: 6th Line & Argyle Street

Arterial Road Alternative B

Timing Plan: PM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	LT	LT	TH	TH	LT	LT
Traffic Volume (vph)	0	0	276	0	0	241
Future Volume (vph)	142	0	465	253	0	325
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			1.00
Frt	1.00		0.95			1.00
Flt Protected	0.95		1.00			1.00
Satd. Flow (prot)	1770		1770			1863
Flt Permitted	0.95		1.00			1.00
Satd. Flow (perm)	1770		1770			1863
Peak-hour factor, PHF	0.86	0.86	0.92	0.86	0.86	0.92
Adj. Flow (vph)	165	0	505	294	0	353
RTOR Reduction (vph)	0	0	18	0	0	0
Lane Group Flow (vph)	165	0	781	0	0	353
Turn Type	Prot		NA			NA
Protected Phases	8		2			6
Permitted Phases					6	
Actuated Green, G (s)	14.3		78.3			78.3
Effective Green, g (s)	14.3		78.3			78.3
Actuated g/C Ratio	0.14		0.77			0.77
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	249		1364			1435
v/s Ratio Prot	c0.09		c0.44			0.19
v/s Ratio Perm						
v/c Ratio	0.66		0.57			0.25
Uniform Delay, d1	41.4		4.8			3.3
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	6.5		1.8			0.4
Delay (s)	47.8		6.5			3.7
Level of Service	D		A			A
Approach Delay (s)	47.8		6.5			3.7
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			11.0		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.59			
Actuated Cycle Length (s)			101.6		Sum of lost time (s)	9.0
Intersection Capacity Utilization			18.3%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
120: McKenzie Road & 6th Line/Beattie Driveway

Arterial Road Alternative B

Timing Plan: PM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	30	0	0	18	0	0	0	0	0	0	0
Future Volume (vph)	167	116	0	34	67	45	0	74	57	64	43	93
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.96			0.94			0.94	
Flt Protected		0.97			0.99			1.00			0.98	
Satd. Flow (prot)		1809			1765			1754			1718	
Flt Permitted		0.97			0.99			1.00			0.98	
Satd. Flow (perm)		1809			1765			1754			1718	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	194	135	0	40	78	52	0	86	66	74	50	108
RTOR Reduction (vph)	0	0	0	0	26	0	0	21	0	0	24	0
Lane Group Flow (vph)	0	329	0	0	144	0	0	131	0	0	208	0
Turn Type		NA			NA			NA			NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		16.2			16.2			36.7			36.7	
Effective Green, g (s)		16.2			16.2			36.7			36.7	
Actuated g/C Ratio		0.26			0.26			0.59			0.59	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		473			461			1039			1018	
v/s Ratio Prot		c0.18			0.08			0.07			c0.12	
v/s Ratio Perm												
v/c Ratio		0.70			0.31			0.13			0.20	
Uniform Delay, d1		20.6			18.4			5.5			5.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		4.4			0.4			0.2			0.5	
Delay (s)		25.0			18.8			5.8			6.3	
Level of Service		C			B			A			A	
Approach Delay (s)		25.0			18.8			5.8			6.3	
Approach LOS		C			B			A			A	
Intersection Summary												
HCM 2000 Control Delay			15.6			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.35									
Actuated Cycle Length (s)			61.9			Sum of lost time (s)				9.0		
Intersection Capacity Utilization			7.9%			ICU Level of Service				A		
Analysis Period (min)			15									

c Critical Lane Group

APPENDIX C

Haldimand County
Caledonia East-West Route Analysis and Evaluation

TECHNICAL CRITERIA	Collector Road Alternative A1	Collector Road Alternative A2	Collector Road Alternative A3	Arterial Road Alternative B
Transportation				
Traffic Operations at Intersections and Level of Service	Intersections operate at LOS C or better in the AM and PM peak hours. 	Intersections operate at LOS C or better in the AM and PM peak hours. 	Intersections operate at LOS C or better in the AM and PM peak hours. 	Intersections operate at LOS C or better in the AM and PM peak hours. 
Travel Time Savings from Beattie Subdivision to Argyle Street and Highway 6 (via Highway 6) [AM(PM)]	NB: 0:06 min (0:04 min) SB: 0:04 min (0:51 min) 	NB: 0:58 min (0:53 min) SB: 0:43 min (1:32 min) 	NB: 0:51 min (0:46 min) SB: 0:29 min (1:25 min) 	NB: 1:20 min (1:06 min) SB: 1:11 min (1:39 min) 
Number of Driveways	82 	30 	32 	0 
Number of Intersections	12 	11 	14 	5 
Network Connectivity	Provides an east-west connection between Argyle Street and McKenzie Road. 	Provides an east-west connection between Argyle Street and McKenzie Road. 	Provides an east-west connection between Argyle Street and McKenzie Road. Access to the Beattie Estates subdivision is discontinuous from Argyle Street. 	Provides an east-west connection between Argyle Street and River Road. 
Summary				
Natural and Social Environment				
Natural Environment	Requires minimal to no clearing of vegetation (not designated as a Core Natural Area). 	Requires clearing of vegetation (not designated as a Core Natural Area). 	Requires clearing of vegetation (not designated as a Core Natural Area). 	Requires clearing of vegetation (not designated as a Core Natural Area). May impact a watercourse identified south of the border of the developable lands. 

Haldimand County
Caledonia East-West Route Analysis and Evaluation

Impacts on Existing Properties	No impacts on existing properties. 	May impact two existing properties on the northeast and northwest corner of the McKenzie Road and 6 th Line intersection (likely mitigated). 	No impacts on existing properties. 	Significant impacts to one property on the east side of McKenzie Road at the intersection with 6 th Line. Requires complete property acquisition for new road. 
Summary				
Engineering				
Cost and Cost Sharing	1.2 km constructed as part of subdivision. 1 km constructed outside of subdivision (DC funded). 	0.8 km constructed as part of subdivision. 1.5 km constructed outside of subdivision (DC funded). 	0.8 km constructed as part of subdivision. 1.5 km constructed outside of subdivision (DC funded). 	3.0 km constructed outside of subdivision (DC funded). 
Development				
Compatibility with Urban Boundary	New road is within the Urban Boundary. 	New road is within the Urban Boundary. 	New road is within the Urban Boundary. 	New road extends south and east of the Urban Boundary. 
Compatibility with Subdivision Plans	Requires modification to the McKenzie subdivision plans to accommodate new road. Does not require modification to the Beattie Estates subdivision plans. 	Does not require modification to the McKenzie subdivision plans. Requires minor modifications to the Beattie Estates subdivision plans to reduce the number of intersections with the new road. 	Does not require modification to the proposed McKenzie or Beattie Estates subdivision plans. 	Does not require modification to the proposed McKenzie or Beattie Estates subdivision plans. 
Ability to Serve Intended Purpose	May result in the need for traffic calming through McKenzie subdivision and serve as a residential road rather than collector. 	May result in the need for traffic calming unless subdivision is redesigned to accommodate collector role (e.g. minimize intersections). 	May result in the need for traffic calming unless subdivision is redesigned to accommodate collector role (e.g. minimize intersections). 	Provides a direct east-west route from Argyle Street to River Road and serves as an arterial road. 
Summary				

Haldimand County
Caledonia East-West Route Analysis and Evaluation

Overall Summary				
Summary				
Recommendation	Not Recommended	Recommended	Not Recommended	Not Recommended

				
Excellent (Most Positive)	Good	Moderate	Poor	Very Poor (Least Positive)