



Traffic Impact Study

Walker - Redford Gravel Pit Expansion

Harold Sutherland Construction Ltd.

P/N 23-3581 | July 17, 2024

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Table of Contents

	Page
1.0 Introduction.....	1
Figure 1 – Location	2
2.0 Context	3
3.0 Travel Demand.....	4
3.1 Horizon Year and Time Period of Analysis	4
3.2 Historic Traffic Volumes	4
Table 1 – Grey Road 3 and 4 Historic AADT Volumes	4
3.3 Projected Background Traffic.....	5
3.4 Site Generated Traffic	5
3.4.1 Traffic Volume.....	5
3.4.2 Directional Distribution.....	6
4.0 Evaluation of Impacts	7
4.1 Methodology	7
4.2 Analysis.....	7
Table 2 – Level of Service - 2025 background with existing pit traffic.....	8
Table 3 – Level of Service – 2025 with expanded pit traffic	8
Table 4 – Level of Service – 2035 with pit expanded pit traffic	8
4.3 Turning Lane Warrants.....	9
4.4 Sight Distance Considerations.....	9
4.5 Concession Road 4	10
4.6 Grey Road 3 / Grey Road 4 Intersection	10
5.0 Conclusions and Recommendations.....	10

Appendix A

Traffic Count Information

Appendix B

Site Generated Traffic

Appendix C

Level of Service Definition

Appendix D

HCS 2023 Analysis

Appendix E

Turning Lane Warrants

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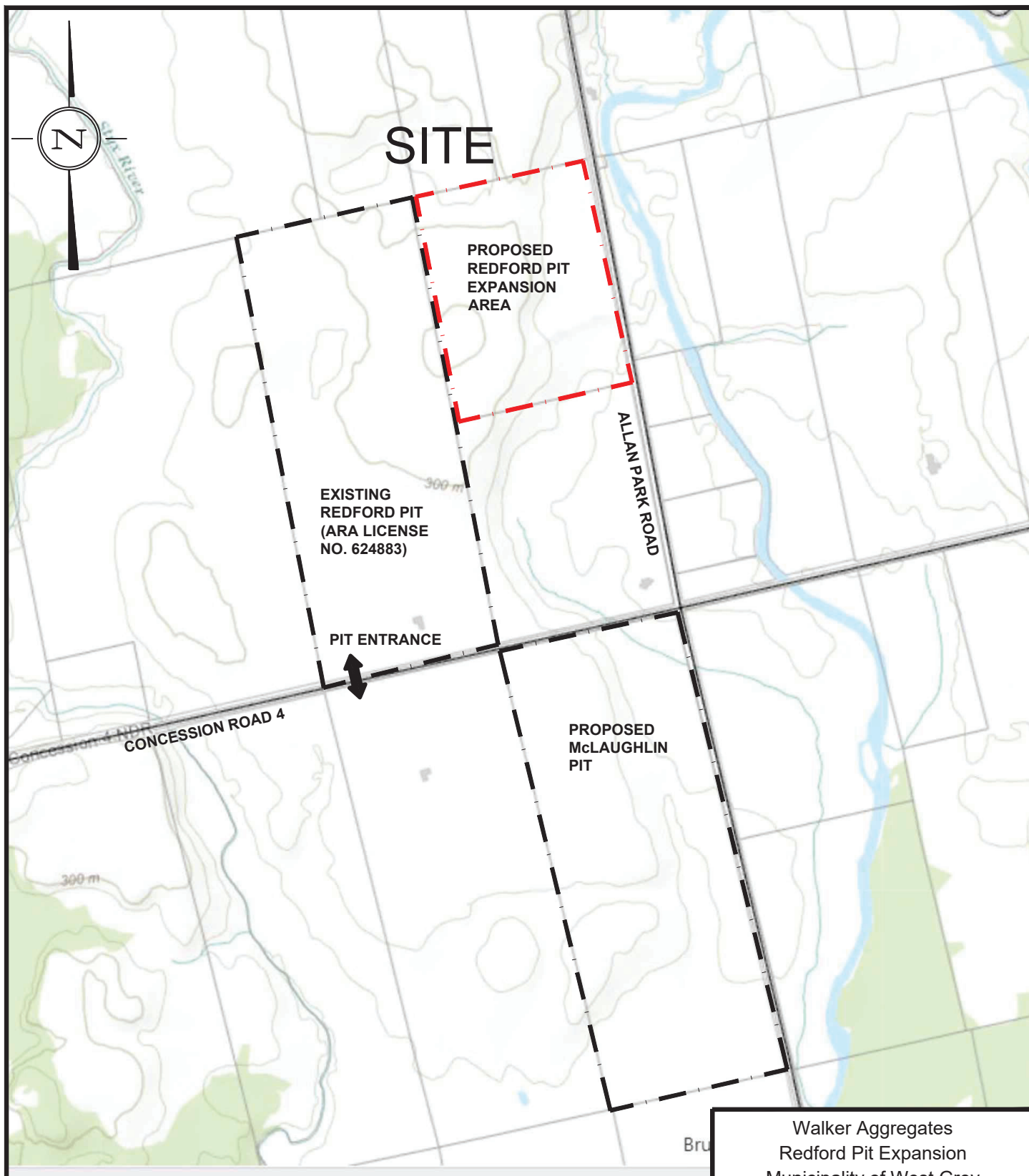
July 17, 2024

1.0 Introduction

Harold Sutherland Construction Ltd., a subsidiary of Walker Aggregates, is proposing to expand the existing Walker - Redford Gravel Pit which is located on 40.9 hectares (101 acres) of land at 381679 Concession Road 4 in the Municipality of West Grey. The existing pit is legally described as Lot 19, Concession 5 in the former Township of Bentick, Municipality of West Grey, County of Grey. The expansion property is located immediately east of the north half of the existing pit property at 133832 Allan Park Road on the North ½ of Lot 20, Concession 5 and has an area of 20.84 hectares (51.5 acres). The site location is shown on Figure 1 on the following page.

The existing Walker - Redford pit has a license limit of 100,000 tonnes per year. With the expansion, it is proposed to increase the tonnage to a maximum of 300,000 tonnes per year.

This study is intended to address policies and support an application for amendments to the Municipality of West Grey's Zoning By-law, and the application under the Aggregate Resources Act (ARA) for a Class A, Category 3 gravel pit.



Walker Aggregates
Redford Pit Expansion
Municipality of West Grey

Figure #1
Location Plan

Scale 1:12,500

P/N 23 - 3581

June 2024

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Source: Grey County GIS, accessed June 14, 2024

2.0 Context

The market for the existing Walker – Redford Pit is generally the local rural area. This includes the communities of Durham, Hanover and Walkerton which are located south of the pit along Grey Road 4.

Trucks hauling material from the expanded pit area will use the existing access from Concession Road 4. Most of the product produced by the pit will be hauled west along Concession Road 4 to Grey Road 3, and the north or south on County Road 3 as needed. Grey Road 3 is located about 1.2 km west of the pit, and Concession Road 4 is just under 5 km north of Grey Road 4. There is no posted speed limit on Concession Road 4, while Grey Road 3 and Grey Road 4 are both posted at 80 km/hr.

The intersection of Grey Road 3 and Grey Road 4 is stop controlled in the north-south direction. Most of the trucks from the Walker - Redford pit that enter this intersection would be turning left or right from Grey Road 3. Grey Road 4 carries much more traffic than Grey Road 3, so it is a higher volume intersection compared to other intersections along Grey Road 3. Although it meets all applicable design standards, the accident rate at the intersection is higher compared to other intersections in the County.

Concession Road 4 is paved from Grey Road 3 to just east of the entrance into the Walker - Redford Pit and has a gravel surface to the east. The asphalt appears to be in good condition, with a width of about 6.8 metres and gravel shoulders of between 0.6 and 1.0 metres wide. Between the pit and Grey Road 3 there are three existing entrances into residential properties, in addition to several farm field entrances.

The gradient of Concession Road 4 is relatively flat across the frontage of the Walker – Redford Pit. The sight distance to and from the pit entrance is about 440 metres to the east and 280 metres to the west. Traffic volumes on Concession Road 4 were observed to be very light.

Grey Road 3 has an asphalt surface with of about 6.8 metres with shoulders of about 1.8 metres wide. For traffic approaching from the north, the sight distance was measured to be about 255 metres, while from the south it is about 900 metres.

An application for another gravel pit on the south side of Concession Road 4 in Lot 20, Concession 4, was recently made by McLaughlin Farms. The maximum annual tonnage is proposed for 100,000 tonnes and it would also use Concession Road 4 as the haul route to Grey Road 3. Another pit has also been proposed by J.T. Excavating Ltd. on the north side of Concession Road 4 in Lot 22, Concession 5. Truck traffic from that site will travel east on Concession Road 4 and then south on Mulock Road to Grey Road 4 so it will not add to the traffic on Road 4 generated by the Walker – Redford and McLaughlin pits.

3.0 Travel Demand

3.1 Horizon Year and Time Period of Analysis

It is assumed for the purposes of this study that the license for the expanded pit will be approved in 2025. A study horizon of 10 years to 2035 has been used.

3.2 Historic Traffic Volumes

Staff from Grey County have provided traffic count data from 2014 to 2022 for the County Roads 3 and 4 at locations not far from the subject site. This information is included in Appendix A and is summarized in Table 1.

The Ministry of Transportation publishes traffic county data from 1988 to 2019 for Provincial Highways. Highway 6 is the closest highway to the study area. For the section of Highway 6 north of Durham, the Average Annual Daily Traffic (AADT) was 4,200 vehicles in 2009, and 3,900 vehicles in 2019. For the section south of Durham, the AADT in 2009 was 6,150, and 6,350 in 2019. In between those years the AADT reached a high of 6,500 in 2014 and a low of 5,400 in 2012. This data shows that over the longer 10-year horizon, there was very little growth in the traffic volumes on Highway 6, which is not unexpected given the rural nature of this area and general lack of new development.

Table 1 – Grey Road 3 and 4 Historic AADT Volumes

Year	Location of Count		
	#00304 Grey Rd. 3 - 200 m north of Con. 8	#00403 Grey Rd. 4 – 400 m east of Rd. 28	#00404 Rd. 4 – 350 m east of Mulock Rd.
2014	1200	9350	5500
2015	1550	10550	5600
2016	1800	9450	5600
2017	1900	10000	5950
2019	1650	9500	8050
2020	2250	9850	5350
2021	1950	9900	6300
2022	1650	9450	5950
5-year Average	1880	9740	6320
Avg. % increase	4.1%	0.1%	1.0%

3.3 Projected Background Traffic

Although the traffic data from Grey County shows some increase in the traffic volumes from 2014 to 2022, data from the MTO for Highway 6 shows little change from 2009 to 2019. Given the fact that there is not much new development occurring in this area, this is not unexpected.

The Grey County Growth Management Strategy Update from July of 2021 provides growth projections through to 2045. From 2021 to 2046 the total population for Grey County is forecasted to increase to 127,130 people from 103,330, which is 0.83% per year. The number of permanent households in the Municipality of West Grey is forecasted to go from 5,410 in 2021 to 6,250 in 2046, which is an increase of 0.58% per year. For the purpose of this analysis, an increase of 1% per year was applied to the traffic on Grey Road 3, which is likely higher than will actually occur. Applying the 1% annual increase to the 5-year average volume of 1880 vehicles per day as of 2022 results in about 1,940 vehicles in 2025 and 2,140 vehicles in 2035.

3.4 Site Generated Traffic

3.4.1 Traffic Volume

Traffic volumes for the proposed operation were estimated in consideration of an assumed breakdown of the types of trucks which may be in use at this pit.

The amount of material shipped from the site will vary from year to year depending on market conditions. However, it cannot exceed the maximum tonnage permitted by the Licence under the Aggregate Resources Act, which is 300,000 tonnes. The annual average production is estimated to be 150,000 Tonnes. Calculations for both the average and maximum tonnage are included in Appendix B.

It is estimated that eighty percent of the annual tonnage is likely to be shipped from June 1st to November 30th each year due to reduced demand and half load restrictions in the winter and spring. The traffic generated by the operation will be comprised primarily of trucks transporting the aggregate products from the pit to customers, with relatively small numbers of employee and service vehicles.

The truck traffic generated by gravel pits and quarries tends to be distributed relatively evenly throughout the day. While the hours of operation for the pit are to be between 7:00 am and 7:00 pm, for the purpose of this analysis it is assumed that 90% of the daily volume will be shipped during the 10 hour period between 7:00 am and 5:00 pm.

The traffic volume from the expanded pit with the increased tonnage is calculated to be 83 vehicles per day or 8 vehicles per hour at the average annual production of 150,000 tonnes and 167 vehicles per day or 17 vehicles per hour at the maximum annual production of 300,000

tonnes. Allowing for an hourly peaking factor of 1.5 as a worst case, there could be a peak volume of up to 12 vehicles per hour based on average production and 25 vehicles based on maximum production.

With the additional traffic from the proposed McLaughlin Pit factored in, the truck traffic could increase to 111 trips per day or 11 trips per hour if both pits are operating at an average production rate, and 222 trips per day or 22 trips per hour at the maximum production rate. If an hourly peaking factor of 1.5 is applied, there could be 17 trips per hour on average and 33 trips per hour maximum.

3.4.2 Directional Distribution

It is expected that almost all of the product from the Walker – Redford pit will be shipped west on Concession Road 4 to Grey Road 3. From there, most of the traffic would likely travel south on Road 3 to Grey Road 4, and then either east or west towards Durham, Hanover or Walkerton. A smaller percentage of traffic may go north on Grey Road 3 to take product to rural areas where demand would be less.

For analysis purposes, it was assumed that 20% of the truck traffic would travel north on Grey Road 3, with the 80% travelling south. The estimated peak hour traffic volumes for average and maximum production (assuming a 1.5 peaking factor) with directional distribution for the turning movements from Concession Road 4 onto Grey Road 3 for both the Walker – Redford and McLaughlin pits are therefore as follows:

Average Production: 17 trips per hour (round to 18)

2 trucks turning in from south (right)

1 truck turning in from north (left)

2 trucks turning out to south (left)

1 truck turning out to north (right)

Maximum Production: 33 trips per hour (round to 34)

14 trucks turning in from south (right)

3 trucks turning in from north (left)

14 trucks turning out to south (left)

3 trucks turning out to north (right)

4.0 Evaluation of Impacts

4.1 Methodology

The intersection of Concession Road 4 and Grey Road 3 was evaluated using the methods described in the 7th Edition of the Highway Capacity Manual¹ in order to determine the expected Level of Service for both existing and future traffic conditions. The Level of Service definitions are included in Appendix C. The traffic software program “HCS 2023” by McTrans was used to carry out the calculations.

The objective of the analysis is to identify "problem" intersections and traffic movements. For rural areas, "problem" intersections and movements are typically defined as those where a Level of Service “D” is incurred, meaning that motorists attempting to turn at intersections would experience longer delays.

Generally, traffic impacts should be mitigated when site generated traffic creates or worsens a "problem" situation.

4.2 Analysis

In order to analyze the impact of the truck traffic turning at Grey Road 3, the background peak hour traffic volume on the road was assumed to be about 10% of the AADT volume. This is probably slightly high as a 12 hour vehicle count from 2013 at the intersection of Grey Roads 3 and 4 showed the peak hour traffic to be about 11% of the 12 hour volume. Therefore, the peak hour volume would be 194 in 2025 and 214 in 2035. It was also assumed that the directional split of the background traffic would be 50% in each direction.

No traffic data is available for Concession 4, however during a site visit the volume was observed to be very low. For analysis it was assumed that the two-way volume would be 10 vehicles in the peak hour plus the volume generated by the existing Walker - Redford pit at a limit of 100,000 tonnes per year. That volume was calculated to be up to 8 trips per hour using the same methodology described in Section 3.4.1.

At unsignalized intersections, the Level of Service analysis is specific to traffic that has to come to a stop at an intersection to make a turning movement or to wait for other vehicles to turn. When there are no additional lanes for specific turning movements, it applies to all of the traffic proceeding in that direction, since a vehicle waiting to turn left would delay any vehicles queued behind that vehicle.

¹ Highway Capacity Manual 7th Edition, National Academies of Science, Engineering and Medicine, 2022.

The analysis was completed for only the Maximum Production scenario. It is expected that in most years the maximum production rate would not be achieved, so the actual impact will be less than what has been calculated in this analysis.

The calculation sheets from the HCS 2023 analysis can be found in Appendix D. Tables 2, 3 and 4 show the results of the HCS 2023 calculations for the Concession Road 4 / Grey Road 3 intersection, for both the 2025 and 2035 background traffic conditions. Table 2 shows the results for only the 2025 background traffic without the gravel pit in operation.

Table 2 – Level of Service - 2025 background with existing pit traffic

Direction	Maximum Production	
	Delay (s)	Level of Service
Southbound	0.2	A
Northbound	0.2	A
Westbound	10.5	B
Eastbound	9.7	A

Table 3 – Level of Service – 2025 with expanded pit traffic

Direction	Maximum Production	
	Delay (s)	Level of Service
Southbound	0.4	A
Northbound	0.1	A
Westbound	12.8	B
Eastbound	9.8	A

Table 4 – Level of Service – 2035 with pit expanded pit traffic

Direction	Maximum Production	
	Delay (s)	Level of Service
Southbound	0.4	A
Northbound	0.1	A
Westbound	13.3	B
Eastbound	9.9	A

By comparing the calculated delays shown in Tables 3 and 4, it can be seen the truck traffic from the pit expansion and the proposed McLaughlin pit will have a negligible impact on the delay at the intersection. The most critical turning movement is for westbound, left turns, and the calculated delay is expected to go from 10.5 seconds under existing conditions to 13.3 seconds in 2035 with the expanded pit in operation. In all cases the intersection is expected to continue operating at a good Level of Service even with the additional truck traffic.

4.3 Turning Lane Warrants

As per Section 3.4.2, the cumulative traffic generation (including the proposed McLaughlin Pit) under maximum demand is estimated to be no more than 34 trucks per hour, which would be 17 trucks entering and 17 leaving. It is estimated that about 20% of the trucks could be going to and coming from the north, which means about 3 or 4 trucks per hour would be making a left turn from Grey Road 3 onto Concession 4 when going to the pit.

The volume of traffic turning left onto Concession 4 from would could represent less than 5% of the 2035 advancing traffic volume assuming an hourly peak of about 107 vehicles in one direction. Referring to the Ministry of Transportation's warrant graphs for Left Turn Lanes it can be seen that using a design speed of 100 km/hr there is no warrant for a left turn lane with the volumes being this low. Even if there were 17 trucks per hour turning left, a left turn lane would not be warranted given the background traffic volumes on County Road 3. The MTO Warrant Graphs can be found in Appendix E.

The Ontario Ministry of Transportation does not have any warrants for when right turn treatments are required, however per Cottrell² (1982), turning lanes are not required until the turning volume is at least 40 vehicles per hour, and a taper isn't recommended until the volume reaches 20 vehicles per hour. On this basis it is concluded that a right turn lane or taper is not warranted at this intersection. The warrant graph for this can be found in Appendix E.

4.4 Sight Distance Considerations

With no speed limit posted on Concession 4, it is assumed to be 80 km/hr. In rural areas, design speeds are typically set at 20 km/hr over the speed limit unless circumstances dictate something lower. For vehicles approaching from the west, the road is relatively flat and straight, so it is reasonable to apply a design speed of 100 km/hr. Vehicles approaching from the east are on a gravel road until the Walker-Redford entrance which would probably result in the speed being a bit lower than for the paved portion.

² Cottrell, B.H. JR, Guidelines for Treatment of Right-turn Movements on Rural Roads, Transportation Research Record 855, 1982.

As a minimum, the available sight distance should exceed the minimum Stopping Sight Distance criteria as described in the Ministry of Transportation Geometric Design Standards for Ontario Highways. For a design speed of 100 km/hr the Minimum Stopping Sight Distance is 185 metres. As noted in Section 2.0, the available sight distance is about 280 metres to the west and 440 metres to the east which exceed the Stopping Sight Distance criteria. The entrance location is therefore considered to be safe.

The available sight distances on Grey Road 3 at the County Road 4 intersection exceed the minimum requirement for a 100 km/hr design speed.

4.5 Concession Road 4

As noted in Section 2.0 Concession 4 is paved from Grey Road 3 to the entrance to the Redford Pit. The road appears to be in a reasonably good structural condition so in our opinion there is no reason for any additional improvements.

4.6 Grey Road 3 / Grey Road 4 Intersection

As noted in Section 2.0, historically there has been a higher accident rate the intersection of Grey Road 3 and Grey Road 4 than at other County Road intersections. Because of this, an increased volume of trucks turning from or onto Grey Road 3 would normally be a concern. In order to make the intersection safer, the County is currently constructing a roundabout at the intersection which will eliminate the stop controls and reduce vehicle speeds. Implementation of the roundabout will eliminate the safety issues that currently exist at the intersection. Construction is expected to be completed before the fall of 2024 and once it is in operation it will eliminate any safety concerns caused by the increased truck traffic.

5.0 Conclusions and Recommendations

Based on our research and analysis, we conclude the following:

- At the maximum licensed tonnage for the proposed aggregate extraction operation, the proposed Walker – Redford Pit Expansion could generate an average of 125 trips per day from May to November. It is estimated that this volume could result in a peak hour volume of up to 12 trips per hour (6 in / 6 out).
- Trucks from the expanded pit will use Concession 4 to access Grey Road 3. Most trucks would likely head south to Grey Road 4 with a smaller percentage going north.
- Trucks turning at the intersection of Concession Road 4 and Grey Road 3 are expected to be able to do so without experiencing any delays, both in the existing (2025) and

future (2035) background traffic conditions. The intersection will continue to operate at a good Level of Service.

- The combination of the volume of trucks turning onto Concession 4 from Grey Road 3 and the background traffic volume on Grey Road 3 is not sufficient to warrant any auxiliary turning lanes.
- Concession 4 is paved between Grey Road 3 and the pit entrance and no further improvements are recommended at this time.
- The roundabout at the intersection of Grey Road 3 and Grey Road 4 that is currently being built will greatly improve the safety of the intersection and eliminate any concerns with increased truck traffic at this location.
- There are no recommendations within this Traffic Impact Study that impact the ARA Site Plan.

All of which is respectfully submitted,
SKELTON, BRUMWELL & ASSOCIATES INC.

per:



Scott W. Brumwell, P. Eng
President



Appendix A

Traffic Count Information

COUNTY OF GREY 2014 TO 2017 TRAFFIC COUNTS AVERAGE 2 DAY COUNT PER LOCATION PER YEAR

Grey County Road	Vicinity Location	Road & Engineering Section	New Location Code	2014						2015						2016						2017						2018						Average 2014-2017				
				Cars Trucks	Single Tandem Tri-Axle	Tractor Trailer	Total	ADT Spg/Fall	% Large Trucks	Cars Trucks	Single Tandem Tri-Axle	Tractor Trailer	Total	ADT Spg/Fall	% Large Trucks	Cars Trucks	Single Tandem Tri-Axle	Tractor Trailer	Total	ADT Spg/Fall	% Large Trucks	Cars Trucks	Single Tandem Tri-Axle	Tractor Trailer	Total	ADT Spg/Fall	% Large Trucks	Cars Trucks	Single Tandem Tri-Axle	Tractor Trailer	Total	ADT Spg/Fall						
1	32m West of Cvk #501156, Warton (North Side of Road) <u>Boundary line</u>	1-003	00101	1158	255	66	1479	1500	22%	1637	189	38	1864	1850	12%	1355	87	15	1457	1450	7%	1563	180	26	1769	1750	12%			0	0	#DIV/0!	1428	178	36	1642	1650	
1	50m West of Mallard St. (West Jct.)	1-013	00102	174	62	28	264	250	34%	303	48	10	361	350	16%	214	26	1	241	250	11%	272	15	1	288	300	6%			0	0	#DIV/0!	241	38	10	289	300	
1	400m East of Kemble Rock Road <u>(South Side Road Entrance)</u>	1-039	00103	276	25	21	322	300	14%	451	33	21	505	500	11%	268	19	1	288	300	7%	361	37	4	402	400	10%			0	0	#DIV/0!	339	29	12	379	400	
1	50m North of Church Side Road	1-045	00104	1262	202	15	1479	1500	15%	1287	275	106	1668	1650	23%	1130	246	17	1393	1400	19%	1851	237	18	2106	2100	12%			0	0	#DIV/0!	1383	240	39	1662	1650	
1	Indian Falls Conservation Park Entrance Balm Beach	1-057	00105	3309	118	11	3438	3450	4%	3428	130	28	3586	3600	4%	3219	126	8	3353	3350	4%	4117	192	13	4322	4300	5%			0	0	#DIV/0!	3518	142	15	3675	3650	
1	300m North of City Limits (East Side)	1-063	00106	4348	338	83	4769	4750	9%	4546	395	129	5070	5050	10%	4316	209	9	4534	4550	5%	5444	146	27	5617	5600	3%			0	0	#DIV/0!	4664	272	62	4998	5000	
1	70m South of 24th St. W. Owen Sound <u>(East Side)</u>	1-067	00107	7265	232	15	7512	7500	3%	7377	803	16	7696	7700	4%	6878	409	10	7297	7300	6%	8189	432	17	8638	8650	5%			0	0	#DIV/0!	7427	344	15	7786	7800	
1	#1295 2nd Ave W. Across From 13th St. W. <u>South of Owen Sound</u>	1-075	00108	4744	1188	303	6235	6250	24%	5655	882	81	6618	6600	15%	4778	793	47	5618	5600	15%	5676	669	39	6384	6400	11%			0	0	#DIV/0!	5213	883	118	6214	6200	
2	100m North of Southline 8, South of Grey Road 4	2-003	00201	533	117	31	694	700	21%	718	110	43	871	850	18%	672	77	19	768	750	13%	806	90	36	932	950	14%			0	0	#DIV/0!	682	99	32	816	800	
2	500m North of 10th Concession, <u>North of Grey Road 4</u>	2-021	00202	1128	117	32	1277	1300	12%	1392	175	90	1657	1650	16%	1258	92	33	1383	1400	9%	1419	178	48	1645	1650	14%			0	0	#DIV/0!	1299	141	51	1491	1500	
2	600m North of 3rd Side Road, North of Grey Road 31	2-028	00203	1208	153	46	1407	1400	14%	1106	184	146	1436	1450	23%	1391	101	33	1525	1550	9%	1220	150	34	1404	1400	13%			0	0	#DIV/0!	1231	147	65	1443	1450	
2	200m North of 12th Side Road (West Side) <u>North of Grey Road 31</u>	2-030	00204	1147	116	24	1287	1300	11%	1166	98	24	1288	1300	9%	1525	151	30	1706	1700	11%	1104	147	35	1286	1300	14%			0	0	#DIV/0!	1236	128	28	1392	1400	
2	1.2km North of 21st Side Road (Victoria Corners) <u>North of Grey Road 119</u>	2-045	00205	1491	167	52	1710	1700	13%	1462	179	90	1731	1750	16%	1789	213	43	2045	2050	13%	1185	209	31	1425	1450	17%			0	0	#DIV/0!	1482	192	54	1728	1750	
3	100m West of Concession 8 At Cvk #113433	3-007	00301	774	38	23	835	850	7%	637	52	21	710	700	10%	576	120	15	711	700	19%	757	75	23	855	850	11%			0	0	#DIV/0!	686	71	21	778	800	
3	1.0km South of Grey Road 9 West Jct.	3-019	00302	2278	112	17	2407	2400	5%	2104	294	117	2515	2500	16%	2306	141	22	2469	2450	7%	2423	285	39	2747	2750	12%			0	0	#DIV/0!	2278	208	49	2535	2550	
3	350m South of Concession 18, North of Grey Road 9 <u>West Jct.</u>	3-022	00303	2033	113	73	2219	2200	8%	2092	150	69	2321	2300	10%	3267	116	120	3503	3500	7%	3504	164	160	3828	3850	8%			0	0	#DIV/0!	2724	138	106	2968	2950	
3	200m North of Concession 8 RDW, <u>North of Grey Road 4</u>	3-037	00304	1131	62	23	1216	1200	7%	1371	118	31	1542	1550	11%	1567	188	50	1805	1800	13%	1518	219	168	1905	1900	20%			0	0	#DIV/0!	1397	152	69	1617	1600	
3	100m South Side Road 6, North of Grey Road 25 <u>West Jct.</u>	3-051	00305	1195	164	74	1433	1450	17%	1673	134	72	1879	1900	11%	1562	217	46	1825	1850	14%	1915	212	150	2277	2300	16%			0	0	#DIV/0!	1586	182	86	1854	1850	
3	150m North of Side Road 2, North of Grey Road 40	3-053	00306	1462	174	181	1817	1800	20%	1247	125	23	1395	1400	11%	1470	129	57	1656	1650	11%	1580	190	90	1860	1850	15%			0	0	#DIV/0!	1440	155	88	1682	1700	
3	1.3km South of Grey Road 5 East Jct.	3-63	00307	2388	371	200	2959	2950	19%	1952	197	29	2178	2200	10%	2126	151	46	2323	2300	8%	2019	99	24	2142	2150	6%			0	0	#DIV/0!	2121	205	75	2401	2400	
3	1.3km South of King's Highway 21	3-066	00308	1323	96	26	1445	1450	8%	930	108	20	1058	1050	12%	1120	79	51	1250	1250	10%	1042	58	15	1115	1100	7%			0	0	#DIV/0!	1104	85	28	1217	1200	
4	100m West of 4th Ave. Hanover <u>West of Grey Road 30</u>	4-006	00401	6081	1199	245	7525	7550	19%	6618	1353	264	8235	8250	20%	7930	648	251	8829	8850	10%	6885	939	155	7979	8000	14%			0	0	#DIV/0!	6879	1035	229	8142	8150	
4	50m East of 18th Ave. N. Hanover (North Side)	4-012	00402	11714	834	194	12742	12750	8%	13059	1001	312	14372	14350	9%	12831	651	180	13662	13650	6%	12185	898	161	13244	13250	8%			0	0	#DIV/0!	12447	846	212	13505	13500	
4	400m East of Grey Road 28 (Fire Hydrant)	4-018	00403	8134	1120	98	9352	9350	13%	10049	313	189	10561	10550	5%	9068	318	77	9463	9450	4%	9075	728	187	9990	10000	9%			0	0	#DIV/0!	9082	622	136	9842	9850	
4	350m East of Mulock Road	4-026	00404	4756	449	288	5493	5500	13%	5083	389	130	5612	5600	8%	5153	355	75	5583	5600	8%	5254	565	140	5959	5950	12%			0	0	#DIV/0!	5062	442	158	5662	5650	
4	100m East of King's Highway 6 (corner of Lambert & Albert St.)	4-045	00405	3093	294	79	3466	3450	11%	3202	209	79	3490	3500	8%	3029	292	58	3379	3400	10%	3972	379	122	4473	4450	11%			0	0	#DIV/0!	3324	294	85	3702	3700	
4	700m East of Baseline Rd. <u>West of Grey Road 23</u>	4-057	00406	2490	101	22	2613	2600	5%	2604	184	44	2832	2850	8%	2674	106	31	2811	2800	5%	2624	260	89	2973	2950	12%			0	0	#DIV/0!	2598	163	47	2807	2800	
4	225m East of Boejack Ranch Road <u>Baseline Rd.</u>	4-060	00407	2068	224	146	2433	2450	15%	2172	126	39	2337	2350	7%	2233	170	58	2461	2450	9%	2226	166	42	2434	2450	9%			0	0	#DIV/0!	2174	172	71	2416	2400	
4	40m East of Harold Best Parkway, <u>Whesterton (Front of Fire Hall)</u>	4-078	00408	3791	395	104	4290	4300	12%	3605	370	115	4090	4100	12%	3777	964	264	5005	5000	25%	3763	680	161	4604	4600	18%			0	0	#DIV/0!	3734	602	161	4497	4500	
4	150m West of East Backline W., North of King's Highway 10	4-093	00409	4392	513	80	4985	5000	12%	4088	588	103	4779	4800	14%	4673	583	248	5504	5500	15%	4420	551	160	5131	5150	14%			0	0	#DIV/0!	4393	559	148	5100	5100	
4	200m East of Osprey/Artemesia T/L, <u>East of Grey Road 11</u>	4-096	00410	2215	253	83	2551	2550	13%	2330	306	121	2757	2750	15%	2145	392	121	2658	2650	19%	2580	244	118	2942	2950	12%			0	0	#DIV/0!	2318	299	111	2727	2750	
4	1.1km West of Road 63 (M409313) <u>West of Grey Road 124</u>	4-106	00411	2311	217	84	2612	2600	12%	2715	213	86	3014	3000	10%	2468	126	50	2644	2650	7%	2681	250	123	3054	3050	12%			0	0	#DIV/0!	2544	202	86	2831	2850	

COUNTY OF GREY: 2014 TO 2021 AVERAGE DAILY TOTAL TRAFFIC COUNTS

Grey County Road	Vicinity Location	Road & Engineering Section	Map Code	New Location Code	2016						2017						2019						2020						2021						2022						5 Year Average	
					Cars & Light Trucks	Trucks >7m	Tractor Trailer >14m	Total	ADT	% Large Trucks	Cars & Light Trucks	Trucks 7- 14m	Tractor Trailer >14m	Total	ADT	% Large Trucks	Cars & Light Trucks	Trucks 7- 14m	Tractor Trailer >14m	Total	ADT	% Large Trucks	Cars & Light Trucks	Trucks 7- 14m	Tractor Trailer >14m	Total	ADT	% Large Trucks	Cars & Light Trucks	Trucks 7- 14m	Tractor Trailer >14m	Total	ADT	% Large Trucks	Cars & Light Trucks	Trucks 7- 14m	Tractor Trailer >14m	Total	ADT	% Large Trucks		
3	350m South of Carpenter Road	3-022	3-3	00303	3267	116	120	3503	3500	7%	3504	164	160	3828	3850	8%	3009	145	70	3224	3200	7%	2503	178	55	2736	2750	9%	2290	164		2454	2450	7%	2591	182		2773	2750	7%	3149	3150
3	200m North of Carpenter Road	3-037	3-4	00304	1567	188	50	1805	1800	13%	1518	219	168	1905	1900	20%	1446	158	22	1626	1650	11%	1912	233	113	2258	2250	15%	1790	207		1937	1950	11%	1503	139		1642	1650	8%	1906	1900
4	400m East of Carpenter Road	4-018	4-3	00403	9068	318	77	9463	9450	4%	9075	728	187	9990	10000	9%	9225	216	73	9514	9500	9%	9475	395		9870	9850	4%	9246	550	89	9885	9900	6%	9057	407		9464	9450	4%	9744	9750
4	350m East of Mullock Road	4-026	4-4	00404	5153	355	75	5583	5600	8%	5254	565	140	5959	5950	12%	7132	336	584	8052	8050	11%	5011	360		5371	5350	7%	5858	448		6306	6300	7%	5511	440		5951	5950	7%	6254	6250

Note: For 2020, 2021, & 2022 when Tractor Trailer >14m cell is blank, that count is included in the Trucks 7-14m cell

Note: No counts in 2018. 2016 has been included in the 5 year average

Highway	Location Description	Dist (KM)	Year	Pattern Type	AADT	SADT	SAWDT	WADT
6			1999	IR	5400	6700	6000	4550
6			2000	IR	5650	6900	6250	4750
6			2001	IR	5750	7100	6350	4850
6			2002	IR	5850	7200	6500	4950
6			2003	IR	5950	7200	6550	5050
6			2004	IR	6050	7500	6700	5100
6			2005	IR	5950	7200	6500	5050
6			2006	IR	6250	7550	6850	5300
6			2007	IR	6050	7350	7300	5150
6	HIGHWAY 6 - S. OF DURHAM		2008	IR	5650	6850	6700	4850
6			2009	IR	6150	7400	6700	5250
6			2010	IR	6050	7200	6600	5150
6			2011	IR	6050	7200	7050	5150
6			2012	CTR	5400	6550	6450	4600
6			2013	CTR	5500	6700	6900	4650
6			2014	CTR	6500	7950	8000	5500
6			2015	CTR	6200	7550	7650	5250
6			2016	CTR	6250	7600	7700	5300
6			2017	CTR	6300	8400	8400	5150
6			2018	CTR	6300	8400	8400	5150
6			2019	CTR	6350	8450	8400	5150
6	DURHAM S LTS BENT SDRD27 START OF NA	2.3	1999					
6	DURHAM N LTS GLENELG TWP END OF NA	29.3	1988	CR	3150	4050	3800	2600
6			1989	IR	3350	4300	3700	2750
6			1990	IR	3600	4550	4000	2950
6			1991	IR	3500	4400	3900	2900
6			1992	IR	3400	4200	3750	2900
6			1993	IR	3450	4250	3550	2800
6			1994	IR	3700	4550	4050	3100
6	HIGHWAY 6 - N. OF DURHAM		1995	IR	3800	4700	4200	3250
6			1996	IR	3900	4850	4350	3300
6			1997	IR	4000	5000	4500	3400
6			1998	IR	4100	5100	4600	3450
6			1999	IR	4050	5000	4500	3400
6			2000	IR	4050	4950	4500	3400
6			2001	IR	4100	5050	4550	3450
6			2002	IR	4100	5050	4550	3500
6			2003	IR	4150	5050	4550	3500
6			2004	IR	4100	5050	4550	3450
6			2005	IR	4100	4950	4500	3500
6			2006	IR	4250	5150	4650	3600
6			2007	IR	4150	5050	5000	3500
6			2008	IR	3900	4700	4650	3350
6			2009	IR	4200	5050	4600	3550
6			2010	IR	4200	5000	4550	3550

Highway	Location Description	Dist (KM)	Year	Pattern Type	AADT	SADT	SAWDT	WADT
6			2011	IR	4200	5000	4900	3600
6			2012	CTR	3650	4450	4350	3100
6			2013	CTR	3650	4450	4600	3100
6			2014	CTR	4150	5050	5100	3550
6			2015	CTR	4050	4950	5000	3450
6			2016	CTR	4050	4950	5000	3450
6			2017	CTR	4050	5400	5400	3300
6			2018	CTR	4050	5400	5400	3300
6			2019	IR	3900	4750	4700	3300
6	S JCT GREY RD 40 DAVID MCNICHOL PKWY	1.1	1988	CR	3350	4300	4000	2800
6			1989	IR	4000	5150	4450	3300
6			1990	IR	4400	5600	4900	3600
6			1991	IR	4300	5400	4750	3550
6			1992	IR	4250	5250	4700	3600
6			1993	IR	4300	5300	4450	3500
6			1994	IR	4200	5150	4600	3500
6			1995	IR	4150	5100	4550	3550
6			1996	IR	4450	5550	4950	3800
6			1997	IR	4550	5700	5100	3850
6			1998	IR	4650	5750	5200	3900
6			1999	IR	4800	5950	5350	4050
6			2000	IR	4650	5700	5150	3950
6			2001	IR	4700	5800	5200	3950
6			2002	IR	4800	5900	5300	4100
6			2003	IR	4800	5850	5300	4050
6			2004	IR	4850	6000	5350	4100
6			2005	IR	4950	5950	5400	4200
6			2006	IR	4900	5900	5350	4150
6			2007	IR	5050	6100	6100	4300
6			2008	IR	5150	6250	6100	4400
6			2009	IR	5200	6250	5650	4400
6			2010	IR	5250	6250	5700	4450
6			2011	IR	5250	6250	6150	4500
6			2012	CTR	4700	5700	5650	4000
6			2013	CTR	4700	5700	5900	4000
6			2014	CTR	4200	5100	5150	3550
6			2015	CTR	4250	5200	5250	3600
6			2016	CTR	4300	5250	5300	3650
6			2017	CTR	4850	6500	6450	3950
6			2018	CTR	4850	6500	6450	3950
6			2019	CTR	4850	6450	6450	3950
6	N JCT GREY RD 40 CHATSWORTH START OF NA	0.6	9999					
6	HWY 10 TORONTO & SYDENHAM STS	11.6	1988	CR	7050	9000	8450	5850
6			1989	IR	7600	9800	8450	6250
6			1990	IR	8150	10400	9050	6700

Appendix B

Site Generated Traffic

APPENDIX B **SITE GENERATED TRAFFIC** **WALKER REDFORD PIT - TOWNSHIP OF WEST GREY**

PIT AGGREGATE

Production

Average	150,000	tonnes
Maximum	300,000	tonnes

Fleet Usage

	Tonnes Per Load	% of Trips
Tandem	15	20%
Triaxle	21	50%
Semi Trailer	35	30%

Average per Load 24 tonnes

Annual Trip Generation

	Total Annual Tonnage	Tonnes Per Load	Trips Per Year
Average Year	150,000	24	6,250
		Total Trips Out	6,250
		Total Trips In	6,250
		Total Trips (Out + In)	12,500
Maximum Year (Licence Limit)	300,000	24	12,500
		Total Trips Out	12,500
		Total Trips In	12,500
		Total Trips (Out + In)	25,000

Daily Trip Generation

Percentage (%) shipped in peak months	80%
Peak Months: June to November	6
Average number of working days per month:	20
Daily Peak Traffic Factor:	1.5

Total Annual Tonnage	Total Trips Per Year	Total Working Days in Peak Months	Trips Per Day in Peak Months
150,000	12,500	120	125
300,000	25,000	120	251

APPENDIX B
SITE GENERATED TRAFFIC
WALKER REDFORD PIT - TOWNSHIP OF WEST GREY

TOTAL TRIP GENERATION

Peak Hours of Operation

From: 7:00 AM

To: 5:00 PM

Total Hours: 10

% Shipped in Peak Hours 100%

Total Annual Tonnage	Trips Per Day	Average Trips Per Peak Hour	Minutes Between Trips
150,000	125	12	4.8
300,000	251	25	2.4

APPENDIX B **CUMULATIVE TRAFFIC** **WALKER REDFORD PIT - TOWNSHIP OF WEST GREY**

PIT AGGREGATE

Production

Average	200,000	tonnes
Maximum	400,000	tonnes

Fleet Usage

	Tonnes Per Load	% of Trips
Tandem	15	20%
Triaxle	21	50%
Semi Trailer	35	30%

Average per Load 24 tonnes

Annual Trip Generation

	Total Annual Tonnage	Tonnes Per Load	Trips Per Year
Average Year	200,000	24	8,333
		Total Trips Out	8,333
		Total Trips In	8,333
		Total Trips (Out + In)	16,667
Maximum Year (Licence Limit)	400,000	24	16,667
		Total Trips Out	16,667
		Total Trips In	16,667
		Total Trips (Out + In)	33,333

Daily Trip Generation

Percentage (%) shipped in peak months	80%
Peak Months: June to November	6
Average number of working days per month:	20
Daily Peak Traffic Factor:	1.5

Total Annual Tonnage	Total Trips Per Year	Total Working Days in Peak Months	Trips Per Day in Peak Months
200,000	16,667	120	167
400,000	33,333	120	333

**APPENDIX B
CUMULATIVE TRAFFIC
WALKER REDFORD PIT - TOWNSHIP OF WEST GREY**

TOTAL TRIP GENERATION

Peak Hours of Operation

From: 7:00 AM

To: 5:00 PM

Total Hours: 10

% Shipped in Peak Hours 100%

Total Annual Tonnage	Trips Per Day	Average Trips Per Peak Hour	Minutes Between Trips
200,000	167	17	3.6
400,000	333	33	1.8

Appendix C

Level of Service Definition

Level of Service at Unsignalized Intersections

The assessment of unsignalized intersections is based on the methods described in the "Highway Capacity Manual 2010", published in 2010 by the Transportation Research Board.

The term "Level of Service" is often used to assist in clarifying the arithmetic analysis associated with traffic engineering. "Level of Service" implies a qualitative measure of traffic flow at an intersection, and is dependent upon vehicle delay and vehicle queue lengths at the approaches. The Level of Service can be determined based on the ratio between traffic volumes and approach capacity or "V/C" ratio. The following table describes the characteristics of each level:

Level of Service	Description	Control Delay (sec)
A	Little or no traffic delay occurs. Approaches appear open, turning movements are easily made, and drivers have freedom of operation.	≤10
B	Short traffic delays occur. Many drivers begin to feel somewhat restricted in terms of freedom of operation.	10 to 15
C	Average traffic delays occur. Operations are generally stable, but drivers emerging from the minor street may experience difficulty in completing their movement. This may occasionally impact on the stability of flow on the major street.	15 to 25
D	Longer traffic delays occur. Motorists emerging from the minor street experience longer delays in making turns. Drivers on the major street will experience congestion and delay as drivers emerging from the minor street interfere with the major through movements.	25 to 35
E	Very long traffic delays occur. Operations approach the capacity of the intersection.	35 to 50
F	Saturation occurs, with vehicle demand exceeding the available capacity. Extremely long traffic delays occur.	>50

Level of Service for Class II, Two Lane Roadways

The assessment of Two-Lane Roadways is based on the methods described in the "Highway Capacity Manual 2010", published in 2010 by the Transportation Research Board.

The term "Level of Service" is often used to assist in clarifying the arithmetic analysis associated with traffic engineering. "Level of Service" implies a qualitative measure of traffic flow on a roadway, and for a Class II two lane roadway is dependent upon the percent time-spent-following other vehicles. The following table describes the characteristics of each level:

Level of Service	Description	% Time Spent Following
A	Highest quality of traffic service, where motorists are generally able to travel at their desired speed. Motorists will not be delayed in platoons for more than 40 percent of their travel time. A maximum flow rate of 490 cars/ hour total in both directions can be achieved with base conditions.	≤ 40
B	The demand for passing to maintain desired speeds becomes more significant. Drivers will not be delayed in platoons for more than 55 percent of their travel time. A flow rate of up to 780 cars / hour total for both directions with base conditions can be achieved.	> 40 to 55
C	There are noticeable increases in platoon formation, platoon size and frequency of passing impediments. Motorists will not be delayed in platoons for more than 70% of their travel time. A total flow rate of 1,190 cars / hour can be achieved with base conditions.	> 55 to 70
D	Unstable traffic flow where passing is extremely difficult. Drivers will not be delayed in platoons for more than 85 percent of their travel time. Maximum flow rates of up to 1,830 cars / hour total in each direction can be achieved under base conditions.	> 70 to 85
E	Passing is virtually impossible and platooning is very intense, with drivers being delayed in platoons for more than 85 percent of their travel time. The highest volume attainable would generally be up to 1,700 cars / hour in one direction and 3,200 cars / hour total for both directions.	> 85

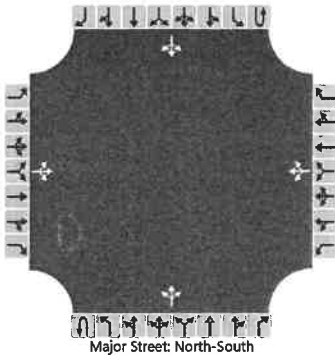
Appendix D

HCS 2023 Analysis

HCS Two-Way Stop-Control Report

General Information		Site Information	
Analyst	S. Brumwell	Intersection	Concession 4 & Grey Road 3
Agency/Co.	Skelton, Brumwell	Jurisdiction	Grey County
Date Performed	4/4/2024	East/West Street	Concession 4
Analysis Year	2025	North/South Street	Grey Road 3
Time Analyzed	Peak Hour	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Walker Redford Pit (Existing)		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		2	1	2		6	1	2		2	97	6		2	97	2
Percent Heavy Vehicles (%)		3	3	3		50	3	65		3				65		
Proportion Time Blocked																
Percent Grade (%)	1				1											
Right Turn Channelized																
Median Type Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.33	6.73	6.33		7.80	6.73	6.95		4.13				4.75		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33		3.95	4.03	3.89		2.23				2.79		

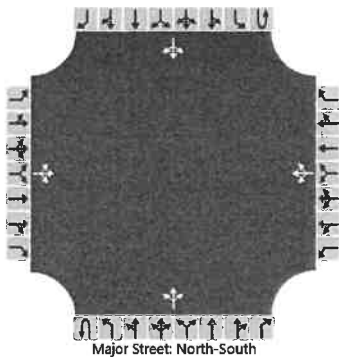
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			5				10			2				2		
Capacity, c (veh/h)			776				662			1477				1164		
v/c Ratio			0.01				0.01			0.00				0.00		
95% Queue Length, Q ₉₅ (veh)			0.0				0.0			0.0				0.0		
Control Delay (s/veh)			9.7				10.5			7.4	0.0	0.0		8.1	0.0	0.0
Level of Service (LOS)			A				B			A	A	A		A	A	A
Approach Delay (s/veh)	9.7				10.5				0.2				0.2			
Approach LOS	A				B				A				A			

HCS Two-Way Stop-Control Report

General Information		Site Information	
Analyst	S. Brumwell	Intersection	Concession 4 & Grey Road 3
Agency/Co.	Skelton, Brumwell	Jurisdiction	Grey County
Date Performed	4/4/2024	East/West Street	Concession 4
Analysis Year	2025	North/South Street	Grey Road 3
Time Analyzed	Peak Hour	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Walker Redford Pit (300000 tonnes)		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		2	1	2		17	1	4		2	97	17		4	97	2
Percent Heavy Vehicles (%)		3	3	3		90	3	90		3				90		
Proportion Time Blocked																
Percent Grade (%)	1				1											
Right Turn Channelized																
Median Type Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.33	6.73	6.33		11.50	6.73	10.50		4.13				8.20		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33		4.31	4.03	4.11		2.23				3.01		

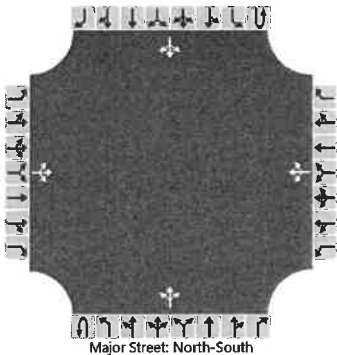
Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			5				24			2				4		
Capacity, c (veh/h)			763				483			1477				949		
v/c Ratio			0.01				0.05			0.00				0.00		
95% Queue Length, Q ₉₅ (veh)			0.0				0.2			0.0				0.0		
Control Delay (s/veh)			9.8				12.8			7.4	0.0	0.0		8.8	0.0	0.0
Level of Service (LOS)			A				B			A	A	A		A	A	A
Approach Delay (s/veh)	9.8				12.8				0.1				0.4			
Approach LOS	A				B				A				A			

HCS Two-Way Stop-Control Report

General Information		Site Information	
Analyst	S. Brumwell	Intersection	Concession 4 & Grey Road 3
Agency/Co.	Skelton, Brumwell	Jurisdiction	Grey County
Date Performed	4/4/2024	East/West Street	Concession 4
Analysis Year	2035	North/South Street	Grey Road 3
Time Analyzed	Peak Hour	Peak Hour Factor	0.92
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25
Project Description	Walker Redford Pit (300000 tonnes)		

Lanes



Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		2	1	2		17	1	4		2	107	17		4	107	2
Percent Heavy Vehicles (%)		3	3	3		90	3	90		3				90		
Proportion Time Blocked																
Percent Grade (%)	1				1											
Right Turn Channelized																
Median Type Storage	Undivided															

Critical and Follow-up Headways

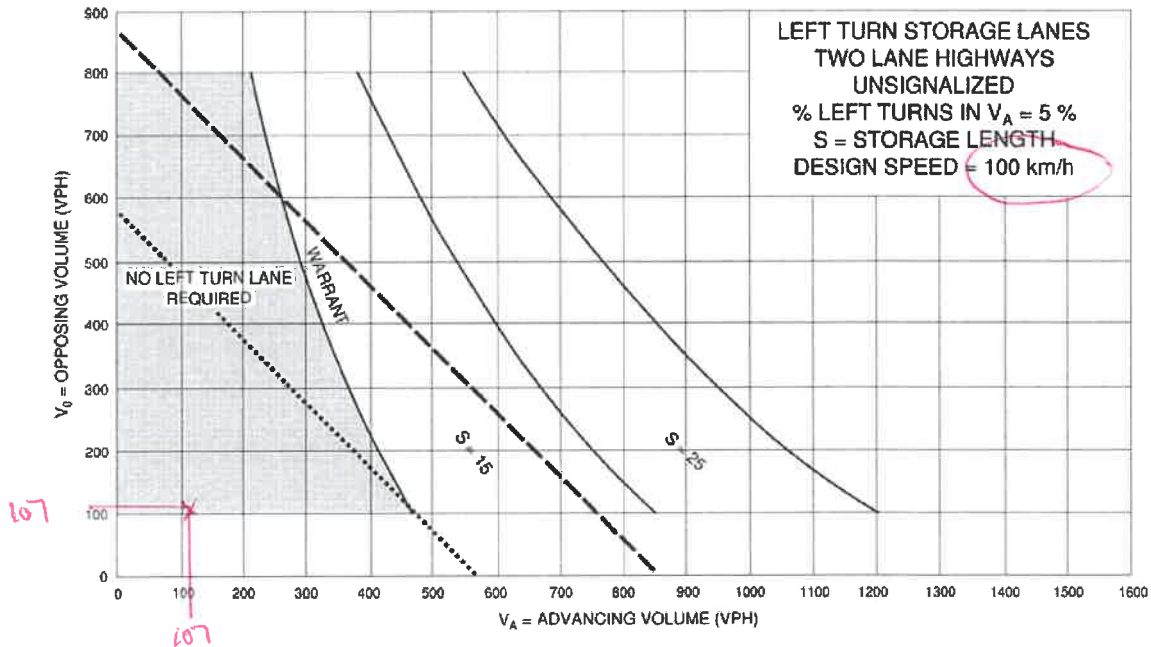
Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.33	6.73	6.33		11.50	6.73	10.50		4.13				8.20		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.53	4.03	3.33		4.31	4.03	4.11		2.23				3.01		

Delay, Queue Length, and Level of Service

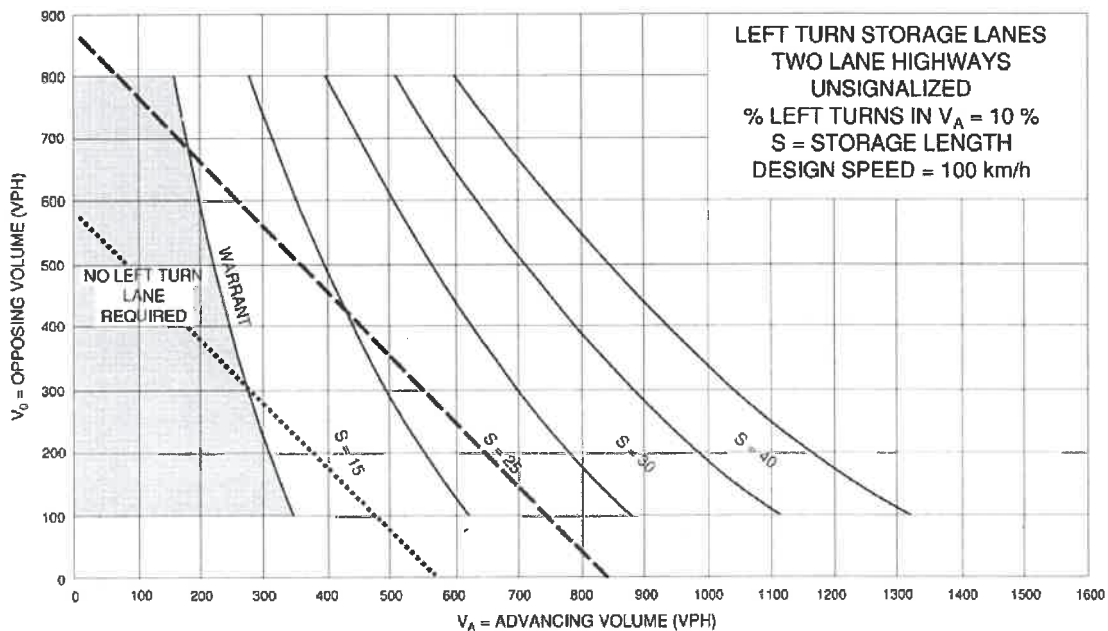
Flow Rate, v (veh/h)			5				24			2				4		
Capacity, c (veh/h)			743				458			1463				930		
v/c Ratio			0.01				0.05			0.00				0.00		
95% Queue Length, Q ₉₅ (veh)			0.0				0.2			0.0				0.0		
Control Delay (s/veh)			9.9				13.3			7.5	0.0	0.0		8.9	0.0	0.0
Level of Service (LOS)			A				B			A	A	A		A	A	A
Approach Delay (s/veh)	9.9				13.3				0.1				0.4			
Approach LOS	A				B				A				A			

Appendix E

Turning Lane Warrants

Exhibit 9A-23

- TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW
- TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS



use of conflicts requires trained personnel and man-hours for observation, whereas volume counts require only mechanical counters. For proposed intersection sites, an estimate of conflicts adds uncertainty, since it would be based on forecast volume data. However, the correlations were not as strong for PHV total and PHV right turn. For these reasons, no clear-cut guidelines resulted from the field data.

GUIDELINES FOR RIGHT-TURN MOVEMENTS

In view of the above, guidelines were developed by using a synthesis of the field data, guidelines of state DOTs, and engineering judgment. The field data provided the basic framework for the guidelines, but the standards used by other state DOTs, especially Iowa and Idaho, were strong influences. Finally, where the first two items were insufficient, engineering judgment was used.

An explanation of how this was accomplished for two-lane highways is given below. Figure 1 shows the regression lines for the radius and lane treatments and the positions of the study sites, where R,

L, and T indicate radius, lane, and taper sites, respectively. The R^2 value for the radius line is 0.6 and that for the lane line is 0.2. Since the R^2 value for the taper line was less than 0.1, this line was not used. The area below the radius suggests a radius treatment, the area between the two lines suggests a taper treatment, and the area above the lane line suggests a lane treatment.

When the guidelines of state DOTs and judgment were used, the guidelines for right-turn movements took the form of Figure 2. The taper range was expanded on the Y-axis by using data from other guidelines, and the lines were leveled off at the points of maximum total PHV for the field sites. The volume conditions for the respective treatments for two-lane highways are indicated.

It was noted that there were more PHV right turns on highways with speed limits under 55 mph. These roads had radius treatments and residential or commercial development close to the roadside without available right-of-way for any special treatment. An adjustment was needed to accommodate these sites effectively in the guidelines.

For two-lane highways with posted speeds of 45

Figure 1. Development of guidelines for right-turn treatment: two-lane road.

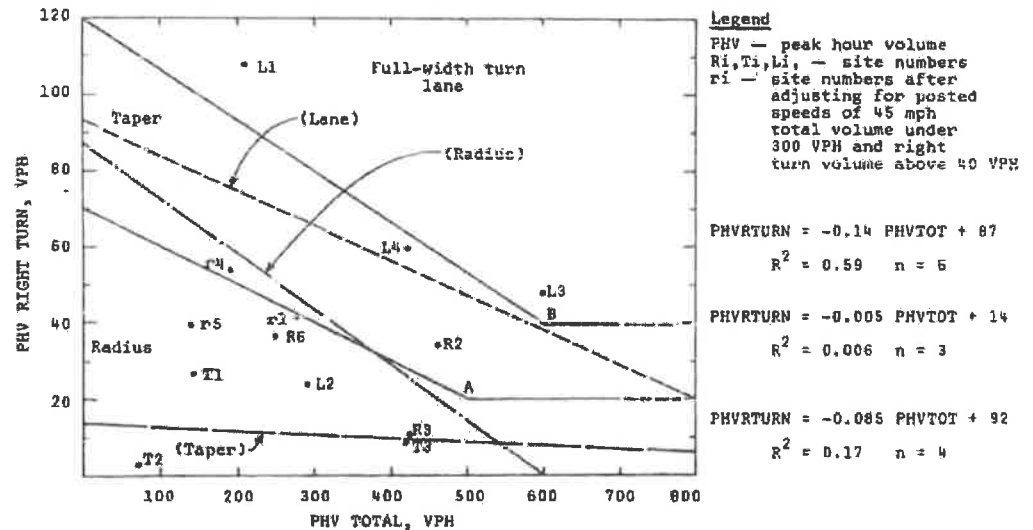


Figure 2. Guidelines for right-turn treatment: two-lane highway.

