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Mineral Resource Impact Assessment

Proposed Residential Development
Half Moon Bay South - Phase 5
Greenbank Road - Ottawa

Prepared For

Mattamy Homes

February 11, 2019

Report PG4803-2

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Appendix 1

Drawing PG4803-2 - Existing Conditions
Historical Aerial Photographs
Aggregate Resource - Drummond (Costello) Pit
The Base Mapping Co. Ltd.- Existing Features Plan - Costello Pit - Project No. C 419-90 - Page No. 1 of 2 - Revision 1 dated September 9, 1996
The Base Mapping Co. Ltd. - Operation and Rehabilitation Plan - Costello Pit - Project No. C 419-90 - Page 2 of 2 - Revision 2 dated May 17, 1999

Appendix 2

Half Moon Bay South - Site Layout dated February 11, 2019

Valcoustics Canada Ltd - Stationary Noise Source Study - Half Moon Bay South and Quinn's Pointe Stage 2 - Project 118-0052 dated May 3, 2018

Valcoustics Canada Ltd - Traffic Noise Assessment - Half Moon Bay South Phase 5 - Project 108-363-300 dated February 1, 2019

Golder Associates Ltd. - Assessment of Dust Impacts from Aggregate Pits on Minto Communities Canada and Mattamy Homes Proposed Developments - Minto and Mattamy Dust Study - Project 1897372 - dated March 2018

CHG Transportation - 3718 Greenbank Road – Half Moon Bay South – Phase 5 Transportation Impact Assessment - Project 2018-32 dated January 2019

1.0 Introduction

Paterson Group (Paterson) was commissioned by Mattamy Homes to conduct a mineral resource impact assessment for the proposed residential development at the aforementioned site and is required by Section 3.7.4 of the City of Ottawa Official Plan.

The objective of the current assessment was to evaluate the potential for land use impacts relating to land use compatibility between the proposed residential development and the adjacent mineral aggregate resources currently in operation. It is noted in Schedule A of the City of Ottawa Official Plan, the proposed development is located within the urban boundary expansion study area. The primary purpose of this area is to accommodate residential population growth.

Based on Section 2.5 of the Provincial Policy Statement 2014, mineral aggregate resources shall be protected from long term use and, where provincial information is available, deposits of mineral aggregate resources shall be identified.

2.0 Proposed Development

It is understood that the proposed residential development will consist of townhouses, singles, residential dwellings with attached garages, associated driveways, local roadways and landscaping areas. It is further understood that the proposed development will be serviced by future municipal water, sanitary and storm services.

3.0 Location and Surface Conditions

The subject site is bordered to the west by undeveloped land and future Greenbank Road, to the north by existing residential development, to the east by existing residential and Greenbank Road and to the south by a future residential development. The subject locations are identified in Drawing PG4803-2- Existing Conditions.

The subject site is a mix of undeveloped, former agricultural land and forested areas. The subject site has significant topographical relief. The ground surface elevation within the eastern portion of the subject site is approximately ±100 m at its lowest elevation, increasing in elevation to approximately ±108 m, along the western portion.

4.0 Adjacent Sand and Gravel Pit

4.1 Status, Type and Location of Pit Operation

Costello Pit (Drummond Pit)

The sand and gravel pit, also known as the Costello Pit, to the west of the subject site is located at 3713 Borrisokane Road and is owned by George W. Drummond Limited. Details of the pit are provided below and attached to the current report. A series of historical aerial photographs have been attached to the present letter to provide an extraction history of the aggregate resource.

The legal description of the pit is CON 3RF PT LOT 9 RP 5R-6254; PART 2 LESS RP 5R-13374 PTS; 9 & 10 RD WIDENING, PIN 045920035.

The site consists of approximately 79.5 acres with a frontage of approximately 310 m along Borrisokane Road. Based on the Ministry of Natural Resources and Forestry database, the following information has been provided for the pit:

- ❏ Site ID: 4074
- ❏ Approval Type: Class A Licence
- ❏ Operation Type: Pit
- ❏ Max. Annual Tonnage: 350,000
- ❏ Licenced Area: 22.3 ha
- ❏ Location Name: n/a

4.2 City of Ottawa Official Plan

The subject site is designated General Urban Area on Schedule B - 'Urban Policy Plan' of the City's Official Plan. The properties north, south and east of the subject site are designated as General Urban Area and to the west as a Sand and Gravel Resource Area and Developing Community (Expansion Area).

Given the subject sites proximity to a designated Sand and Gravel Resource Area on Schedule A of the City's Official Plan, the proposed residential development is required to adhere to restrictions outlined in Policies 10, 11, 12 and 13 of Section 3.7.4 of the City's Official Plan - Development Restriction on Adjacent Lands listed below.

***Policy 10**:*
Limited types of new development may be approved within 500 metres of a Bedrock Resource Area or within 300 metres of a Sand and Gravel Resource Area, provided such development does not conflict with future mineral aggregate extraction.

Policy 11:
Where there is an existing licensed pit or quarry, development may be approved within the area of potential impact, referenced in policy 10, where an impact assessment study is completed and demonstrates that the mineral aggregate operation, including future expansion in depth or extent, will not be affected by the development.

***Policy 12**:*
The Ministry of Natural Resources will be consulted in review of studies necessary.

***Policy 13**:*
Where the City approves the development of land in accordance with policies above, the City may impose conditions to ensure the development provides adequate buffering and/or separation between the new proposed use and the mineral aggregate area/operation.

4.3 Provincial Standards - Aggregate Resources of Ontario

The existing sand and gravel pit northwest of the subject site is currently being developed as an open pit. For the purpose of this report, it is understood that the future development of the sand and gravel pit will be on the basis of a licence for a pit to extract resources to an elevation below the water table (Category 1 Licence - Class "A" pit below water).

Based on the Operational Standards Section of the Aggregate Resources of Ontario: Provincial Standards, Version 1.0, excavation setbacks are required for all licenced mineral aggregate operations. Excavation setbacks are defined in **Section 5.10** of the Operational Standards for a Category 1 Licence as the following:

> ***5.10.1*** fifteen metres from the boundary of the site;
> ***5.10.2*** thirty metres from any part of the boundary of the site that abuts:
> ***5.10.2.1*** a highway,
> ***5.10.2.2*** land in use for residential purposes at the time the licence was issued, or
> ***5.10.2.3*** land restricted to residential use by a zoning by-law when the licence was issued; or
> ***5.10.3*** thirty metres from any body of water that is not the result of excavation below the water table; "

Based on Section 5.10 of the Operational Standards for a Category 1 Licence, a minimum setback of 15 m will be required from the property boundary of the pit operation along the western and northern border of the proposed residential development. It is understood that the 15 m setback will be applied on the adjacent owner's land.

5.0 Compatibility and Mitigation Analysis

Based on recent discussions with the Owner of the Costello Pit (Drummond Pit), it is understood that the aggregate resource located at 3713 Borrisokane Road and adjacent to the northwest property boundary of the proposed residential development is currently in operation and is expected to continue for 2 years. It is understood that mineral extraction at the Brazeau Pit has ceased, and that the Brazeau Pit has been purchased for a future development. Therefore, although the former Brazeau Pit is identified on site plans, it is no longer a concern for this assessment.

An existing residential development is located to the east of the two aforementioned sand and gravel pits. It should be noted that the Costello Pit is already impacted by the adjacent land uses of the existing residential development. Therefore, the proposed development will not add to the additional burden on the continued operation of the sand and gravel pit.

5.1 Noise

Both a transportation noise source study and a stationary noise source study was completed for Half Moon Bay Phase 5 by Valcoustics Canada Ltd and can be found in Appendix 2. A summary of the report has been provided below.

Brazeau Pit

Information included in the noise impact assessment indicates that the Brazeau Pit has completed the above water table extraction of the eastern portion of the pit. It is further understood that the working face is currently at about the midpoint of the site, heading west. At the time of writing the report, it was unknown if below the water table extraction was to be completed. The conservative approach would be to assume that below water extraction may occur in the future. Due to the anticipated noise levels generated by the continued extraction on the Brazeau Pit, mitigation measures will be required for dwellings in close proximity to this pit. Based on the analysis, a sound barrier may be constructed to reduce the noise levels to an acceptable limit, but would need to be unreasonably high. Therefore, it was proposed that the first row of dwellings to the south and east of the Brazeau Pit be held, in addition to the construction of sound barriers that range in height from 4.5 m to 9 m. Once the operations at the pit have been completed, the sound barrier requirement can be removed and the dwellings on hold can be constructed.

Drummond (Costello) Pit

Information included in the noise impact assessment indicates that the Drummond (Costello) Pit has sufficient aggregate for approximately 5 additional years of operation. Therefore, it is assumed that this pit is nearing the end of their operations. Additionally, it was noted that all extraction along the western portion has been completed and has been rehabilitated. For the noise analysis, a worst case scenario was devised in order to obtain a conservative result. This scenario indicates that the noise levels of the closest dwellings to Drummond (Costello) Pit will be exceeded, requiring sound mitigation measures to be implemented. However, provided the noise mitigation measures outlined for the Costello Pit are abided by, no additional mitigation measures will be required.

Summary of the Stationary Noise Analysis

At the time of issuance of this report, it is understood that the Brazeau Pit is no longer operational. Therefore, all noise sources derived from this pit are no longer impacting the development. However, the recommendations for the noise from the Drummond (Costello) pit mirror the recommendations for the Brazeau Pit.

It is noted that these noise mitigation measures (sound barriers and a hold on building lots) are limited to Phase 7. Therefore, a 4.5 m high noise barrier will be required to be constructed along Phase 7 as prescribed in the aforementioned reports to reduce the noise levels within Phase 5. However, there will be no holds on any lots within the Phase 5 development. The designation between Phase 7 and Phase 5 can be viewed on the Half Moon Bay site plan included in Appendix 2.

It should be noted that once the Drummond (Costello) Pit has ceased its mineral extraction, similar to the Brazeau Pit, that the stationary noise source will be eliminated and all noise mitigation measures prescribed (the hold on building lots in addition to the 4.5 m high noise barrier and existing soil berm) will no longer be required.

5.2 Traffic

It is understood that the current truck route for the operation at the Costello Pit and Todd Pit is Borrisokane Road and will continue utilizing the road for future operations, while the proposed residential development will be accessed primarily from the realigned Greenbank Road. It should be noted that the proposed development is not anticipating to have any frontage along Borrisokane Road. As such, the additional traffic generated by the proposed development will not preclude or hinder future pit operations, nor will truck traffic generated by the pit operation interfere with the proposed development. Therefore, no potential compatibility impacts are anticipated between the proposed residential development and the current and future operation of the Costello Pit or Todd Pit.

The traffic report prepared by CGH, and presented in Appendix 2, do not indicate any conflict with the current or future traffic to hinder future pit operations.

5.3 Dust

A Dust impact assessment was completed by Golder Associates Ltd and can be referenced in Appendix 2. This report indicates that the estimated dust emissions are below the Schedule 3 TSP limit at the adjacent property boundary of the proposed residential development. Therefore, provided that the resource pits continue to operate in a similar manner and they implement their BMP Plan to minimize dust migration off-site, the levels are anticipated to remain at acceptable levels. Therefore, additional dust mitigation measures for the current and future operations of the sand and gravel pits will not be required.

5.4 Vibration

It is understood that current and future operations for the sand and gravel pits will not require blasting for excavation purpose. As a result, sources of vibration from the operation are limited to hauling and excavation equipment only, and have minimal impact on the proposed residential development. Similarly, blasting will not be required for excavation purposes during the construction stages of the proposed residential development, as such, sources of vibrations will be limited to oversized vehicles and construction equipment. Therefore, additional vibration mitigation measures will not be required for the sand and gravel pit or the proposed residential development as the potential impact of vibrations will be minimal.

5.5 Groundwater

It is understood that the subject site will be connected to municipal water and sewer services and will not adversely impact the groundwater levels of the current and future operations of the sand and gravel pit. Based on recent discussions with the Owner of the Brazeau Pit, excavation work below the groundwater table was completed in select areas of the deposit and may continue in the future. Based on the Operation Plan of the Costello Pit and Todd Pit attached to the current report, it is understood that the long-term groundwater level is expected to be at a geodetic elevation of approximately 95 m. The owner noted that excavation methods below the groundwater table at the sand and gravel pit consists of dredging techniques. Due to dredging techniques implemented at the sand and gravel pit, the operation will not adversely impact the groundwater levels within the proposed residential development.

6.0 Conclusions

Based on the technical studies relating to noise and dust by others, as well as Paterson's review of the subject site, the proposed residential development will not negatively impact the current and future operation of the aggregate resource pit. Provided that the sound mitigation measures outlined in the Stationary Noise Source Study Report, prepared by Valcoustics Canada Inc and is located in Appendix 2, any excessive noise will be mitigated to acceptable levels and should not negatively impact the proposed development. However, all houses within the 300 m area of influence should contain the following warning clause:

> "Purchasers are advised that due to the proximity of the adjacent gravel pit operations, sound from the gravel pits may, at times, be audible"

It is expected that the operation of the aggregate resource pit will continue to adhere to the Aggregate Resources of Ontario Provincial Standards, Version 1, as well as the adjacent property owners.

7.0 Statement of Limitations

The recommendations provided in this report are in accordance with our present understanding of the project.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Mattamy Homes, or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

February 11, 2019

Stephanie A. Boisvenue,P.Eng.

David J. Gilbert, P.Eng.

Report Distribution:

- ❑ Mattamy Homes (3 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

DRAWING PG4803-2 - Existing Conditions

Historical Aerial Photographs

Aggregate Resource - Drummond (Costello) Pit

Aggregate Resource - Brazeau Pit

The Base Mapping Co. Ltd.- Existing Features Plan - Costello Pit - Project No. C 419-90 - Page No. 1 of 2 - Revision 1 dated September 9, 1996

The Base Mapping Co. Ltd. - Operation and Rehabilitation Plan - Costello Pit - Project No. C 419-90 - Page 2 of 2 - Revision 2 dated May 17, 1999

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NO.	REVISIONS	DATE	INITIAL
0			

MATTAMY HOMES

MINERAL RESOURCE IMPACT ASSESSMENT
HALF MOON BAY SOUTH - PHASE 5

OTTAWA, ONTARIO

Title:

EXISTING CONDITIONS

Scale: 1:7500	Date: 02/2019
Drawn by: RCG	Report No.: PG4803-2
Checked by: SB	Dwg. No.: **PG4803-2**
Approved by: DJG	Revision No.: 0

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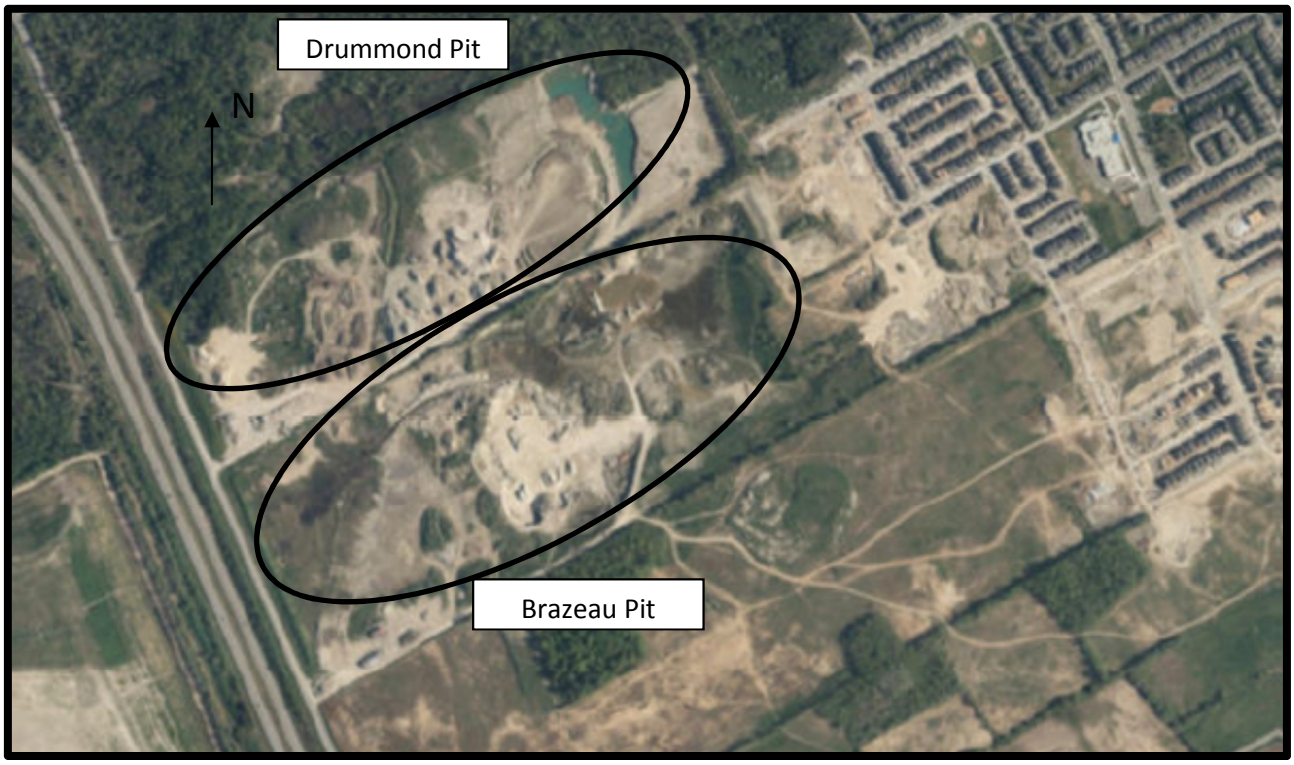


FIGURE 1

HISTORICAL PHOTOGRAPH - 2017

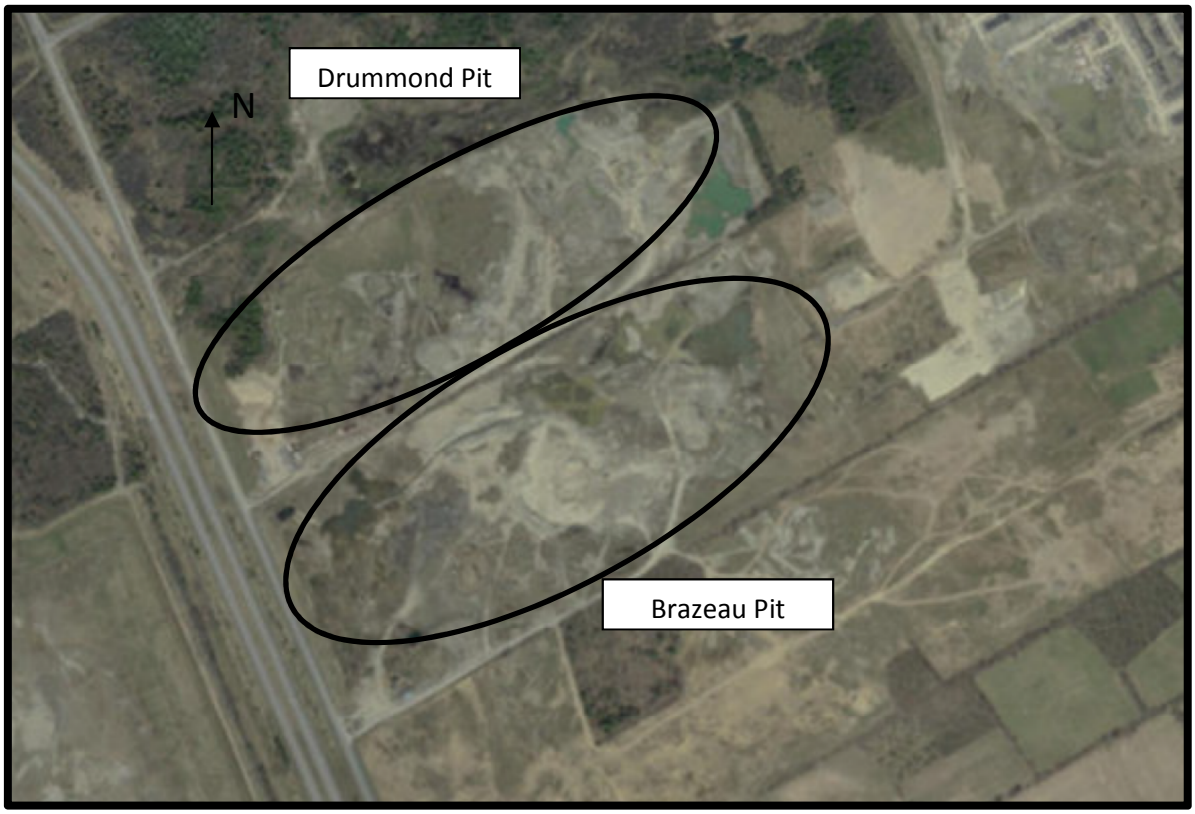


FIGURE 2

HISTORICAL PHOTOGRAPH - 2014

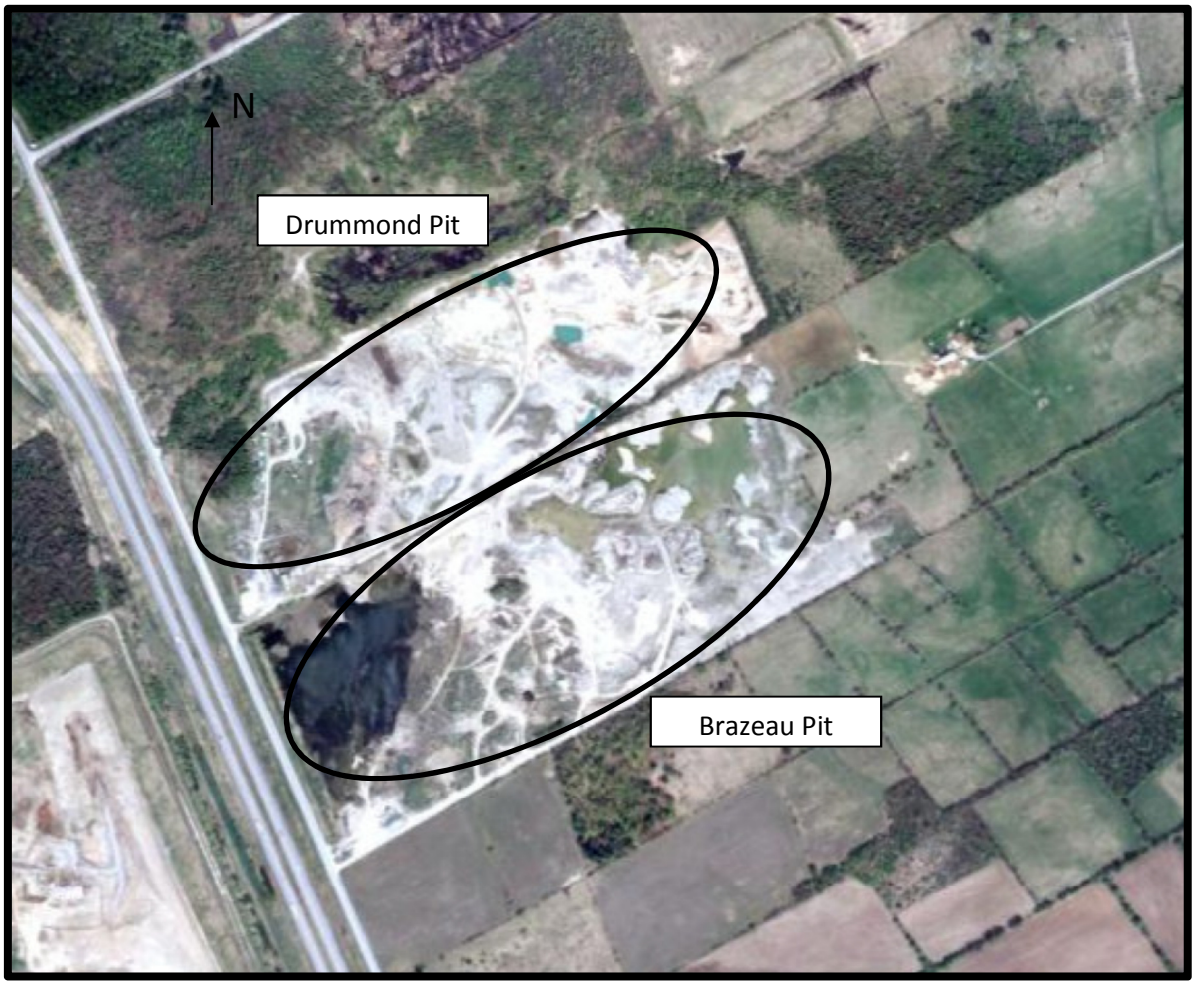


FIGURE 3

HISTORICAL PHOTOGRAPH - 2008

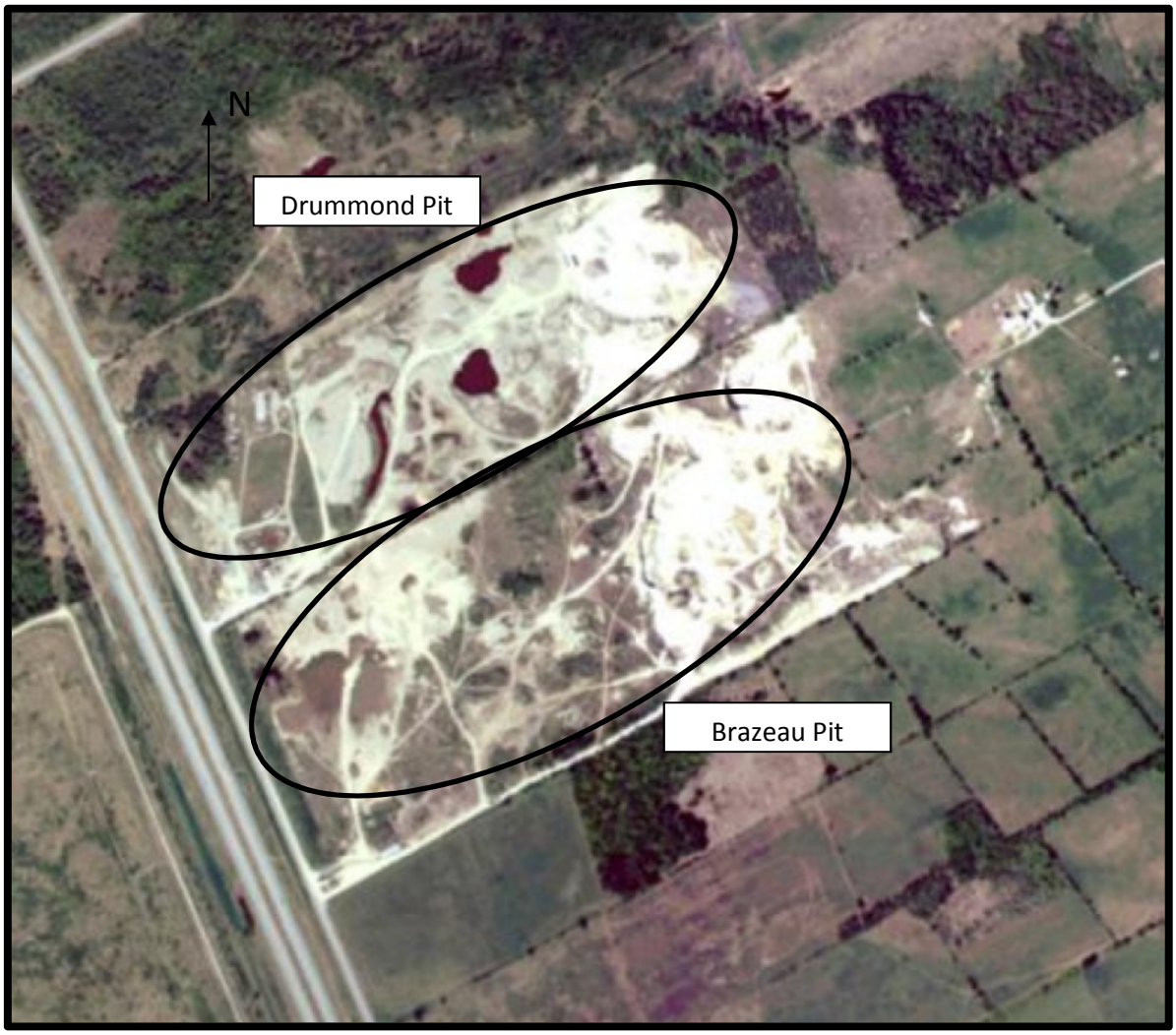


FIGURE 4

HISTORICAL PHOTOGRAPH - 1999

Ontario

PRINT

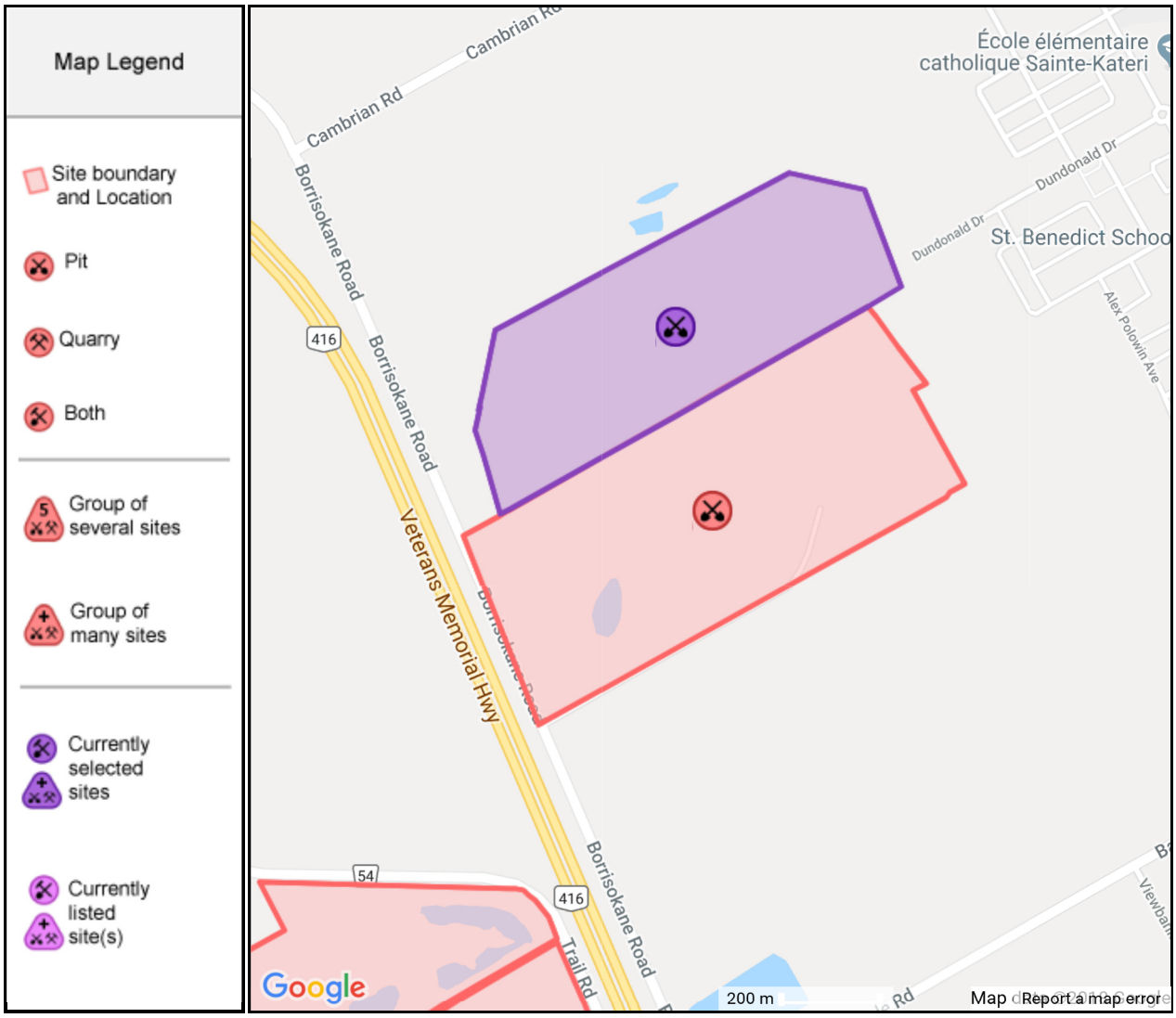
Search Criteria

Geographic Location: Cluster selected. Centre of map is: -75.747927°N,45.237616°W

Approval Type: Class A Licence-or-Class B Licence-or-Aggregate Permit-or-Wayside Permit-or-MTO Permit

Operation Type: Pit-or-Quarry

Search Results (1)



Site ID	Client Name	Approval Type	Operation Type
4074	George W. Drummond Limited	Class A Licence	Pit
	Location Name	**Max. Annual Tonnage**	**Licenced Area (ha)**
		350000	22.3

Created on Friday, May 18, 2018

Ontario

PRINT

Marcel Brazeau Limited

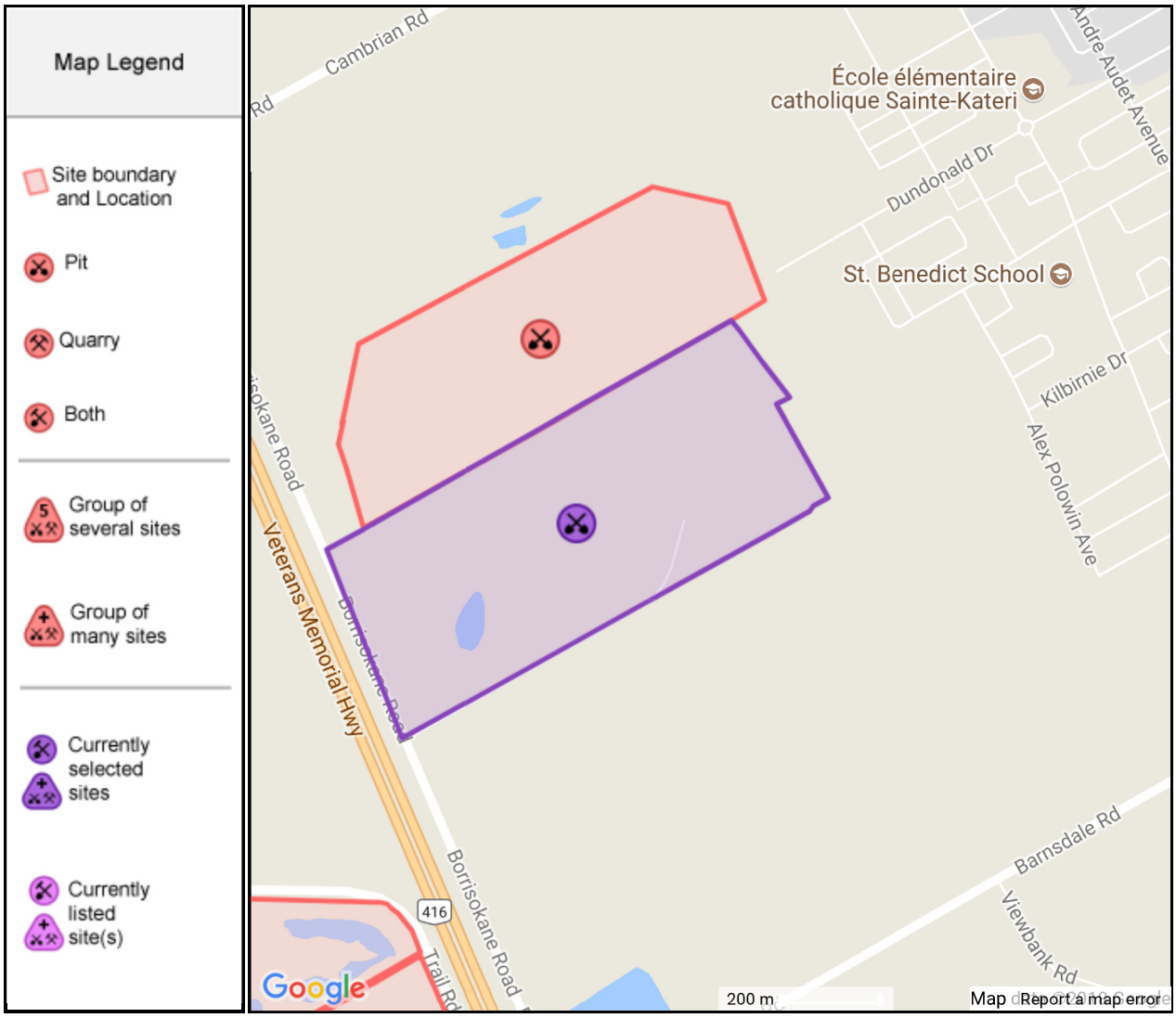
Search Criteria

Geographic Location: Cluster selected. Centre of map is: -75.744434°N,45.237844°W

Approval Type: Class A Licence-or-Class B Licence-or-Aggregate Permit-or-Wayside Permit-or-MTO Permit

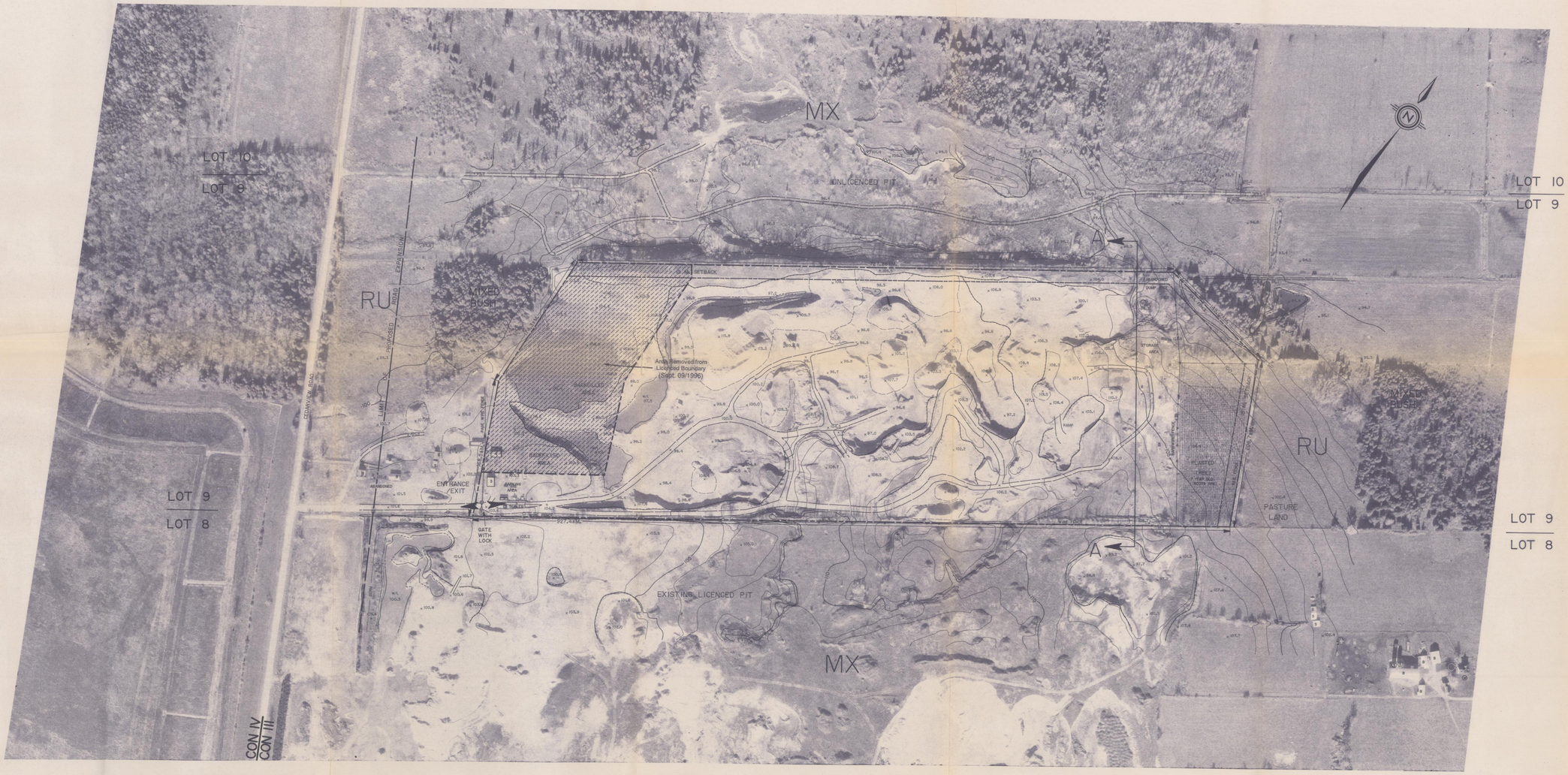
Operation Type: Pit-or-Quarry

Search Results (1)



Site ID	Client Name	Approval Type	Operation Type
4219	Marcel Brazeau Limited	Class A Licence	Pit
	Location Name	**Max. Annual Tonnage**	**Licenced Area (ha)**
		300000	43.7

Created on Monday, May 14, 2018



EXISTING FEATURES

Property licenced for pit operation as designated under the authority of the Aggregate Resources Act 1989.

A pit area presently exists on the majority of the licenced area. Natural drainage of the property is by seepage into the soil and surface drainage to the east.

A weigh scale, garage, office and barn all present on the site near the entrance/exit to the pit.

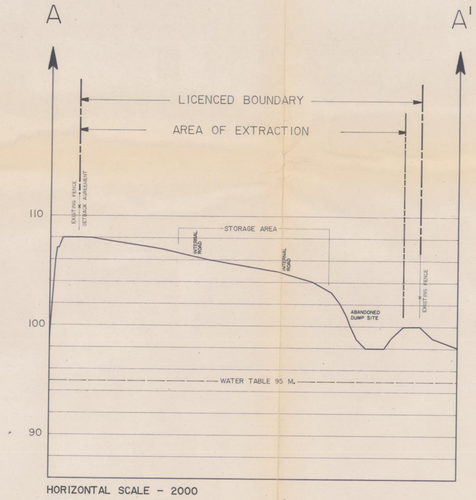
Fencing is not required along the north boundary. Fencing and setback is not required along the south boundary as there exists a boundary agreement between Brazeau and George W. Drummond Ltd., owners of the two properties in concern.

There is no setback along the west boundary as the adjacent property is owned by George Drummond.

A tree plantation of 7 year old Scots pine exists on the licenced property located at the east end. This area has been leased out by Drummond until 2002.

INDEX OF SITE BUILDINGS

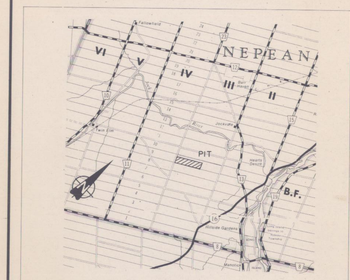
	Classification	Area (m²)
1.	Weigh Scale Office	12.8
2.	Office Trailer	25.0
3.	Storage Garage	109.6
4.	Barn	98.6



HORIZONTAL SCALE - 2000
VERTICAL SCALE - 200

M.O.E. Well Water Data 1991 (in metres)

Con.	Lot	Well No.	Elevation Ft.	Water Found	Static Water Level
III	8	15-6040	97m	20.4	6.4



KEY MAP CITY OF NEPEAN

EXISTING FEATURES

NOTES

	Revision Values as of Sept. 09/1996
1. LICENCED AREA 27.5 ± HECTARES.	23.5 ± ha
2. AREA OF OPERATION 25.8 ± HECTARES.	22.3 ± ha
3. EXISTING DISTURBED AREA 22 ± HECTARES.	20.5± ha.

4. THIS SITE PLAN IS PREPARED FOR SUBMISSION TO THE MINISTRY OF NATURAL RESOURCES IN CONJUNCTION WITH AN APPLICATION FOR A CLASS 'A' LICENCE UNDER THE AGGREGATE RESOURCES ACT & REGULATIONS.
5. THIS PLAN WAS PREPARED USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS.
6. LOT, CONCESSION AND BOUNDARY LINES ON THIS PLAN ARE APPROXIMATE.
7. THIS IS NOT A LEGAL SURVEY DRAWING IN ACCORDANCE WITH THE PROVINCE OF ONTARIO SURVEYORS ACT 1987.

OFFICE COPY

COSTELLO PIT

ARA No. 4074

PART OF LOT 9, CONCESSION III
CITY OF NEPEAN

GEORGE W. DRUMMOND LIMITED
30 RIDEAU HEIGHTS DRIVE
NEPEAN, ONTARIO K2E 7A6

LEGEND

- BOUNDARY OF AREA TO BE LICENCED
- LIMIT OF EXTRACTION (SETBACK LINE)
- ENTRANCE AND OR EXIT
- PIT/QUARRY FACE EXISTING/PROPOSED
- STOCKPILE: EXISTING/PROPOSED
- DIRECTION OF OPERATION AND PHASE
- WELL
- STANDING WATER
- TEST HOLE
- BUILDING: S-SILO, H-HOUSE, G-GARAGE B-BARN, S-SHED.
- FENCE/GATE
- ROAD: PAVED, UNPAVED
- RAILWAY
- POLE: HYDRO/TELEPHONE
- HYDRO TOWER
- LAKE/POND
- WATERCOURSE: DOUBLE, SINGLE, FLOW ARROW
- BRIDGE, CULVERT
- MARSH
- EXISTING CONTOURS
- PROPOSED CONTOURS
- SPOT ELEVATION
- BUSH: DECIDUOUS/CONIFEROUS
- EXISTING BERM
- PROPOSED BERM
- CROSS SECTION
- Area Removed from Licenced Boundary

PHOTO SCALE	ROLL No.	EXPOSURE No.	LINE No.	PHOTO DATE
1:15000	90066	37-39	1	NOV. 1990
MAP SCALE 1:2000	CONTOUR INTERVAL 1 METRE	DATE OF SITE PLAN DEC. 1990		

0 50 100 150 metres

AMENDMENTS	DATE
Modified licenced boundary and corresponding calculations and notes.	Sept. 09, 1996

SITE PLANS APPROVED BY MINISTRY OF NATURAL RESOURCES
SIGNATURE
DATE Sept 17/96

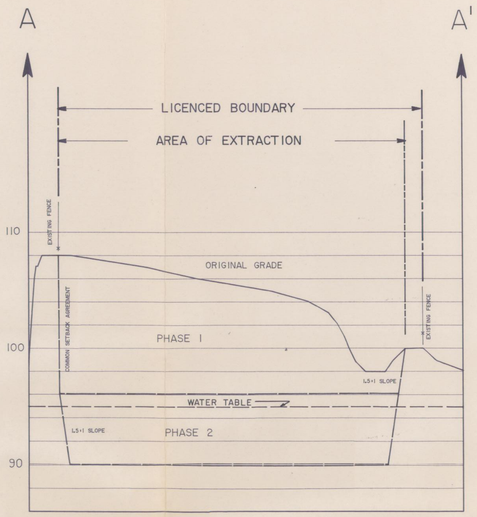
PAGE 1 of 2 | CONTRACT C 419 - 90

THIS IS NOT A CERTIFIED COPY UNLESS EMBOSSED WITH SEAL

THE BASE MAPPING CO. LTD.
UNIT 37 - 81 AURIGA DRIVE, NEPEAN, ONTARIO K2E 7Y3
(613) 723-8100 FAX: (613) 723-8569

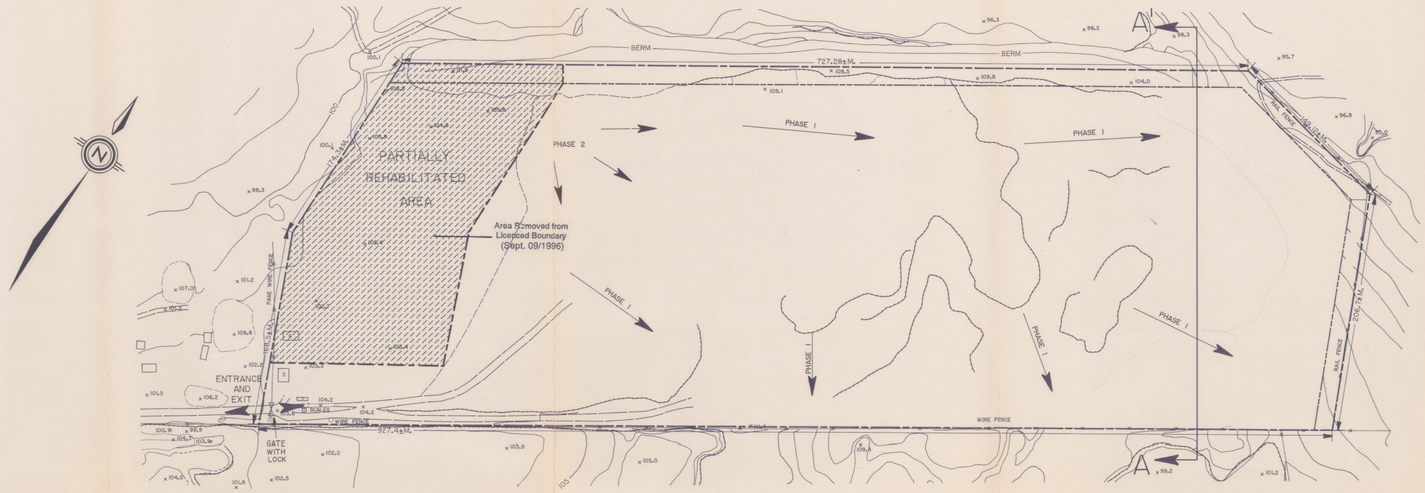
D. Lebrash
SEP 10 1996

OPERATION PLAN



HORIZONTAL SCALE - 2000

VERTICAL SCALE - 200



GENERAL

The pit will operate in accordance with the Aggregate Resources Act 1989.

Fencing and setback is not required along the south limits of the pit as agreed upon by Marcel Irazeau (pit owner to the south of Drummond) and George W. Drummond Ltd. Fencing is also not required for the north boundary. Various locations, where fences need not be established, have been agreed upon by the Ministry of Natural Resources.

The entrance/exit to the pit has a gate with a lock on it.

The entrance/exit to the pit is from Cedarview Road.

There exists no limitations to the types or location of excavation equipment which may operate on the site. All machinery is equipped with noise and dust suppressors.

Information pertaining to water wells is indicated on the Existing Features Plan.

Product stockpiles are stored within the confines of the limit of extraction.

Recycling of asphalt is permitted within the extraction limits. Area for recycling will be kept 10 metres from any open water.

The tree plantation area lease, upon its expiry date, will be subject to mining activity. Operation of this area will fall into regular mining phases as described within the Operation notes.

OPERATION

The licenced pit hectarage will be mined in two phases of operation. Phase 1 above water table, Phase 2 below water table.

Phase 1 mining is active, operating to a depth of approximately 95 metres as indicated on the Operation Plan. Direction of operation moves from the west towards the east.

Phase 2 mining will follow the Phase 1 mining pattern beginning from the westerly limits of the licenced property and proceeding in a easterly direction, as indicated on the Operation Plan.

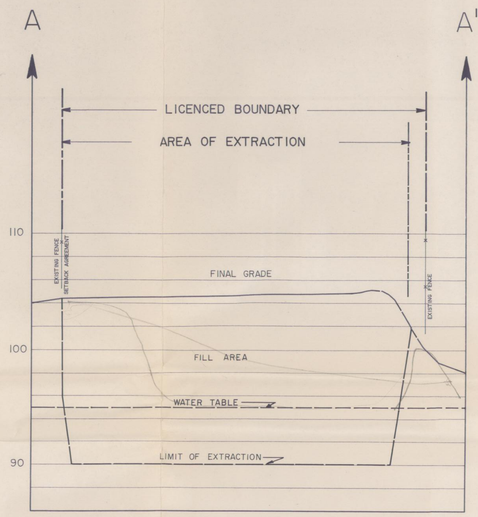
Phase 2 will begin mining operation upon completion of Phase 1. Mining will be below the water table. Extraction of the material will be by dragline methods. No pumping or letting of water will be needed. Final operation depth will be approximately 90 metres.

Amendment – April 29/99

Import topsoil to process for resale.

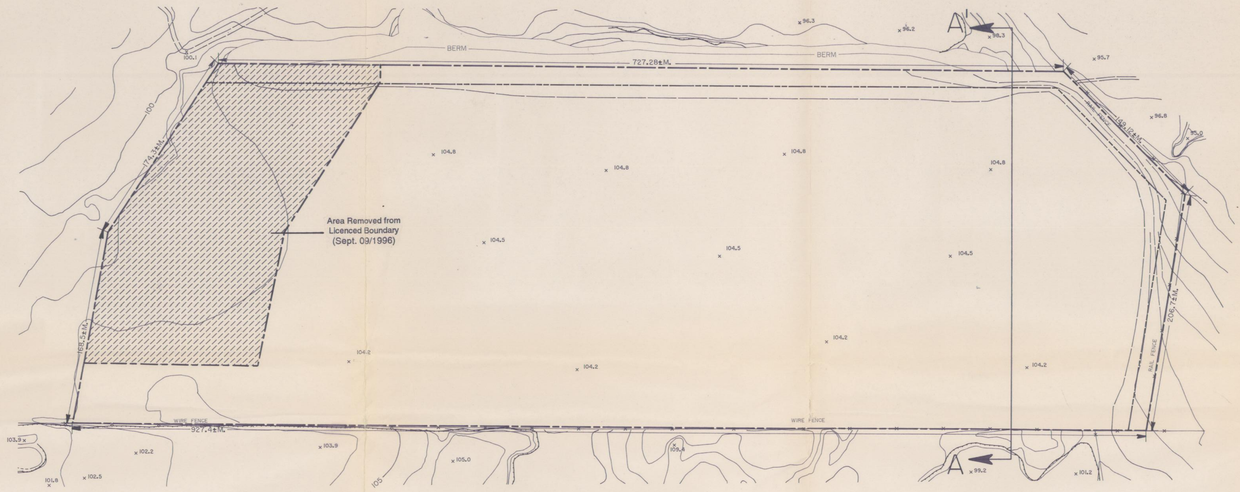
To allow Phases 1 & 2 to operate concurrently and simultaneous in various locations due to the differently quality of material throughout the site and also the high concentration of clay ridges.

PROGRESSIVE REHABILITATION AND FINAL REHABILITATION PLAN



HORIZONTAL SCALE - 2000

VERTICAL SCALE - 200



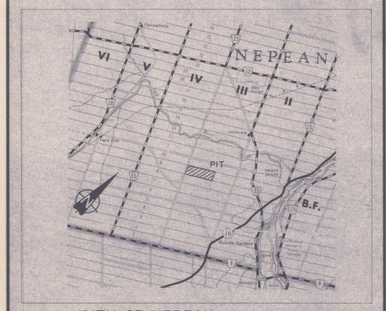
REHABILITATION

Maximum hectarage to be rehabilitated is approximately 22.3 hectares. Progressive rehabilitation will be carried out on the site. In the general this would be carried out by filling from a westerly to easterly direction.

The pit will be backfilled with acceptable inert material. The final site elevation will be approximately 104 metres, sloping slightly to the south, as indicated on the Rehabilitation Plan. The sloped surface will then be sewn with a grass legume mixture.

Adequate soil would be spread on the site to facilitate an adequate growth for grass legume mixture.

The site can then be adequately utilized for building development or pasture.



KEY MAP CITY OF NEPEAN

OPERATION & REHAB. PLANS

NOTES

	Revision Values as of Sept. 09/1996
1. LICENCED AREA 27.5± HECTARES.	23.5 ± ha
2. AREA OF OPERATION 25.9± HECTARES.	22.3 ± ha
3. EXISTING DISTURBED AREA 16.4± HECTARES.	16.4 ± ha

4. THIS SITE PLAN IS PREPARED FOR SUBMISSION TO THE MINISTRY OF NATURAL RESOURCES IN CONJUNCTION WITH AN APPLICATION FOR A CLASS 'A' LICENCE UNDER THE AGGREGATE RESOURCES ACT & REGULATIONS.
5. THIS PLAN WAS PREPARED USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS.
6. LOT, CONCESSION AND BOUNDARY LINES ON THIS PLAN ARE APPROXIMATE.
7. THIS IS NOT A LEGAL SURVEY DRAWING IN ACCORDANCE WITH THE PROVINCE OF ONTARIO SURVEYORS ACT 1987.

COSTELLO PIT

ARA No. 4074

PART OF LOT 9, CONCSSION III

CITY OF NEPEAN

GEORGE W. DRUMMOND LIMITED
30 RIDEAU HEIGHTS DRIVE
NEPEAN, ONTARIO K2E 7A6

LEGEND

- BOUNDARY OF AREA TO BE LICENCED
- LIMIT OF EXTRACTION (SETBACK LINE)
- ENTRANCE AND OR EXIT
- PIT/QUARRY FACE EXISTING/PROPOSED
- STOCKPILE: EXISTING/PROPOSED
- DIRECTION OF OPERATION AND PHASE
- WELL
- STANDING WATER
- TEST HOLE
- BUILDING: S-SILO, H-HOUSE, G-GARAGE, B-BARN, S-SHED.
- FENCE/GATE
- ROAD: PAVED, UNPAVED
- RAILWAY
- POLE: HYDRO/TELEPHONE
- HYDRO TOWER
- LAKE/POND
- WATERCOURSE: DOUBLE, SINGLE, FLOW ARROW
- BRIDGE, CULVERT
- MARSH
- EXISTING CONTOURS
- PROPOSED CONTOURS
- SPOT ELEVATION
- BUSH: DECIDUOUS/CONIFEROUS
- EXISTING BERM
- PROPOSED BERM
- CROSS SECTION
- Area Removed from Licenced Boundary

PHOTO SCALE	ROLL No.	EXPOSURE No.	LINE No.	PHOTO DATE
1:15000	90066	37-39	1	NOV. 1990
MAP SCALE	CONTOUR INTERVAL	DATE OF SITE PLAN		
1:2000	1 METRE	DEC. 1990		

0 50 100 150 metres

AMENDMENTS	DATE
Modified licenced boundary and corresponding, calculations and notes.	Sept. 09, 1996
See amendment dated April 29/99	May 17/99

SITE PLANS APPROVED BY MINISTRY OF NATURAL RESOURCES.

SIGNATURE DATE

PAGE 2 of 2	CONTRACT C 419 - 90

THIS IS NOT A CERTIFIED COPY UNLESS EMBOSSED WITH SEAL

THE BASE MAPPING CO. LTD.

SEP 10 1996

UNIT 37 - 81 AURIGA DRIVE, NEPEAN, ONTARIO K2E 7V3
(613) 723 - 8100 FAX: (613) 723 - 8569

APPENDIX 2

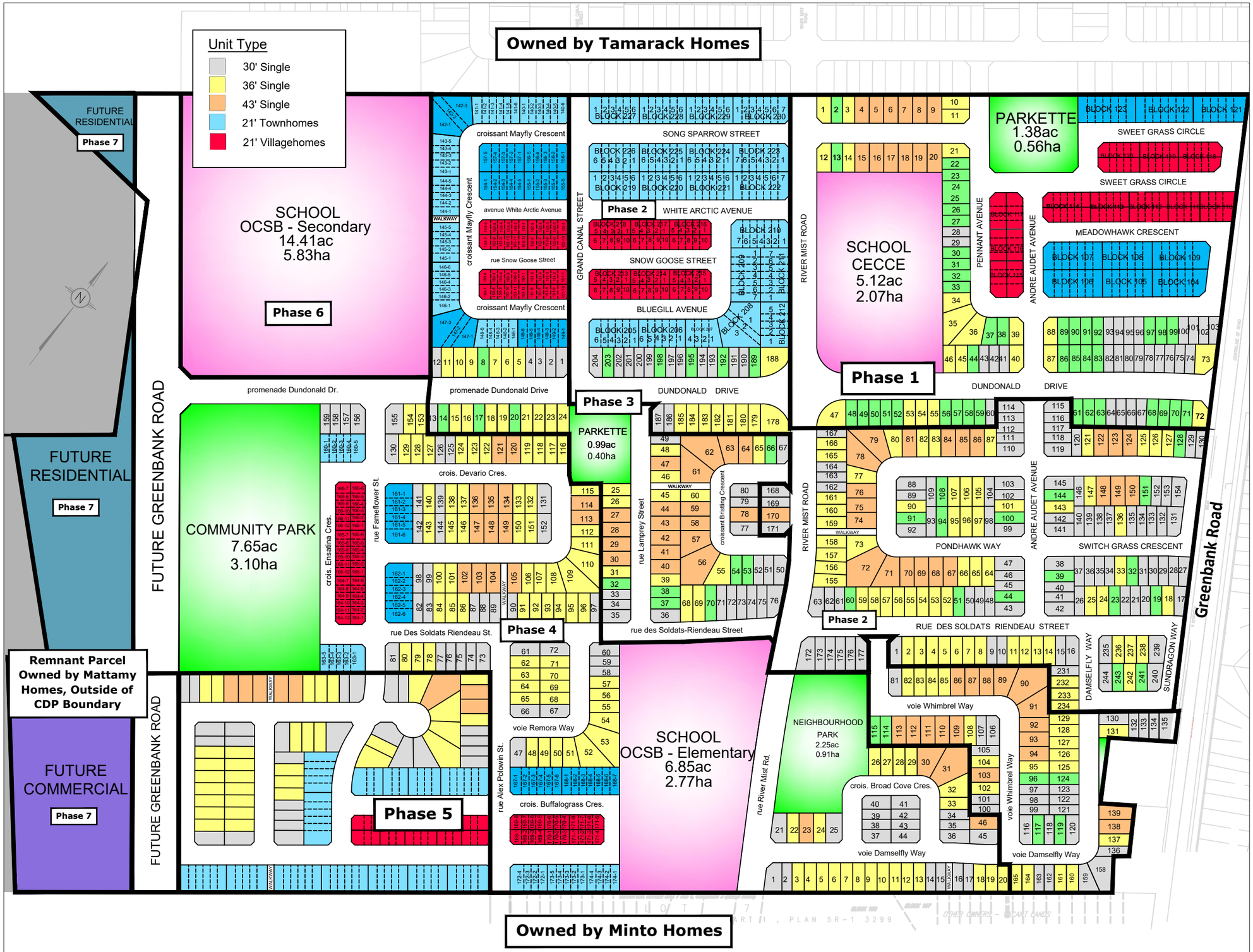
Half Moon Bay South - Site Layout dated February 11, 2019

Valcoustics Canada Ltd - Stationary Noise Source Study - Half Moon Bay South and Quinn's Pointe Stage 2 - Project 118-0052 dated May 3, 2018

Valcoustics Canada Ltd - Traffic Noise Assessment - Half Moon Bay South Phase 5 - Project 108-363-300 dated February 1, 2019

Golder Associates Ltd. - Assessment of Dust Impacts from Aggregate Pits on Minto Communities Canada and Mattamy Homes Proposed Developments - Minto and Mattamy Dust Study - Project 1897372 - dated March 2018

CHG Transportation - 3718 Greenbank Road – Half Moon Bay South – Phase 5 Transportation Impact Assessment - Project 2018-32 dated January 2019



Half Moon Bay South

February 11, 2019

HMBS Phase 1 & 2 Lot Count

162	BTB Townhomes	(24.5%)
120	21' Townhomes	(18%)
58	23' Townhomes	(9%)
101	30' Singles	(15%)
29	30' Singles Corner	(4%)
63	34' Singles	(9.5%)
84	36 Singles	(13%)
10	36 Singles Corner	(2%)
34	43' Singles	(5%)
661	TOTAL	

HMBS Phase 3 Lot Count

44	BTB Townhomes	(17%)
38	21' Townhomes	(15%)
32	23' Townhomes	(12%)
36	30' Singles	(14%)
13	30' Singles Corner	(5%)
17	34' Singles	(6%)
45	36 Singles	(17%)
36	43' Singles	(14%)
261	TOTAL	

HMBS Phase 4 Lot Count

58	BTB Townhomes	(22%)
23	21' Townhomes	(9%)
25	23' Townhomes	(9%)
35	30' Singles	(12%)
22	30' Singles Corner	(8%)
84	36 Singles	(31%)
18	43' Singles	(9%)
265	TOTAL	

HMBS Phase 5 Lot Count

32	BTB Townhomes	(19%)
65	21' Townhomes	(40%)
16	30' Singles	(10%)
10	30' Singles Corner	(6%)
33	36 Singles	(21%)
8	43' Singles	(5%)
164	TOTAL	

HMBS Total Lot Count

297	BTB Townhomes	(22%)
247	21' Townhomes	(18%)
115	23' Townhomes	(9%)
186	30' Singles	(14%)
74	30' Singles Corner	(5%)
80	34' Singles	(6%)
247	36' Singles	(18%)
10	36' Singles Corner	(1%)
97	43' Singles	(7%)

Stationary Noise Source Study

Half Moon Bay South and Quinn's Pointe Stage 2

Proposed Residential Development

Greenbank Road South of Cambrian Road
City of Ottawa

May 3, 2018
Project: 118-0052

Prepared for

Mattamy Homes and Minto Developments

Prepared by

Anthony Amarra, M.Sc.

Reviewed by

John Emeljanow, B.Eng., P.Eng.

VALCOUSTICS
Canada Ltd.

Revision History

Revision #	Date	Comments
1.0	May 3, 2018	Issued to Client

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Stationary Noise Source Study

Half Moon Bay South and Quinn's Pointe Stage 2

Proposed Residential Development

Greenbank Road South of Cambrian Road
City of Ottawa

1.0 INTRODUCTION

1.1 PURPOSE

Valcoustics Canada Ltd. (VCL) has prepared this stationary noise source study for the proposed Mattamy Half Moon Bay South Phase 5 and Minto Quinn's Pointe Stage 2 residential developments in the City of Ottawa.

The potential sound levels and noise mitigation needed to comply with the Ministry of the Environment and Climate Change (MOE) stationary source noise guidelines are outlined herein.

1.2 SITE

The site is part of the Barrhaven South Urban Expansion Area, which is proposed to be developed mainly for residential dwellings. The proposed developments will include school blocks, neighbourhood parks, a commercial block, park & ride block, and storm water management facilities. The noise study was prepared using the Concept Plan.

The overall site is bounded by:

- Future (under construction) residential uses to the east (other lands within the Half Moon Bay South development);
- Existing aggregate extraction operations to the north and northwest; and
- Vacant lands to the west and south.

Figure 1 shows a Key Plan. Figure 2 shows the Site Plan.

Note, there is an existing berm to the east of Brazeau Pit. This existing berm is part of the noise mitigation recommended for northern portion of the Half Moon Bay South development (Phase 4). This berm overlaps with some of the low and medium-density blocks, as shown on Figure 3. It is

understood that the intent is for the berm to remain until the extraction and processing operations at the aggregate pits are completed.

2.0 ENVIRONMENTAL NOISE GUIDELINES

The applicable noise guidelines are those in MOE Publication NPC-300, *"Environmental Noise Guideline, Stationary and Transportation Sources – Approval and Planning"*. These guidelines address both transportation sources of sound as well as stationary noise sources.

NPC-300 is also referenced in the City of Ottawa Environmental Noise Control Guidelines.

2.1 MOE PUBLICATION NPC-300

NPC-300 defines a "stationary noise source" as sources of sound normally operated within the property lines of a facility, including on-site vehicle movements. Industrial and commercial facilities are considered stationary sources of sound. An aggregate extraction facility is specifically listed in NPC-300 as being a stationary noise source. The MOE sound level limits are summarized in Appendix A and discussed below.

For this study, the site is considered a Class 2 area due to the density of the adjacent developments as well as the proximity to nearby roadways (i.e. Greenbank Road).

The sound level limits for Class 2 areas are the higher of the ambient sound level or the minimum exclusion limits which are:

- 50 dBA during the daytime (between 0700 and 1900 hours) and evening (between 1900 and 2300 hours) and 45 dBA during the nighttime (between 2300 and 0700 hours) at an exterior plane of window; and

- 50 dBA during the daytime and 45 dBA during the evening at an outdoor point of reception.

2.2 CITY OF OTTAWA ENVIRONMENTAL NOISE CONTROL GUIDELINES

The 2016 City of Ottawa Environmental Noise Control Guidelines provide guidance on how to assess noise from stationary sources onto proposed noise-sensitive developments.

The guidelines reference MOE Publication NPC-300, which establishes the sound level limits based on the area class. Thus, the City of Ottawa requirements are consistent with the MOE requirements.

3.0 NOISE IMPACT ASSESSMENT

The stationary noise sources with the potential to adversely impact the proposed development are the existing (active) sand and gravel pits to the west of Future Greenbank Road. There are two areas licensed for extraction. The Brazeau Pit is immediately northwest of the proposed development, while the Drummond Pit is north of Brazeau Pit.

Staff of VCL previously met with the owners of the Brazeau and Drummond Pits on July 18, 2013. The purpose of the meetings was to obtain an understanding of the operations at both pits, to determine the predictable worst-case operations and to understand the areas that remain to be extracted.

Memorandums outlining the operations at the two pits (as discussed during the meeting) were prepared and circulated to the owners. These are included as Appendix B. To date, only the owners of Brazeau Pit have responded, indicating there could be up to 50 loads shipped in an hour occasionally.

3.1 METHOD

The noise analysis was done using CadnaA V4.6 environmental acoustics modelling software. The 3-D model follows the procedures of ISO 9613 Part 2.

Receptors representing the worst-case dwelling locations in the proposed development were chosen. The receptors were taken at a height of 4.5 m above grade for the exterior plane-of-window receptors, representing windows on the second storey, and 1.5 m above grade for the outdoor points of reception, representing the rear yards.

The noise sources were modelled as operating at the base of the extraction pits, at an elevation of approximately 97 m asl. This represents both the current and future operations, including below water table extraction.

3.2 BRAZEAU PIT

The Brazeau Pit has a Class A licence to extract up to 300,000 tonnes of aggregate per year.

Above water table extraction of the eastern portion of the Brazeau Pit has been completed. The working face is currently at about the midpoint of the site and is progressing westerly. It was also noted that below water table extraction is also permitted over the entire site. During the meeting with VCL staff, the operators were not certain whether below water table extraction would occur.

The operations that typically occur on the site are outlined in Appendix B. The information in Appendix B was also confirmed via phone calls in 2018. Note that the worst-case assessment has assumed that all operations, including below water table extraction could occur anywhere on the site (that has not already been extracted). It was also assumed that the processing plant and additional screens only operate during the daytime, and all other sources can operate at any time during the day, evening or night.

Typical maximum sound emission levels for the equipment was used based on experience as well as measurements performed during the on-site meeting. The emission levels for the Brazeau Pit are outlined in Table 1.

Detailed noise analyses of the worst-case gravel pit activities were done at the proposed dwellings closest to the gravel pits. Compliance with the noise guidelines at these receptors would inherently result in compliance at all dwellings within the proposed development.

3.2.1 Analysis Results

Figure 3 and Table 2 show the predicted unmitigated sound levels due to the worst-case operations at Brazeau Pit.

The sound levels exceed the MOE noise guideline limits by up to 21 dBA during the daytime and 18 dBA during the evening/nighttime at R13. This is due to the direct line of sight between the first row of dwellings and the pit.

The operational locations shown on Figure 3 represent the worst-case in terms of exposure of the dwellings to the sources.

3.2.2 Mitigation Requirements

Due to the significant excesses at the closest receptors, mitigation measures are required to comply with the MOE noise guideline limits.

To meet the noise guideline limits at the closest proposed dwellings to the Brazeau Pit, unreasonably high sound barriers are required.

To reduce the height of sound barrier required to a more reasonable level, portions of the site could be held until operations at Brazeau Pit have ended. Specifically, the portions that could be held are the first row of dwellings to the south and east of Brazeau Pit. This is in addition to the dwellings which overlap with the existing berm. Where dwellings are to be held, sound barriers could be constructed to provide sufficient screening for the remaining dwellings.

Figure 4 shows the extents and heights of the sound barriers. Table 3 summarizes the mitigated sound levels. Once operations at the pit have been exhausted, the sound barriers can be removed and the remaining dwellings constructed.

Note that the sound barrier must be of solid construction with no gaps, cracks or holes (except for small openings required for water drainage) and must have a minimum surface weight of 20 kg/m^2. A variety of materials are available, including concrete, wood, earthen berms or a combination of the above.

3.3 DRUMMOND PIT

The Drummond Pit has a Class A licence to extract up to 350,000 tonnes of aggregate per year. From discussions with the owner as of 2015, the pit has enough aggregate for approximately five more years of operation. Thus, this pit is nearing the end of operations on the site.

Extraction of the western portion of the Drummond Pit has been completed. In fact, the furthest western portion of the site has been removed from the licenced area and extraction there is no longer permitted. The remaining portion of the western part of the pit has been rehabilitated. Thus, the only active area is at the eastern end of the site. Extraction is still occurring in the (original) setback along the northern boundary of the site. The other area where extraction could occur is the southeastern corner of the site.

The operations that typically occur on the site are outlined in Appendix B. Note that the worst-case assessment has assumed that all operations, including below water table extraction, could occur anywhere on site. As in the Brazeau Pit, it was also assumed that the processing plant does not need to operate during the nighttime period; all other sources were assumed to operate at any time of the day, evening or night.

3.3.1 Analysis Results

Figure 5 and Table 4 show the predicted unmitigated sound levels due to the worst-case operations at Drummond Pit. Since Drummond Pit is significantly further from the proposed dwellings compared to Brazeau Pit, the noise guideline limits are met at all locations except R13 and R14. However, assuming the mitigation for Brazeau Pit is implemented (i.e. these dwellings are held until extraction and processing at the pits is completed), then the excesses at these receptors would also be addressed.

4.0 DISCUSSION

The results outlined above indicate that the noise guideline limits from worst case operations will be exceeded at the closest dwelling units within the proposed development. The only activity assumed to not occur at night is the processing of aggregate. All other activities, which include extraction (both above and below water table), material movement, loading of shipping trucks and the movement of shipping trucks, are assumed to occur at night. If processing were permitted at night, additional noise mitigation would need to be incorporated into the gravel pit operations since the sound levels would exceed the applicable guideline limits at the dwellings currently under construction to the north. Mitigation measures implemented for the gravel pits to comply at the dwellings to the north could also benefit the proposed dwellings to the south.

It must also be noted that the proposed dwellings are exposed to the Future Greenbank Road. This road will eventually carry significant road traffic volumes and will have dedicated bus lanes. Using ultimate traffic volumes for Future Greenbank Road (AADT of 35,000), the minimum daytime ambient sound level at the dwellings east of Greenbank Road is predicted to be 66 dBA at R01 and R05, and 64 dBA at R03 and R04 during the daytime. This is higher than the sound levels due to Brazeau Pit.

It is recognized that it may take a considerable amount of time for the road traffic on Future Greenbank Road to reach the ultimate volume. However, if half the ultimate volume were used, the minimum sound levels would only be reduced by 3 dBA; if one quarter of the ultimate volume were used, the minimum predicted sound levels would be reduced by 6 dBA. These sound levels are still higher than the predicted sound levels from the gravel pit operations.

5.0 CONCLUSIONS

A detailed assessment of the noise impact from the gravel pit operations onto the proposed Mattamy Half Moon Bay South Phase 5 and Minto Quinn's Pointe Stage 2 residential development has been completed. In accordance with the MOE requirements, a predictable worst-case scenario was assessed.

The results of the stationary noise impact assessment indicate that, with the mitigation measures outlined above, the MOE noise guideline limits will be met at all dwellings. Future homeowners within approximately 300 m of the property line of the licensed gravel pits should be made aware of the potential noise situation by including the following warning clause in all Offers of Purchase and Sale and by registering it on title:

> *"Purchasers are advised that due to the proximity of the adjacent gravel pit operations, sound from the gravel pits may, at times, be audible".*

6.0 REFERENCES

1. "Environmental Noise Guidelines, Stationary and Transportation Sources – Approval and Planning", Ontario Ministry of the Environment and Climate Change, Publication NPC-300, October 2013.

2. "Environmental Noise Control Guidelines", City of Ottawa Planning and Growth Management Department, January 2016.

AA/JE/tk
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TABLE 1

EQUIPMENT SOUND EMISSION LEVELS

Equipment	Sound Emission Level (dBA) at 15 m Reference Distance
BRAZEAU PIT	
Front End Loader	75
Excavator	80
Processing Plant	91
Screen	75
Shipping Trucks	78
DRUMMOND PIT	
Front End Loader	75
Excavator	70
Processing Plant	91
Shipping Trucks	78

TABLE 2

BRAZEAU PIT – PREDICTED UNMITIGATED SOUND LEVELS

Receptor	Description	Time Period	Predicted Sound Level (dBA)(1)	Performance Limit (dBA)	Compliance with Performance Limit?
R01	West-facing window on the dwelling to the east	Daytime	54	50	NO
		Evening	48	50	YES
		Nighttime	48	45	NO
R02	Rear yard of dwelling to the east	Daytime	48	50	NO
		Evening	44	45	YES
		Nighttime	—	—	N/A(2)
R03	West-facing window on the dwelling to the east	Daytime	51	50	NO
		Evening	47	50	YES
		Nighttime	47	45	NO
R04	West-facing window on the dwelling to the east	Daytime	50	50	YES
		Evening	47	50	YES
		Nighttime	47	45	NO
R05	West-facing window on the townhouse block to the east	Daytime	49	50	YES
		Evening	46	50	YES
		Nighttime	46	45	NO
R06	West-facing window on the dwelling to the south	Daytime	50	50	YES
		Evening	44	50	YES
		Nighttime	44	45	YES
R07	West-facing window on the dwelling to the south	Daytime	52	50	NO
		Evening	46	50	YES
		Nighttime	46	45	NO
R08	West-facing window on the dwelling to the south	Daytime	58	50	NO
		Evening	50	50	YES
		Nighttime	50	45	NO
R09	North-facing window on dwelling to the south	Daytime	70	50	NO
		Evening	60	50	NO
		Nighttime	60	45	NO
R10	North-facing window on dwelling to the south	Daytime	68	50	NO
		Evening	59	50	NO
		Nighttime	59	45	NO
R11	Rear yard of dwelling to the south	Daytime	70	50	NO
		Evening	60	45	NO
		Nighttime	—	—	N/A(2)
R12	Rear yard of dwelling to the south	Daytime	67	50	NO
		Evening	58	45	NO
		Nighttime	—	—	N/A(2)
R13	West-facing window of dwelling to the west of Future Greenbank Road	Daytime	71	50	NO
		Evening	63	50	NO
		Nighttime	63	45	NO
R14	Rear yard of dwelling to the west of Future Greenbank Road	Daytime	69	50	NO
		Evening	59	45	NO
		Nighttime	54	—	N/A(2)

Notes:
(1) See Figure 3.
(2) Nighttime sound level limits do not apply to outdoor points of reception.

TABLE 3

BRAZEAU PIT – PREDICTED MITIGATED SOUND LEVELS(1)

Receptor	Description	Time Period	Predicted Sound Level (dBA)(2)	Performance Limit (dBA)	Compliance with Performance Limit?
R01	West-facing window on the dwelling to the east	Daytime	50	50	YES
		Evening	45	50	YES
		Nighttime	45	45	YES
R02	Rear yard of dwelling to the east	Daytime	49	50	YES
		Evening	43	45	YES
		Nighttime	—	—	N/A(3)
R03	West-facing window on the dwelling to the east	Daytime	45	50	YES
		Evening	43	50	YES
		Nighttime	43	45	YES
R04	West-facing window on the dwelling to the east	Daytime	44	50	YES
		Evening	42	50	YES
		Nighttime	42	45	YES
R05	West-facing window on the townhouse block to the east	Daytime	44	50	YES
		Evening	43	50	YES
		Nighttime	43	45	YES
R06	West-facing window on the dwelling to the south	Daytime	47	50	YES
		Evening	43	50	YES
		Nighttime	43	45	YES
R07	West-facing window on the dwelling to the south	Daytime	48	50	YES
		Evening	43	50	YES
		Nighttime	43	45	YES
R08	West-facing window on the dwelling to the south	Daytime	50	50	NO
		Evening	42	50	YES
		Nighttime	42	50	YES

Notes:

(1) As part of the mitigation, receptors R09 to R14 cannot be constructed until after the Brazeau Pit operations cease
(2) See Figure 4.
(3) Nighttime sound level limits do not apply to outdoor points of reception.

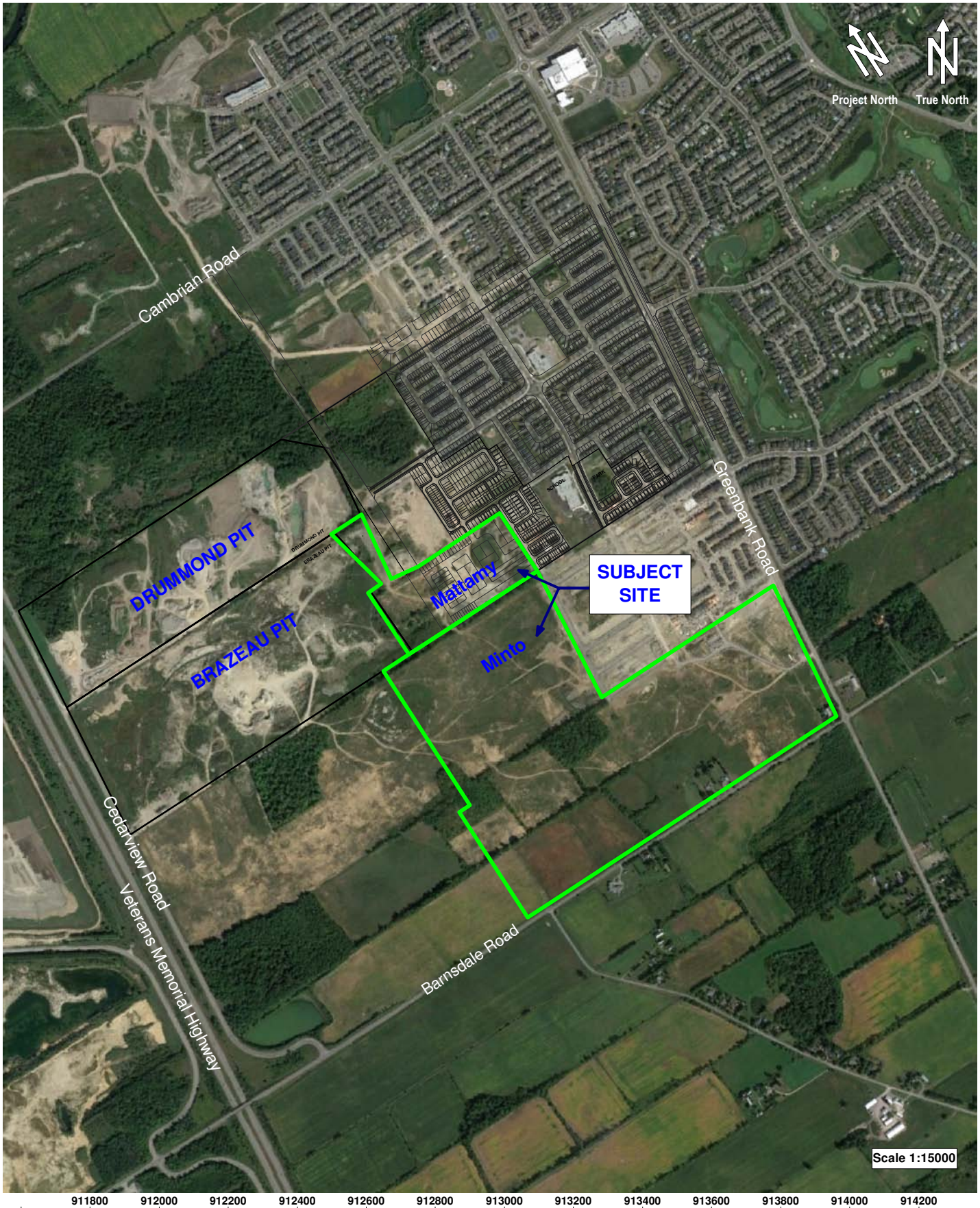
TABLE 4

DRUMMOND PIT – PREDICTED UNMITIGATED SOUND LEVELS

Receptor	Description	Time Period	Predicted Sound Level (dBA)[1]	Performance Limit (dBA)	Compliance with Performance Limit?
R01	West-facing window on the dwelling to the east	Daytime	44	50	YES
		Evening	41	50	YES
		Nighttime	41	45	YES
R02	Rear yard of dwelling to the east	Daytime	42	50	YES
		Evening	39	45	YES
		Nighttime	—	—	N/A[2]
R03	West-facing window on the dwelling to the east	Daytime	42	50	YES
		Evening	38	50	YES
		Nighttime	38	45	YES
R04	West-facing window on the dwelling to the east	Daytime	46	50	YES
		Evening	41	50	YES
		Nighttime	41	45	YES
R05	West-facing window on the townhouse block to the east	Daytime	46	50	YES
		Evening	41	50	YES
		Nighttime	41	45	YES
R06	West-facing window on the dwelling to the south	Daytime	37	50	YES
		Evening	36	50	YES
		Nighttime	36	45	YES
R07	West-facing window on the dwelling to the south	Daytime	40	50	YES
		Evening	38	50	YES
		Nighttime	38	45	YES
R08	West-facing window on the dwelling to the south	Daytime	44	50	YES
		Evening	40	50	YES
		Nighttime	40	45	YES
R09	North-facing window on dwelling to the south	Daytime	49	50	YES
		Evening	42	50	YES
		Nighttime	42	45	YES
R10	North-facing window on dwelling to the south	Daytime	49	50	YES
		Evening	42	50	YES
		Nighttime	42	45	YES
R11	Rear yard of dwelling to the south	Daytime	50	50	YES
		Evening	43	45	YES
		Nighttime	—	—	N/A[2]
R12	Rear yard of dwelling to the south	Daytime	50	50	YES
		Evening	43	45	YES
		Nighttime	—	—	N/A[2]
R13	West-facing window of dwelling to the west of Future Greenbank Road	Daytime	52	50	NO
		Evening	45	50	YES
		Nighttime	45	45	YES
R14	Rear yard of dwelling to the west of Future Greenbank Road	Daytime	54	50	NO
		Evening	46	45	NO
		Nighttime	—	—	N/A[2]

Notes:

(1) See Figure 5.
(2) Nighttime sound level limits do not apply to outdoor points of reception.



VALCOUSTICS Canada Ltd.
consulting acoustical engineers

Title	Date	Figure
Key Plan	2018-05-01	1
Project Name	Project No.	
Half Moon Bay South and Quinn's Pointe Stage 2	118-0052	

E:\AA\1180052\Cadna\KEY PLAN.cna

Date Plotted: 01.05.18

legend

- CDP Boundary
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Commercial
- Park & Ride
- Storm Water Management Facility
- School Site / Library Site
- Park
- Active Sand & Gravel Pits
- Urban Expansion Study Area
- Existing Woodlot
- 300m Extraction Site Buffer
- 500m Land Fill Buffer
- 1000m Land Fill Buffer
- Possible Tree Retention
- Proposed Splash Pad
- Transit Platform
- BRT Route
- BRT Station
- Property Ownership Boundary
- 1 Minto Lands
- 2 Moloughney Property West
- 3 Moloughney Property East
- 4 Boyle Property
- 5 Mattamy Lands
- 6 Brazeau Lands
- 7 Drummond Lands

VALCOUSTICS Canada Ltd.

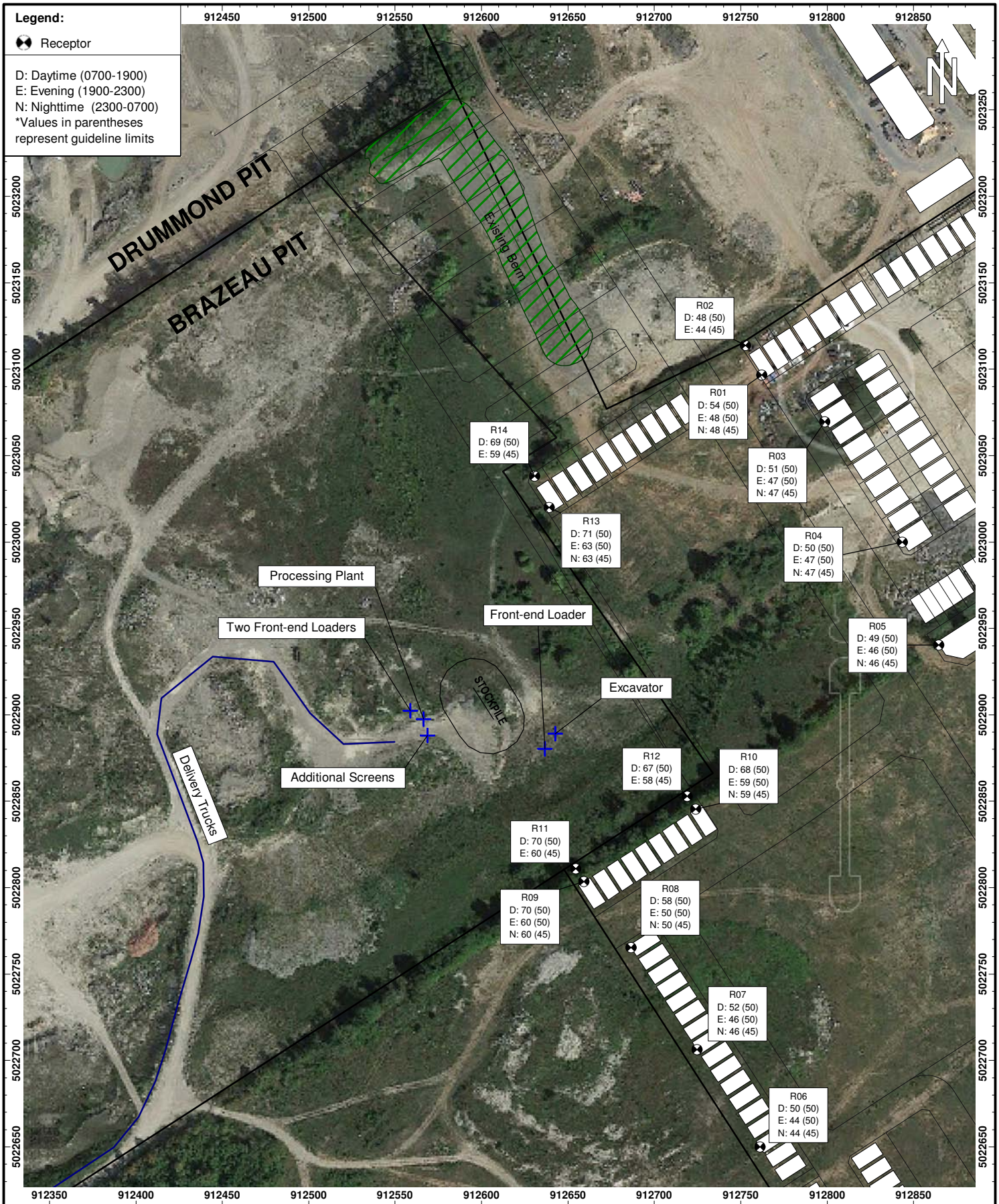
Title: Site Plan

Project Name: Half Moon Bay South and Quinn's Pointe Stage 2

Date: 2018-05-01

Project No.: 118-0052

Figure: 2



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Title	Date	Figure
Brazeau Pit - Predicted Worst-Case Sound Levels (dBA)	**2018-05-01**	**3**
Project Name	Project No.	
Half Moon Bay South and Quinn's Pointe Stage 2	**118-0052**	

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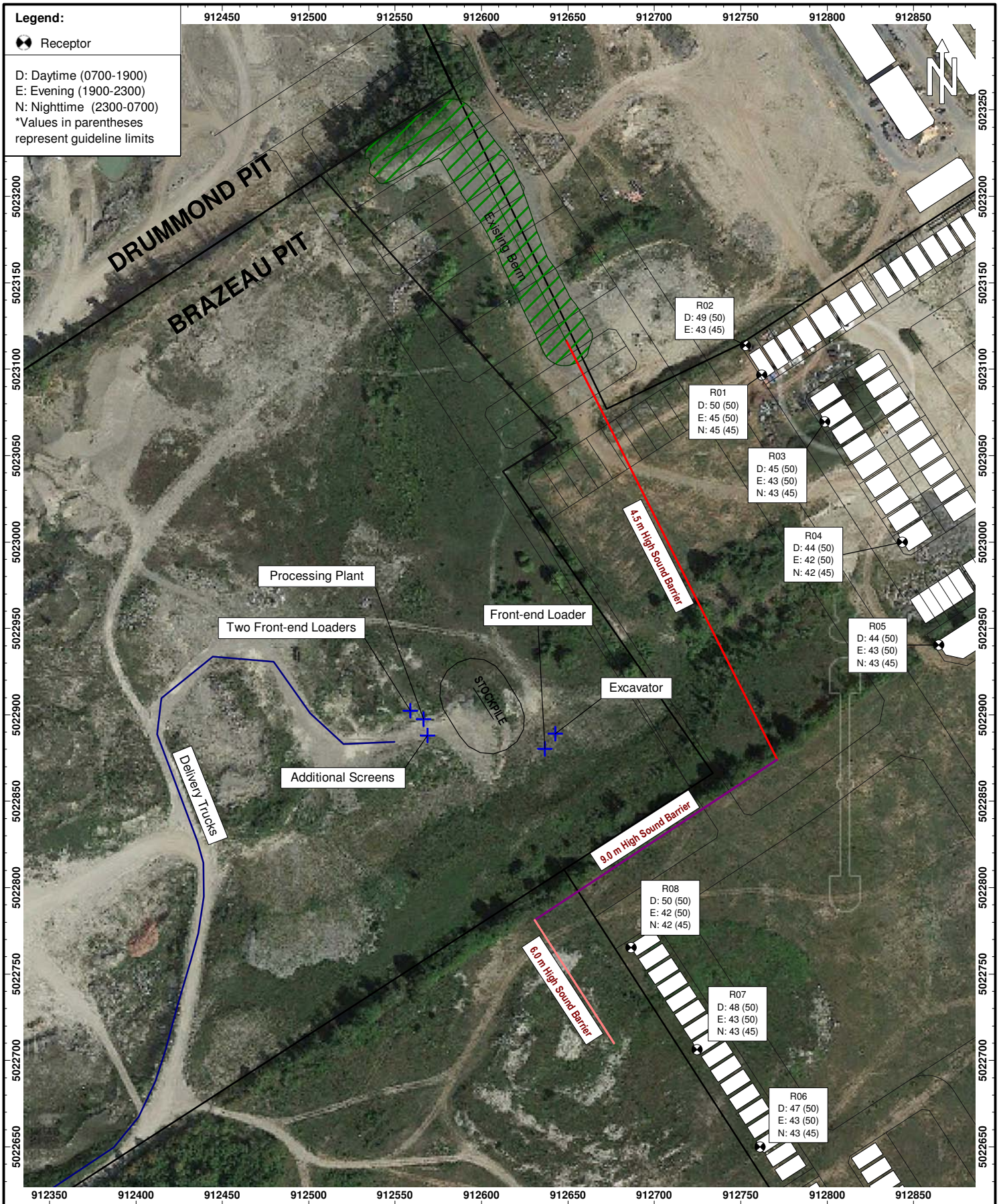
Date Plotted: 01.05.18



VALCOUSTICS Canada Ltd.
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Title	Date	Figure
Brazeau Pit - Predicted Worst-Case Sound Levels (dBA) with Mitigation	**2018-05-01**	**4**
Project Name	Project No.	
Half Moon Bay South and Quinn's Pointe Stage 2	**118-0052**	

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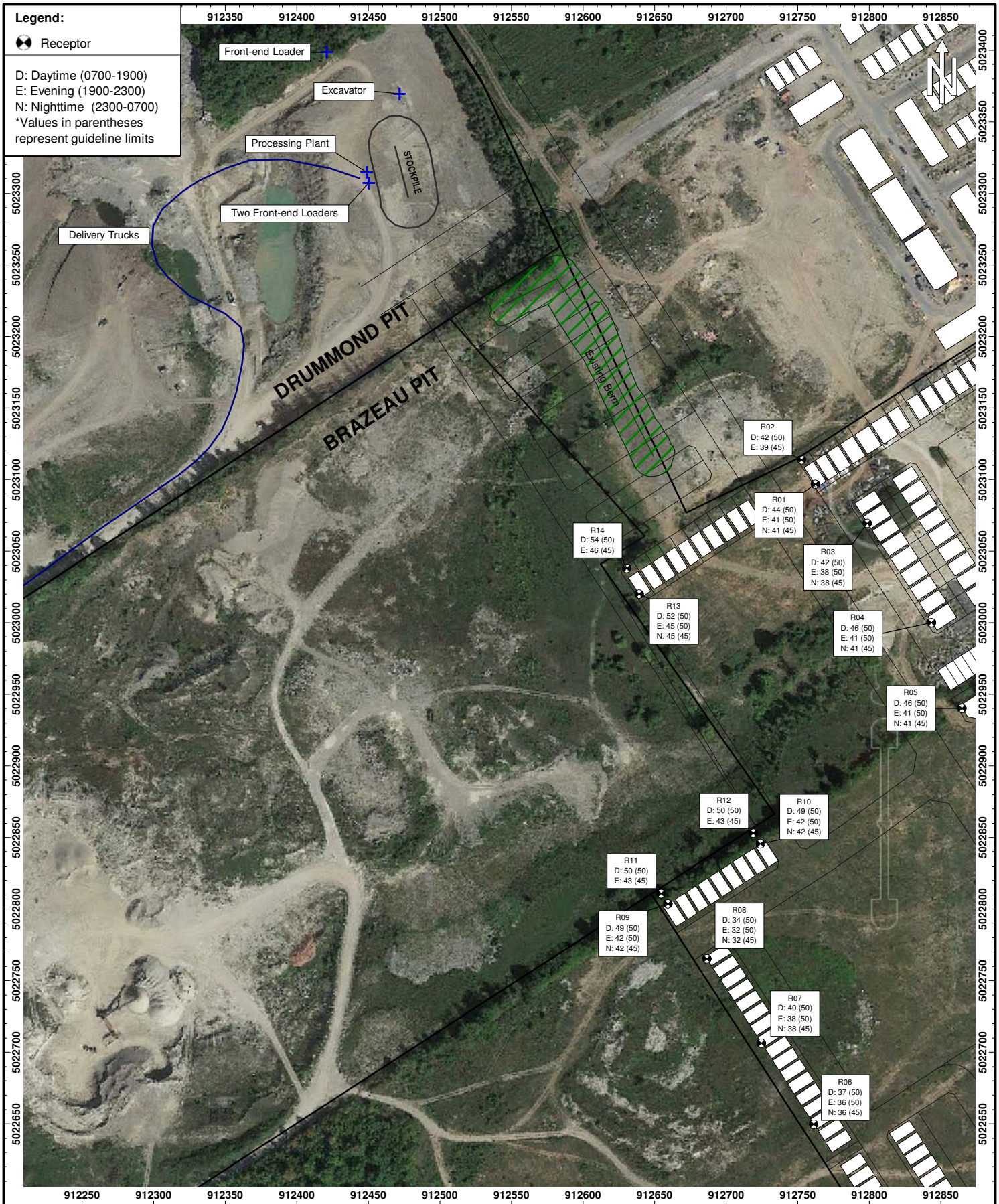
Date Plotted: 01.05.18



VALCOUSTICS Canada Ltd.
consulting acoustical engineers

Title	Date	Figure
Drummond Pit - Predicted Worst-Case Sound Levels (dBA)	**2018-05-01**	**5**
Project Name: **Half Moon Bay South and Quinn's Pointe Stage 2**	Project No.: **118-0052**	

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Date Plotted: 01.05.18

APPENDIX A

ENVIRONMENTAL NOISE GUIDELINES

APPENDIX A

ENVIRONMENTAL NOISE GUIDELINES

MINISTRY OF THE ENVIRONMENT AND CLIMATE CHANGE (MOE)

Reference: MOE Publication NPC-300, October 2013: *"Environmental Noise Guideline, Stationary and Transportation Source – Approval and Planning"*.

SPACE	SOURCE	TIME PERIOD	CRITERION
Living/dining, den areas of residences, hospitals, nursing homes, schools, daycare centres, etc.	Road	07:00 to 23:00	45 dBA
	Rail	07:00 to 23:00	40 dBA
	Aircraft	24-hour period	NEF/NEP 5
Living/dining, den areas of residences, hospitals, nursing homes, etc. (except schools or daycare centres)	Road	23:00 to 07:00	45 dBA
	Rail	23:00 to 07:00	40 dBA
	Aircraft	24-hour period	NEF/NEP 5
Sleeping quarters	Road	07:00 to 23:00	45 dBA
	Rail	07:00 to 23:00	40 dBA
	Aircraft	24-hour period	NEF/NEP 0
Sleeping quarters	Road	23:00 to 07:00	40 dBA
	Rail	23:00 to 07:00	35 dBA
	Aircraft	24-hour period	NEF/NEP 0
Outdoor Living Areas	Road and Rail	07:00 to 23:00	55 dBA
Outdoor Point of Reception	Aircraft	24-hour period	NEF/NEP 30#
	Stationary Source		
	Class 1 Area	07:00 to 19:00(1)	50* dBA
		19:00 to 23:00(1)	50* dBA
	Class 2 Area	07:00 to 19:00(2)	50* dBA
		19:00 to 23:00(2)	45* dBA
	Class 3 Area	07:00 to 19:00(3)	45* dBA
		19:00 to 23:00(3)	40* dBA
	Class 4 Area	07:00 to 19:00(4)	55* dBA
		19:00 to 23:00(4)	55* dBA

…./cont'd

SPACE	SOURCE	TIME PERIOD	CRITERION
Plane of a Window of Noise Sensitive Spaces	Stationary Source		
	Class 1 Area	07:00 to 19:00(1)	50* dBA
		19:00 to 23:00(1)	50* dBA
		23:00 to 07:00(1)	45* dBA
	Class 2 Area	07:00 to 19:00(2)	50* dBA
		19:00 to 23:00(2)	50* dBA
		23:00 to 07:00(2)	45* dBA
	Class 3 Area	07:00 to 19:00(3)	45* dBA
		19:00 to 23:00(3)	45* dBA
		23:00 to 07:00(3)	40* dBA
	Class 4 Area	07:00 to 19:00(4)	60* dBA
		19:00 to 23:00(4)	60* dBA
		23:00 to 07:00(4)	55* dBA

\# may not apply to in-fill or re-development.
* or the minimum hourly background sound exposure $L_{eq(1)}$, due to road traffic, if higher.
(1) Class 1 Area: Urban.
(2) Class 2 Area: Urban during day; rural-like evening and night.
(3) Class 3 Area: Rural.
(4) Class 4 Area: Subject to land use planning authority's approval.

Reference: MOE Publication ISBN 0-7729-2804-5, 1987: *"Environmental Noise Assessment in Land-Use Planning"*.

EXCESS ABOVE RECOMMENDED SOUND LEVEL LIMITS (dBA)(1)	CHANGE IN SUBJECTIVE LOUDNESS ABOVE	MAGNITUDE OF THE NOISE PROBLEM	NOISE CONTROL MEASURES (OR ACTION TO BE TAKEN)
No excess (<55 dBA)	—	No expected noise problem	None
1 to 5 inclusive (56 to 60 dBA)	Noticeably louder	Slight noise impact	If no physical measures are taken, then prospective purchasers or tenants should be made aware by suitable warning clauses.
6 to 10 inclusive (61 - 65 dBA)	Almost twice as loud	Definite noise impact	Recommended.
11 to 15 inclusive (66 - 70 dBA)	Almost three times as loud	Serious noise impact	Strongly Recommended.
16 and over (>70 dBA)	Almost four times as loud	Very serious noise impact	Strongly Recommended (may be mandatory).

(1) Potential excess above noise guideline limit, as outlined in the table below, applies only to the criterion for an outdoor living area from road and rail noise sources.

APPENDIX B

OPERATIONAL MEMORANDA

VALCOUSTICS
Canada Ltd.
Sound solutions to acoustical challenges

MEMORANDUM

TO: Marcel Brazeau **VIA EMAIL**

FROM: John Emeljanow/Ian Matthew

DATE: August 8, 2013

RE: Operations Review
Brazeau Pit

FILE: 108363.100

As per our on site meeting on July 18, 2013, outlined below is our understanding of the permitted operations at the above noted gravel pit. If there is anything within this memorandum that is incorrect, please let us know as soon as possible.

As you are aware, residential development is proposed to the east of your site. As part of the approvals process, a noise study is needed demonstrating that the predictable worst case operations of the gravel pit site comply with the Ministry of Environment (MOE) noise guidelines. The applicable guideline is MOE Publication NPC-205 as an aggregate extraction and processing facility is considered a stationary noise source. Note that construction and rehabilitation activities are excluded from assessment under NPC-205. Equipment used for construction and rehabilitation simply needs to comply with the noise emission limits in MOE Publication NPC-115. Thus, the noise assessment is applicable to the extraction, processing and shipping activities that occur on your site.

Based on our meeting to review your operations, our understanding of the predictable worst case operations are:

- Regular operating hours are during the daytime period (i.e. 0700 to 1900 hours). However, the pit is licensed to operate 24 hours per day. Thus, nighttime operations were also considered in the assessment;
- The approximate location of the current extraction face is shown on Figure 1. Extraction is progressing from east to west across the site;
- Above water table extraction to the east of the current face has been completed;

- Other than the trucks travelling along the southern boundary of the site, which are at undisturbed grade, all equipment operates at the bottom elevation of the pit (at an elevation of approximately 97.5 m);

- The typical operation that occurs on the site is shipping. Trucks enter the site, travel to the aggregate stockpile location (which is close to the working face) where they are loaded by a front end loader and then they leave the site;

- Once the stockpiles are depleted, a portable processing plant (which includes a crusher, vibratory screen and stacker) are brought to the site. The processing plant operates in close proximity to the working face to minimize the distance material needs to be transported. Aggregate is extracted from the face using up to 2 front end loaders which directly feed the processing plant which replenishes the stockpiles;

- For dust control purposes, the processing plant is always located to the west of the stockpiles. Thus, the stockpiles would be in between the proposed residential development and the processing equipment. The stockpiles would be 40 to 50 feet in height;

- The processing plant only operates during the daytime period (i.e. 0700 to 1900 hours);

- Two additional screens could operate on the site in close proximity to the working face;

- As the site is licensed to ship up to 300,000 tonnes of material per year, we estimate in a worst case hour there could be 25 loads of aggregate leaving the site. Thus, there would be 25 trucks coming to and leaving the site in a predictable worst case hour;

- If below water table extraction were to be done, an excavator would be added to the equipment operating on the site. Extraction would be from the east to west across the site. Other than the excavator extracting material from below the water table, all other equipment and its operation would be similar to what was outlined above;

- During the winter time, the site is used for snow storage. Snow is hauled to the site and is piled using a front end loader. The snow pile will always be in between the loader and the proposed residential development. This activity primarily occurs on the western end of the site.

As indicated above, please let us know if we have misinterpreted your operations in any way. If there are any questions, please do not hesitate to call (Valcoustics, 905-764-5223).

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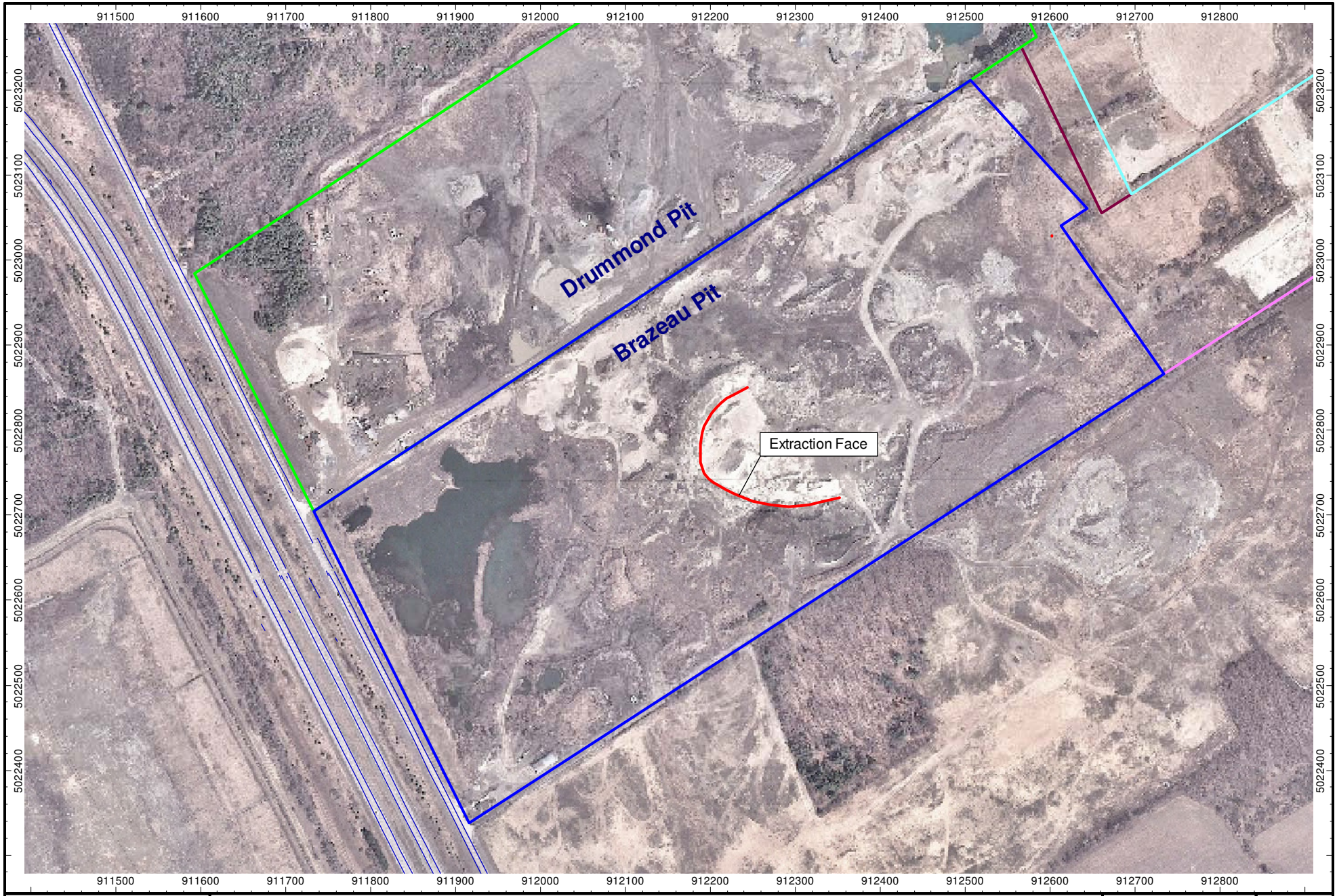

VALCOUSTICS Canada Ltd.
consulting acoustical engineers

Title: **Current Extraction Face - Brazeau Pit**	Date: **August 7, 2013**	Figure: **1**
Project Name: **Half Moon Bay South - Pit Assessment**	Project No.: **108-363.100**	

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Date Plotted: 07.08.13

VALCOUSTICS
Canada Ltd.
Sound solutions to acoustical challenges

MEMORANDUM

TO: Scott Drummond **VIA EMAIL**

FROM: John Emeljanow/Ian Matthew

DATE: August 8, 2013

RE: Operations Review
Drummond Pit

FILE: 108363.100

As per our on site meeting on July 18, 2013, outlined below is our understanding of the permitted operations at the above noted gravel pit. If there is anything within this memorandum that is incorrect, please let us know as soon as possible.

As you are aware, residential development is proposed to the east of your site. As part of the approvals process, a noise study is needed demonstrating that the predictable worst case operations of the gravel pit site comply with the Ministry of Environment (MOE) noise guidelines. The applicable guideline is MOE Publication NPC-205 as an aggregate extraction and processing facility is considered a stationary noise source. Note that construction and rehabilitation activities are excluded from assessment under NPC-205. Equipment used for construction and rehabilitation simply needs to comply with the noise emission limits in MOE Publication NPC-115. Thus, the noise assessment is applicable to the extraction, processing and shipping activities that occur on your site.

Based on our meeting to review your operations, our understanding of the predictable worst case operations are:

- There is approximately 5 years of pit operations remaining;
- Operating hours are during the daytime period (i.e. 0700 to 1700 hours);
- There are two extraction locations remaining on the site. One is along the 15 m setback to the north and the other is the northeast corner of the site. For the northeast corner, extraction would be from west to east;
- Other than the trucks travelling along the southern boundary of the site, which are at undisturbed grade, all equipment operates at the bottom elevation of the pit (at an elevation of approximately 97.5 m);

- The typical operation that occurs on the site is shipping. Trucks enter the site, travel to the aggregate stockpile location (which is close to the working face) where they are loaded by a front end loader and then they leave the site;

- Once the stockpiles are depleted, a portable processing plant (which includes a crusher, vibratory screen and stacker) are brought to the site. The processing plant operates in close proximity to the working face to minimize the distance material needs to be transported. Aggregate is extracted from the face using up to 2 front end loaders which directly feed the processing plant which replenishes the stockpiles;

- For dust control purposes, the processing plant is always located to the west of the stockpiles. Thus, the stockpiles would be in between the proposed residential development and the processing equipment. The stockpiles would be 40 to 50 feet in height;

- As the site is licensed to ship up to 350,000 tonnes of material per year, we estimate in a worst case hour there could be 25 loads of aggregate leaving the site. Thus, there would be 25 trucks coming to and leaving the site in a predictable worst case hour. The trucks would be loaded from the west side of the stockpiles;

- If below water table extraction were to be done, an excavator would be added to the equipment operating on the site. Other than the excavator extracting material from below the water table, all other equipment and its operation would be similar to what was outlined above;

As indicated above, please let us know if we have misinterpreted your operations in any way. If there are any questions, please do not hesitate to call (Valcoustics, 905-764-5223).

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APPENDIX C
SAMPLE CALCULATIONS

118-0052 Half Moon Bay South Phase 5 and Quinn's Pointe Stage 2

Point Source Table

Name	M.	ID	Result. PWL			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Height		Coordinates		
			Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night						X	Y	Z
			(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		(m)		(m)	(m)	(m)
Processing Plant	~	DrCVS_PRCS	122.5	122.5	122.5	Lw	CRV		0.0	0.0	0.0				60.00	0.00	0.00	0.0		(none)	3.50	r	912448.77	5023314.62	100.50
Two Front-end Loaders	~	DrFEL_PRCS	109.4	109.4	109.4	Lw	FEL950 + 10*log10(2)		0.0	0.0	0.0				60.00	0.00	60.00	0.0		(none)	2.50	r	912450.35	5023307.10	99.50
Front-end Loader	~	DrFEL_TYP	106.4	106.4	106.4	Lw	FEL950		0.0	0.0	0.0				60.00	0.00	60.00	0.0		(none)	2.50	r	912421.08	5023398.87	99.50
Excavator	~	DrExc	101.9	101.9	101.9	Lw	EXC330		0.0	0.0	0.0				60.00	0.00	60.00	0.0		(none)	2.50	r	912471.92	5023369.38	99.50
Excavator		BrEXC	111.1	111.1	111.1	Lw	EXC350		0.0	0.0	0.0				60.00	0.00	60.00	0.0		(none)	2.50	r	912642.72	5022888.94	100.00
Processing Plant		BrCVS	122.5	122.5	122.5	Lw	CRV		0.0	0.0	0.0				60.00	0.00	0.00	0.0		(none)	3.50	r	912566.43	5022897.59	100.50
Front-end Loader		BrFEL	106.4	106.4	106.4	Lw	FEL950		0.0	0.0	0.0				60.00	0.00	60.00	0.0		(none)	2.50	r	912636.73	5022880.26	99.50
Additional Screens		BrSCR	109.5	109.5	109.5	Lw	SCR + 10*log10(2)		0.0	0.0	0.0				60.00	0.00	0.00	0.0		(none)	3.50	r	912568.83	5022888.17	100.50
Two Front-end Loaders		BrFEL	109.4	109.4	109.4	Lw	FEL950 + 10*log10(2)		0.0	0.0	0.0				60.00	0.00	60.00	0.0		(none)	2.50	r	912558.76	5022902.49	99.50

Line Source Table

Name	M.	ID	Result. PWL			Result. PWL'			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Moving Pt. Src			
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night				Number			Speed
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		Day	Evening	Night	(km/h)
Delivery Trucks		BrTrkC1	116.8	-3.2	116.8	86.8	-33.2	86.8	PWL-Pt	vclHvyTrkA		0.0	0.0	0.0							0.0		(none)	100.0	0.0	100.0	20.0
Delivery Trucks	~	DrTrk	114.1	-2.9	114.1	83.7	-33.2	83.7	PWL-Pt	vclHvyTrkA		0.0	0.0	0.0							0.0		(none)	50.0	0.0	50.0	20.0

Sound Power Levels

Name	ID	Type	Oktave Spectrum (dB)												Source
			Weight.	31.5	63	125	250	500	1000	2000	4000	8000	A	lin	
Heavy Truck Movement	vclHvyTrkA	Lw		101.7	98.2	97.3	91.3	95.0	97.2	101.8	105.7	104.3	109.8	110.6	MTO long truck at 20 kph
Front End Loader (CAT950)	FEL950	Lw		109.0	109.0	114.0	109.0	100.0	99.0	96.0	97.0	94.0	106.4	117.2	FHWA Const. Noise Handbook Table 9.4
Excavator (Deere 350G)	EXC350	Lw		100.1	108.8	108.1	110.7	108.0	106.9	102.5	97.0	92.2	111.1	116.1	7/18/2013 Measurement
Excavator (CAT 330)	EXC330	Lw		100.0	97.0	102.0	99.0	98.0	97.0	96.0	88.0	80.0	101.9	107.4	Noise and Dust Study
Screen (non-vibratory)	SCR	Lw		108.4	116.8	110.4	103.0	102.6	101.2	99.1	94.9	90.9	106.4	118.6	7/18/2013 Measurement
Crusher + Vibratory Screen	CRV	Lw		110.9	119.5	122.9	114.8	116.7	116.2	116.4	115.1	109.7	122.5	127.0	7/18/2013 Measurement

Calculation Configuration

Configuration	
Parameter	Value
General	
Country	International
Max. Error (dB)	0.00
Max. Search Radius (#(Unit,LEN))	2000.00
Min. Dist Src to Rcvr	0.00
Partition	
Raster Factor	0.50
Max. Length of Section (#(Unit,LEN))	1000.00
Min. Length of Section (#(Unit,LEN))	1.00
Min. Length of Section (%)	0.00
Proj. Line Sources	On
Proj. Area Sources	On
Ref. Time	
Reference Time Day (min)	60.00
Reference Time Night (min)	60.00
Daytime Penalty (dB)	0.00
Recr. Time Penalty (dB)	0.00
Night-time Penalty (dB)	0.00
DTM	
Standard Height (m)	100.00
Model of Terrain	Triangulation
Reflection	
max. Order of Reflection	2
Search Radius Src	100.00
Search Radius Rcvr	100.00
Max. Distance Source - Rcvr	1000.00 1000.00
Min. Distance Rvcr - Reflector	1.00 1.00
Min. Distance Source - Reflector	0.10
Industrial (ISO 9613)	
Lateral Diffraction	some Obj
Obst. within Area Src do not shield	On
Screening	Excl. Ground Att. over Barrier
	Dz with limit (20/25)
Barrier Coefficients C1,2,3	3.0 20.0 0.0
Temperature (#(Unit,TEMP))	10
rel. Humidity (%)	70
Ground Absorption G	0.00
Wind Speed for Dir. (#(Unit,SPEED))	3.0
Roads (RLS-90)	
Strictly acc. to RLS-90	
Railways (Schall 03 (1990))	
Strictly acc. to Schall 03 / Schall-Transrapid	
Aircraft (???)	
Strictly acc. to AzB	

Receiver
Name: R08
ID: R08
X: 912686.47 m
Y: 5022765.42 m
Z: 115.28 m

Point Source, ISO 9613, Name: "Processing Plant", ID: "BrCVS"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
6	912566.43	5022897.59	100.50	0	D	A	122.5	0.0	0.0	0.0	0.0	56.1	1.9	-1.2	0.0	0.0	9.1	0.0	0.0	56.6
6	912566.43	5022897.59	100.50	0	N	A	122.5	0.0	-188.0	0.0	0.0	56.1	1.9	-1.2	0.0	0.0	9.1	0.0	0.0	-131.4
6	912566.43	5022897.59	100.50	0	E	A	122.5	0.0	-188.0	0.0	0.0	56.1	1.9	-1.2	0.0	0.0	9.1	0.0	0.0	-131.4
11	912566.43	5022897.59	100.50	1	D	A	122.5	0.0	0.0	0.0	0.0	56.4	2.0	-1.2	0.0	0.0	23.8	0.0	5.6	35.9
11	912566.43	5022897.59	100.50	1	N	A	122.5	0.0	-188.0	0.0	0.0	56.4	2.0	-1.2	0.0	0.0	23.8	0.0	5.6	-152.1
11	912566.43	5022897.59	100.50	1	E	A	122.5	0.0	-188.0	0.0	0.0	56.4	2.0	-1.2	0.0	0.0	23.8	0.0	5.6	-152.1

Point Source, ISO 9613, Name: "Excavator", ID: "BrEXC"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
19	912642.72	5022888.94	100.00	0	D	A	111.1	0.0	0.0	0.0	0.0	53.4	0.7	0.0	0.0	0.0	18.3	0.0	0.0	38.7
19	912642.72	5022888.94	100.00	0	N	A	111.1	0.0	0.0	0.0	0.0	53.4	0.7	0.0	0.0	0.0	18.3	0.0	0.0	38.7
19	912642.72	5022888.94	100.00	0	E	A	111.1	0.0	-188.0	0.0	0.0	53.4	0.7	0.0	0.0	0.0	18.3	0.0	0.0	-149.3

Point Source, ISO 9613, Name: "Front-end Loader", ID: "BrFEL"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
31	912636.73	5022880.26	99.50	0	D	A	106.4	0.0	0.0	0.0	0.0	53.0	0.9	1.1	0.0	0.0	12.8	0.0	0.0	38.5
31	912636.73	5022880.26	99.50	0	N	A	106.4	0.0	0.0	0.0	0.0	53.0	0.9	1.1	0.0	0.0	12.8	0.0	0.0	38.5
31	912636.73	5022880.26	99.50	0	E	A	106.4	0.0	-188.0	0.0	0.0	53.0	0.9	1.1	0.0	0.0	12.8	0.0	0.0	-149.5

Point Source, ISO 9613, Name: "Two Front-end Loaders", ID: "BrFEL"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
51	912558.76	5022902.49	99.50	0	D	A	109.4	0.0	0.0	0.0	0.0	56.5	1.2	-1.2	0.0	0.0	7.7	0.0	0.0	45.2
51	912558.76	5022902.49	99.50	0	N	A	109.4	0.0	0.0	0.0	0.0	56.5	1.2	-1.2	0.0	0.0	7.7	0.0	0.0	45.2
51	912558.76	5022902.49	99.50	0	E	A	109.4	0.0	-188.0	0.0	0.0	56.5	1.2	-1.2	0.0	0.0	7.7	0.0	0.0	-142.8
56	912558.76	5022902.49	99.50	1	D	A	109.4	0.0	0.0	0.0	0.0	56.8	1.2	-1.2	0.0	0.0	20.3	0.0	12.3	20.0
56	912558.76	5022902.49	99.50	1	N	A	109.4	0.0	0.0	0.0	0.0	56.8	1.2	-1.2	0.0	0.0	20.3	0.0	12.3	20.0
56	912558.76	5022902.49	99.50	1	E	A	109.4	0.0	-188.0	0.0	0.0	56.8	1.2	-1.2	0.0	0.0	20.3	0.0	12.3	-168.0

Point Source, ISO 9613, Name: "Additional Screens", ID: "BrSCR"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
61	912568.83	5022888.17	100.50	0	D	A	109.5	0.0	0.0	0.0	0.0	55.6	1.1	-1.0	0.0	0.0	8.9	0.0	0.0	44.8
61	912568.83	5022888.17	100.50	0	N	A	109.5	0.0	-188.0	0.0	0.0	55.6	1.1	-1.0	0.0	0.0	8.9	0.0	0.0	-143.2
61	912568.83	5022888.17	100.50	0	E	A	109.5	0.0	-188.0	0.0	0.0	55.6	1.1	-1.0	0.0	0.0	8.9	0.0	0.0	-143.2

Line Source, ISO 9613, Name: "Delivery Trucks", ID: "BrTrkC1"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
67	912423.87	5022857.79	99.50	0	D	A	86.8	18.2	0.0	0.0	0.0	59.9	6.3	-2.2	0.0	0.0	7.0	0.0	0.0	34.0
67	912423.87	5022857.79	99.50	0	N	A	86.8	18.2	0.0	0.0	0.0	59.9	6.3	-2.2	0.0	0.0	7.0	0.0	0.0	34.0
67	912423.87	5022857.79	99.50	0	E	A	-33.2	18.2	0.0	0.0	0.0	59.9	6.3	-2.2	0.0	0.0	7.0	0.0	0.0	-86.0
85	912417.10	5022875.90	99.50	1	D	A	86.8	8.4	0.0	0.0	0.0	62.1	7.3	-2.8	0.0	0.0	26.8	0.0	4.6	-2.9
85	912417.10	5022875.90	99.50	1	N	A	86.8	8.4	0.0	0.0	0.0	62.1	7.3	-2.8	0.0	0.0	26.8	0.0	4.6	-2.9
85	912417.10	5022875.90	99.50	1	E	A	-33.2	8.4	0.0	0.0	0.0	62.1	7.3	-2.8	0.0	0.0	26.8	0.0	4.6	-122.9
93	912422.62	5022861.13	99.50	1	D	A	86.8	10.3	0.0	0.0	0.0	61.2	6.9	-2.6	0.0	0.0	26.8	0.0	3.1	1.7
93	912422.62	5022861.13	99.50	1	N	A	86.8	10.3	0.0	0.0	0.0	61.2	6.9	-2.6	0.0	0.0	26.8	0.0	3.1	1.7
93	912422.62	5022861.13	99.50	1	E	A	-33.2	10.3	0.0	0.0	0.0	61.2	6.9	-2.6	0.0	0.0	26.8	0.0	3.1	-118.3
98	912418.00	5022873.51	99.50	1	D	A	86.8	12.0	0.0	0.0	0.0	61.4	7.0	-2.7	0.0	0.0	26.8	0.0	3.1	3.1
98	912418.00	5022873.51	99.50	1	N	A	86.8	12.0	0.0	0.0	0.0	61.4	7.0	-2.7	0.0	0.0	26.8	0.0	3.1	3.1

Line Source, ISO 9613, Name: "Delivery Trucks", ID: "BrTrkC1"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
98	912418.00	5022873.51	99.50	1	E	A	-33.2	12.0	0.0	0.0	0.0	61.4	7.0	-2.7	0.0	0.0	26.8	0.0	3.1	-116.9
100	912413.76	5022884.84	99.50	1	D	A	86.8	9.3	0.0	0.0	0.0	61.6	7.1	-2.8	0.0	0.0	26.9	0.0	3.2	0.1
100	912413.76	5022884.84	99.50	1	N	A	86.8	9.3	0.0	0.0	0.0	61.6	7.1	-2.8	0.0	0.0	26.9	0.0	3.2	0.1
100	912413.76	5022884.84	99.50	1	E	A	-33.2	9.3	0.0	0.0	0.0	61.6	7.1	-2.8	0.0	0.0	26.9	0.0	3.2	-119.9
103	912434.59	5022829.10	99.50	1	D	A	86.8	7.0	0.0	0.0	0.0	61.2	6.9	-2.4	0.0	0.0	26.6	0.0	3.1	-1.7
103	912434.59	5022829.10	99.50	1	N	A	86.8	7.0	0.0	0.0	0.0	61.2	6.9	-2.4	0.0	0.0	26.6	0.0	3.1	-1.7
103	912434.59	5022829.10	99.50	1	E	A	-33.2	7.0	0.0	0.0	0.0	61.2	6.9	-2.4	0.0	0.0	26.6	0.0	3.1	-121.7
107	912433.38	5022832.35	99.50	1	D	A	86.8	2.9	0.0	0.0	0.0	61.2	6.9	-2.4	0.0	0.0	26.6	0.0	3.1	-5.8
107	912433.38	5022832.35	99.50	1	N	A	86.8	2.9	0.0	0.0	0.0	61.2	6.9	-2.4	0.0	0.0	26.6	0.0	3.1	-5.8
107	912433.38	5022832.35	99.50	1	E	A	-33.2	2.9	0.0	0.0	0.0	61.2	6.9	-2.4	0.0	0.0	26.6	0.0	3.1	-125.8
112	912430.86	5022839.08	99.50	1	D	A	86.8	10.9	0.0	0.0	0.0	61.3	6.9	-2.5	0.0	0.0	26.7	0.0	3.1	2.2
112	912430.86	5022839.08	99.50	1	N	A	86.8	10.9	0.0	0.0	0.0	61.3	6.9	-2.5	0.0	0.0	26.7	0.0	3.1	2.2
112	912430.86	5022839.08	99.50	1	E	A	-33.2	10.9	0.0	0.0	0.0	61.3	6.9	-2.5	0.0	0.0	26.7	0.0	3.1	-117.8
115	912426.02	5022852.03	99.50	1	D	A	86.8	11.8	0.0	0.0	0.0	61.5	7.0	-2.6	0.0	0.0	26.7	0.0	3.1	2.8
115	912426.02	5022852.03	99.50	1	N	A	86.8	11.8	0.0	0.0	0.0	61.5	7.0	-2.6	0.0	0.0	26.7	0.0	3.1	2.8
115	912426.02	5022852.03	99.50	1	E	A	-33.2	11.8	0.0	0.0	0.0	61.5	7.0	-2.6	0.0	0.0	26.7	0.0	3.1	-117.2
118	912421.28	5022864.72	99.50	1	D	A	86.8	10.7	0.0	0.0	0.0	61.6	7.1	-2.7	0.0	0.0	26.8	0.0	3.2	1.5
118	912421.28	5022864.72	99.50	1	N	A	86.8	10.7	0.0	0.0	0.0	61.6	7.1	-2.7	0.0	0.0	26.8	0.0	3.2	1.5
118	912421.28	5022864.72	99.50	1	E	A	-33.2	10.7	0.0	0.0	0.0	61.6	7.1	-2.7	0.0	0.0	26.8	0.0	3.2	-118.5
122	912417.20	5022875.63	99.50	1	D	A	86.8	10.6	0.0	0.0	0.0	61.8	7.2	-2.8	0.0	0.0	26.8	0.0	3.2	1.1
122	912417.20	5022875.63	99.50	1	N	A	86.8	10.6	0.0	0.0	0.0	61.8	7.2	-2.8	0.0	0.0	26.8	0.0	3.2	1.1
122	912417.20	5022875.63	99.50	1	E	A	-33.2	10.6	0.0	0.0	0.0	61.8	7.2	-2.8	0.0	0.0	26.8	0.0	3.2	-118.9
125	912413.74	5022884.91	99.50	1	D	A	86.8	9.2	0.0	0.0	0.0	61.9	7.2	-2.8	0.0	0.0	26.9	0.0	3.2	-0.4
125	912413.74	5022884.91	99.50	1	N	A	86.8	9.2	0.0	0.0	0.0	61.9	7.2	-2.8	0.0	0.0	26.9	0.0	3.2	-0.4
125	912413.74	5022884.91	99.50	1	E	A	-33.2	9.2	0.0	0.0	0.0	61.9	7.2	-2.8	0.0	0.0	26.9	0.0	3.2	-120.4
133	912346.01	5022622.36	115.15	0	D	A	86.8	20.0	0.0	0.0	0.0	62.3	7.4	-1.9	0.0	0.0	0.0	0.0	0.0	38.8
133	912346.01	5022622.36	115.15	0	N	A	86.8	20.0	0.0	0.0	0.0	62.3	7.4	-1.9	0.0	0.0	0.0	0.0	0.0	38.8
133	912346.01	5022622.36	115.15	0	E	A	-33.2	20.0	0.0	0.0	0.0	62.3	7.4	-1.9	0.0	0.0	0.0	0.0	0.0	-81.2
137	912534.80	5022883.72	99.50	0	D	A	86.8	14.7	0.0	0.0	0.0	56.7	5.0	-1.7	0.0	0.0	8.2	0.0	0.0	33.3
137	912534.80	5022883.72	99.50	0	N	A	86.8	14.7	0.0	0.0	0.0	56.7	5.0	-1.7	0.0	0.0	8.2	0.0	0.0	33.3
137	912534.80	5022883.72	99.50	0	E	A	-33.2	14.7	0.0	0.0	0.0	56.7	5.0	-1.7	0.0	0.0	8.2	0.0	0.0	-86.7
141	912534.80	5022883.72	99.50	1	D	A	86.8	14.7	0.0	0.0	0.0	57.6	5.3	-1.8	0.0	0.0	26.3	0.0	2.7	11.3
141	912534.80	5022883.72	99.50	1	N	A	86.8	14.7	0.0	0.0	0.0	57.6	5.3	-1.8	0.0	0.0	26.3	0.0	2.7	11.3
141	912534.80	5022883.72	99.50	1	E	A	-33.2	14.7	0.0	0.0	0.0	57.6	5.3	-1.8	0.0	0.0	26.3	0.0	2.7	-108.7
145	912521.60	5022883.24	99.50	1	D	A	86.8	4.9	0.0	0.0	0.0	58.4	5.7	-2.0	0.0	0.0	26.5	0.0	2.8	0.3
145	912521.60	5022883.24	99.50	1	N	A	86.8	4.9	0.0	0.0	0.0	58.4	5.7	-2.0	0.0	0.0	26.5	0.0	2.8	0.3
145	912521.60	5022883.24	99.50	1	E	A	-33.2	4.9	0.0	0.0	0.0	58.4	5.7	-2.0	0.0	0.0	26.5	0.0	2.8	-119.7
148	912529.55	5022883.53	99.50	1	D	A	86.8	11.1	0.0	0.0	0.0	58.2	5.5	-1.9	0.0	0.0	26.4	0.0	2.8	6.9
148	912529.55	5022883.53	99.50	1	N	A	86.8	11.1	0.0	0.0	0.0	58.2	5.5	-1.9	0.0	0.0	26.4	0.0	2.8	6.9
148	912529.55	5022883.53	99.50	1	E	A	-33.2	11.1	0.0	0.0	0.0	58.2	5.5	-1.9	0.0	0.0	26.4	0.0	2.8	-113.1
156	912251.22	5022561.80	112.98	0	D	A	86.8	21.0	0.0	0.0	0.0	64.6	8.6	-2.5	0.0	0.0	0.0	0.0	0.0	37.1
156	912251.22	5022561.80	112.98	0	N	A	86.8	21.0	0.0	0.0	0.0	64.6	8.6	-2.5	0.0	0.0	0.0	0.0	0.0	37.1
156	912251.22	5022561.80	112.98	0	E	A	-33.2	21.0	0.0	0.0	0.0	64.6	8.6	-2.5	0.0	0.0	0.0	0.0	0.0	-82.9
160	912490.18	5022915.83	99.50	0	D	A	86.8	15.6	0.0	0.0	0.0	58.9	5.8	-2.3	0.0	0.0	7.0	0.0	0.0	32.9
160	912490.18	5022915.83	99.50	0	N	A	86.8	15.6	0.0	0.0	0.0	58.9	5.8	-2.3	0.0	0.0	7.0	0.0	0.0	32.9
160	912490.18	5022915.83	99.50	0	E	A	-33.2	15.6	0.0	0.0	0.0	58.9	5.8	-2.3	0.0	0.0	7.0	0.0	0.0	-87.1
171	912481.79	5022927.69	99.50	1	D	A	86.8	8.8	0.0	0.0	0.0	59.9	6.3	-2.6	0.0	0.0	26.8	0.0	3.0	2.1
171	912481.79	5022927.69	99.50	1	N	A	86.8	8.8	0.0	0.0	0.0	59.9	6.3	-2.6	0.0	0.0	26.8	0.0	3.0	2.1
171	912481.79	5022927.69	99.50	1	E	A	-33.2	8.8	0.0	0.0	0.0	59.9	6.3	-2.6	0.0	0.0	26.8	0.0	3.0	-117.9
174	912492.37	5022912.73	99.50	1	D	A	86.8	14.6	0.0	0.0	0.0	59.4	6.1	-2.4	0.0	0.0	26.7	0.0	2.9	8.7
174	912492.37	5022912.73	99.50	1	N	A	86.8	14.6	0.0	0.0	0.0	59.4	6.1	-2.4	0.0	0.0	26.7	0.0	2.9	8.7
174	912492.37	5022912.73	99.50	1	E	A	-33.2	14.6	0.0	0.0	0.0	59.4	6.1	-2.4	0.0	0.0	26.7	0.0	2.9	-111.3
179	912510.41	5022892.03	99.50	0	D	A	86.8	14.2	0.0	0.0	0.0	57.7	5.4	-1.9	0.0	0.0	6.7	0.0	0.0	33.0
179	912510.41	5022892.03	99.50	0	N	A	86.8	14.2	0.0	0.0	0.0	57.7	5.4	-1.9	0.0	0.0	6.7	0.0	0.0	33.0
179	912510.41	5022892.03	99.50	0	E	A	-33.2	14.2	0.0	0.0	0.0	57.7	5.4	-1.9	0.0	0.0	6.7	0.0	0.0	-87.0
184	912510.41	5022892.03	99.50	1	D	A	86.8	14.2	0.0	0.0	0.0	58.5	5.7	-2.1	0.0	0.0	26.5	0.0	2.8	9.4
184	912510.41	5022892.03	99.50	1	N	A	86.8	14.2	0.0	0.0	0.0	58.5	5.7	-2.1	0.0	0.0	26.5	0.0	2.8	9.4
184	912510.41	5022892.03	99.50	1	E	A	-33.2	14.2	0.0	0.0	0.0	58.5	5.7	-2.1	0.0	0.0	26.5	0.0	2.8	-110.6
186	912505.65	5022896.39	99.50	1	D	A	86.8	3.4	0.0	0.0	0.0	59.1	5.9	-2.2	0.0	0.0	26.6	0.0	2.9	-2.2
186	912505.65	5022896.39	99.50	1	N	A	86.8	3.4	0.0	0.0	0.0	59.1	5.9	-2.2	0.0	0.0	26.6	0.0	2.9	-2.2
186	912505.65	5022896.39	99.50	1	E	A	-33.2	3.4	0.0	0.0	0.0	59.1	5.9	-2.2	0.0	0.0	26.6	0.0	2.9	-122.2
188	912512.07	5022890.50	99.50	1	D	A	86.8	11.8	0.0	0.0	0.0	58.8	5.8	-2.2	0.0	0.0	26.5	0.0	2.9	6.7

Line Source, ISO 9613, Name: "Delivery Trucks", ID: "BrTrkC1"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
188	912512.07	5022890.50	99.50	1	N	A	86.8	11.8	0.0	0.0	0.0	58.8	5.8	-2.2	0.0	0.0	26.5	0.0	2.9	6.7
188	912512.07	5022890.50	99.50	1	E	A	-33.2	11.8	0.0	0.0	0.0	58.8	5.8	-2.2	0.0	0.0	26.5	0.0	2.9	-113.3
191	912518.88	5022884.27	99.50	1	D	A	86.8	5.1	0.0	0.0	0.0	58.5	5.7	-2.0	0.0	0.0	26.5	0.0	2.8	0.3
191	912518.88	5022884.27	99.50	1	N	A	86.8	5.1	0.0	0.0	0.0	58.5	5.7	-2.0	0.0	0.0	26.5	0.0	2.8	0.3
191	912518.88	5022884.27	99.50	1	E	A	-33.2	5.1	0.0	0.0	0.0	58.5	5.7	-2.0	0.0	0.0	26.5	0.0	2.8	-119.7
193	912462.09	5022932.23	99.50	0	D	A	86.8	15.5	0.0	0.0	0.0	59.9	6.3	-2.5	0.0	0.0	0.0	0.0	0.0	38.5
193	912462.09	5022932.23	99.50	0	N	A	86.8	15.5	0.0	0.0	0.0	59.9	6.3	-2.5	0.0	0.0	0.0	0.0	0.0	38.5
193	912462.09	5022932.23	99.50	0	E	A	-33.2	15.5	0.0	0.0	0.0	59.9	6.3	-2.5	0.0	0.0	0.0	0.0	0.0	-81.5
204	912458.11	5022932.56	99.50	1	D	A	86.8	14.3	0.0	0.0	0.0	60.6	6.6	-2.7	0.0	0.0	26.9	0.0	3.1	6.6
204	912458.11	5022932.56	99.50	1	N	A	86.8	14.3	0.0	0.0	0.0	60.6	6.6	-2.7	0.0	0.0	26.9	0.0	3.1	6.6
204	912458.11	5022932.56	99.50	1	E	A	-33.2	14.3	0.0	0.0	0.0	60.6	6.6	-2.7	0.0	0.0	26.9	0.0	3.1	-113.4
207	912475.63	5022931.11	99.50	1	D	A	86.8	9.0	0.0	0.0	0.0	60.2	6.4	-2.6	0.0	0.0	26.8	0.0	3.0	2.0
207	912475.63	5022931.11	99.50	1	N	A	86.8	9.0	0.0	0.0	0.0	60.2	6.4	-2.6	0.0	0.0	26.8	0.0	3.0	2.0
207	912475.63	5022931.11	99.50	1	E	A	-33.2	9.0	0.0	0.0	0.0	60.2	6.4	-2.6	0.0	0.0	26.8	0.0	3.0	-118.0
247	912429.66	5022921.63	99.50	0	D	A	86.8	15.8	0.0	0.0	0.0	60.6	6.6	-2.6	0.0	0.0	0.0	0.0	0.0	38.0
247	912429.66	5022921.63	99.50	0	N	A	86.8	15.8	0.0	0.0	0.0	60.6	6.6	-2.6	0.0	0.0	0.0	0.0	0.0	38.0
247	912429.66	5022921.63	99.50	0	E	A	-33.2	15.8	0.0	0.0	0.0	60.6	6.6	-2.6	0.0	0.0	0.0	0.0	0.0	-82.0
264	912417.28	5022911.63	99.50	1	D	A	86.8	8.1	0.0	0.0	0.0	61.4	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	-0.7
264	912417.28	5022911.63	99.50	1	N	A	86.8	8.1	0.0	0.0	0.0	61.4	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	-0.7
264	912417.28	5022911.63	99.50	1	E	A	-33.2	8.1	0.0	0.0	0.0	61.4	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	-120.7
267	912432.19	5022923.68	99.50	1	D	A	86.8	15.0	0.0	0.0	0.0	61.2	6.9	-2.8	0.0	0.0	26.9	0.0	3.1	6.5
267	912432.19	5022923.68	99.50	1	N	A	86.8	15.0	0.0	0.0	0.0	61.2	6.9	-2.8	0.0	0.0	26.9	0.0	3.1	6.5
267	912432.19	5022923.68	99.50	1	E	A	-33.2	15.0	0.0	0.0	0.0	61.2	6.9	-2.8	0.0	0.0	26.9	0.0	3.1	-113.5
271	912418.43	5022912.56	99.50	1	D	A	86.8	9.8	0.0	0.0	0.0	61.7	7.1	-2.9	0.0	0.0	26.9	0.0	3.2	0.5
271	912418.43	5022912.56	99.50	1	N	A	86.8	9.8	0.0	0.0	0.0	61.7	7.1	-2.9	0.0	0.0	26.9	0.0	3.2	0.5
271	912418.43	5022912.56	99.50	1	E	A	-33.2	9.8	0.0	0.0	0.0	61.7	7.1	-2.9	0.0	0.0	26.9	0.0	3.2	-119.5
275	912424.59	5022917.54	99.50	1	D	A	86.8	8.1	0.0	0.0	0.0	61.6	7.1	-2.9	0.0	0.0	26.9	0.0	3.2	-1.0
275	912424.59	5022917.54	99.50	1	N	A	86.8	8.1	0.0	0.0	0.0	61.6	7.1	-2.9	0.0	0.0	26.9	0.0	3.2	-1.0
275	912424.59	5022917.54	99.50	1	E	A	-33.2	8.1	0.0	0.0	0.0	61.6	7.1	-2.9	0.0	0.0	26.9	0.0	3.2	-121.0
277	912430.43	5022922.26	99.50	1	D	A	86.8	9.4	0.0	0.0	0.0	61.5	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	0.4
277	912430.43	5022922.26	99.50	1	N	A	86.8	9.4	0.0	0.0	0.0	61.5	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	0.4
277	912430.43	5022922.26	99.50	1	E	A	-33.2	9.4	0.0	0.0	0.0	61.5	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	-119.6
279	912434.22	5022925.32	99.50	1	D	A	86.8	0.5	0.0	0.0	0.0	61.4	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	-8.3
279	912434.22	5022925.32	99.50	1	N	A	86.8	0.5	0.0	0.0	0.0	61.4	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	-8.3
279	912434.22	5022925.32	99.50	1	E	A	-33.2	0.5	0.0	0.0	0.0	61.4	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	-128.3
282	912427.84	5022744.68	99.87	0	D	A	86.8	14.5	0.0	0.0	0.0	59.3	6.0	-0.4	0.0	0.0	8.5	0.0	0.0	27.8
282	912427.84	5022744.68	99.87	0	N	A	86.8	14.5	0.0	0.0	0.0	59.3	6.0	-0.4	0.0	0.0	8.5	0.0	0.0	27.8
282	912427.84	5022744.68	99.87	0	E	A	-33.2	14.5	0.0	0.0	0.0	59.3	6.0	-0.4	0.0	0.0	8.5	0.0	0.0	-92.2
287	912144.36	5022493.45	110.37	0	D	A	86.8	21.1	0.0	0.0	0.0	66.7	9.7	-3.0	0.0	0.0	7.7	0.0	0.0	26.7
287	912144.36	5022493.45	110.37	0	N	A	86.8	21.1	0.0	0.0	0.0	66.7	9.7	-3.0	0.0	0.0	7.7	0.0	0.0	26.7
287	912144.36	5022493.45	110.37	0	E	A	-33.2	21.1	0.0	0.0	0.0	66.7	9.7	-3.0	0.0	0.0	7.7	0.0	0.0	-93.3
290	912420.49	5022718.72	103.14	0	D	A	86.8	14.2	0.0	0.0	0.0	59.6	6.2	-0.2	0.0	0.0	7.4	0.0	0.0	28.0
290	912420.49	5022718.72	103.14	0	N	A	86.8	14.2	0.0	0.0	0.0	59.6	6.2	-0.2	0.0	0.0	7.4	0.0	0.0	28.0
290	912420.49	5022718.72	103.14	0	E	A	-33.2	14.2	0.0	0.0	0.0	59.6	6.2	-0.2	0.0	0.0	7.4	0.0	0.0	-92.0
292	912437.74	5022784.09	99.50	0	D	A	86.8	13.3	0.0	0.0	0.0	59.0	5.9	-1.2	0.0	0.0	9.2	0.0	0.0	27.2
292	912437.74	5022784.09	99.50	0	N	A	86.8	13.3	0.0	0.0	0.0	59.0	5.9	-1.2	0.0	0.0	9.2	0.0	0.0	27.2
292	912437.74	5022784.09	99.50	0	E	A	-33.2	13.3	0.0	0.0	0.0	59.0	5.9	-1.2	0.0	0.0	9.2	0.0	0.0	-92.8
297	912439.17	5022804.61	99.50	0	D	A	86.8	12.9	0.0	0.0	0.0	59.0	5.9	-1.6	0.0	0.0	7.8	0.0	0.0	28.6
297	912439.17	5022804.61	99.50	0	N	A	86.8	12.9	0.0	0.0	0.0	59.0	5.9	-1.6	0.0	0.0	7.8	0.0	0.0	28.6
297	912439.17	5022804.61	99.50	0	E	A	-33.2	12.9	0.0	0.0	0.0	59.0	5.9	-1.6	0.0	0.0	7.8	0.0	0.0	-91.4
309	912439.09	5022808.84	99.50	1	D	A	86.8	7.2	0.0	0.0	0.0	61.5	7.0	-2.3	0.0	0.0	26.5	0.0	3.1	-1.9
309	912439.09	5022808.84	99.50	1	N	A	86.8	7.2	0.0	0.0	0.0	61.5	7.0	-2.3	0.0	0.0	26.5	0.0	3.1	-1.9
309	912439.09	5022808.84	99.50	1	E	A	-33.2	7.2	0.0	0.0	0.0	61.5	7.0	-2.3	0.0	0.0	26.5	0.0	3.1	-121.9
314	912406.43	5022677.64	112.04	0	D	A	86.8	13.6	0.0	0.0	0.0	60.4	6.5	-0.5	0.0	0.0	0.0	0.0	0.0	34.1
314	912406.43	5022677.64	112.04	0	N	A	86.8	13.6	0.0	0.0	0.0	60.4	6.5	-0.5	0.0	0.0	0.0	0.0	0.0	34.1
314	912406.43	5022677.64	112.04	0	E	A	-33.2	13.6	0.0	0.0	0.0	60.4	6.5	-0.5	0.0	0.0	0.0	0.0	0.0	-85.9
320	912414.15	5022697.08	107.96	0	D	A	86.8	12.9	0.0	0.0	0.0	60.0	6.3	-0.3	0.0	0.0	5.1	0.0	0.0	28.6
320	912414.15	5022697.08	107.96	0	N	A	86.8	12.9	0.0	0.0	0.0	60.0	6.3	-0.3	0.0	0.0	5.1	0.0	0.0	28.6
320	912414.15	5022697.08	107.96	0	E	A	-33.2	12.9	0.0	0.0	0.0	60.0	6.3	-0.3	0.0	0.0	5.1	0.0	0.0	-91.4
330	912433.97	5022765.78	99.50	0	D	A	86.8	12.0	0.0	0.0	0.0	59.1	5.9	-0.8	0.0	0.0	10.8	0.0	0.0	23.8
330	912433.97	5022765.78	99.50	0	N	A	86.8	12.0	0.0	0.0	0.0	59.1	5.9	-0.8	0.0	0.0	10.8	0.0	0.0	23.8
330	912433.97	5022765.78	99.50	0	E	A	-33.2	12.0	0.0	0.0	0.0	59.1	5.9	-0.8	0.0	0.0	10.8	0.0	0.0	-96.2

Line Source, ISO 9613, Name: "Delivery Trucks", ID: "BrTrkC1"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
333	912394.38	5022658.60	114.90	0	D	A	86.8	13.6	0.0	0.0	0.0	60.9	6.7	-1.0	0.0	0.0	0.0	0.0	0.0	33.8
333	912394.38	5022658.60	114.90	0	N	A	86.8	13.6	0.0	0.0	0.0	60.9	6.7	-1.0	0.0	0.0	0.0	0.0	0.0	33.8
333	912394.38	5022658.60	114.90	0	E	A	-33.2	13.6	0.0	0.0	0.0	60.9	6.7	-1.0	0.0	0.0	0.0	0.0	0.0	-86.2
334	911973.77	5022377.21	108.04	0	D	A	86.8	21.2	0.0	0.0	0.0	69.2	11.1	-3.3	0.0	0.0	0.0	0.0	0.0	31.1
334	911973.77	5022377.21	108.04	0	N	A	86.8	21.2	0.0	0.0	0.0	69.2	11.1	-3.3	0.0	0.0	0.0	0.0	0.0	31.1
334	911973.77	5022377.21	108.04	0	E	A	-33.2	21.2	0.0	0.0	0.0	69.2	11.1	-3.3	0.0	0.0	0.0	0.0	0.0	-88.9
343	912413.51	5022899.20	99.50	0	D	A	86.8	13.2	0.0	0.0	0.0	60.7	6.6	-2.5	0.0	0.0	7.3	0.0	0.0	27.9
343	912413.51	5022899.20	99.50	0	N	A	86.8	13.2	0.0	0.0	0.0	60.7	6.6	-2.5	0.0	0.0	7.3	0.0	0.0	27.9
343	912413.51	5022899.20	99.50	0	E	A	-33.2	13.2	0.0	0.0	0.0	60.7	6.6	-2.5	0.0	0.0	7.3	0.0	0.0	-92.1
348	912414.64	5022908.68	99.50	1	D	A	86.8	2.6	0.0	0.0	0.0	61.4	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	-6.3
348	912414.64	5022908.68	99.50	1	N	A	86.8	2.6	0.0	0.0	0.0	61.4	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	-6.3
348	912414.64	5022908.68	99.50	1	E	A	-33.2	2.6	0.0	0.0	0.0	61.4	7.0	-2.8	0.0	0.0	26.9	0.0	3.2	-126.3
349	912413.51	5022899.20	99.50	1	D	A	86.8	13.2	0.0	0.0	0.0	61.7	7.1	-2.8	0.0	0.0	26.9	0.0	3.2	3.9
349	912413.51	5022899.20	99.50	1	N	A	86.8	13.2	0.0	0.0	0.0	61.7	7.1	-2.8	0.0	0.0	26.9	0.0	3.2	3.9
349	912413.51	5022899.20	99.50	1	E	A	-33.2	13.2	0.0	0.0	0.0	61.7	7.1	-2.8	0.0	0.0	26.9	0.0	3.2	-116.1
371	912412.69	5022892.30	99.50	1	D	A	86.8	8.5	0.0	0.0	0.0	62.0	7.3	-2.8	0.0	0.0	26.9	0.0	3.2	-1.3
371	912412.69	5022892.30	99.50	1	N	A	86.8	8.5	0.0	0.0	0.0	62.0	7.3	-2.8	0.0	0.0	26.9	0.0	3.2	-1.3
371	912412.69	5022892.30	99.50	1	E	A	-33.2	8.5	0.0	0.0	0.0	62.0	7.3	-2.8	0.0	0.0	26.9	0.0	3.2	-121.3
378	912413.55	5022899.47	99.50	1	D	A	86.8	8.7	0.0	0.0	0.0	62.0	7.3	-2.9	0.0	0.0	26.9	0.0	3.2	-1.0
378	912413.55	5022899.47	99.50	1	N	A	86.8	8.7	0.0	0.0	0.0	62.0	7.3	-2.9	0.0	0.0	26.9	0.0	3.2	-1.0
378	912413.55	5022899.47	99.50	1	E	A	-33.2	8.7	0.0	0.0	0.0	62.0	7.3	-2.9	0.0	0.0	26.9	0.0	3.2	-121.0
385	912437.23	5022820.62	99.50	0	D	A	86.8	11.1	0.0	0.0	0.0	59.2	6.0	-1.8	0.0	0.0	7.0	0.0	0.0	27.4
385	912437.23	5022820.62	99.50	0	N	A	86.8	11.1	0.0	0.0	0.0	59.2	6.0	-1.8	0.0	0.0	7.0	0.0	0.0	27.4
385	912437.23	5022820.62	99.50	0	E	A	-33.2	11.1	0.0	0.0	0.0	59.2	6.0	-1.8	0.0	0.0	7.0	0.0	0.0	-92.6
391	912435.52	5022826.58	99.50	1	D	A	86.8	-4.1	0.0	0.0	0.0	61.2	6.9	-2.4	0.0	0.0	26.6	0.0	3.1	-12.7
391	912435.52	5022826.58	99.50	1	N	A	86.8	-4.1	0.0	0.0	0.0	61.2	6.9	-2.4	0.0	0.0	26.6	0.0	3.1	-12.7
391	912435.52	5022826.58	99.50	1	E	A	-33.2	-4.1	0.0	0.0	0.0	61.2	6.9	-2.4	0.0	0.0	26.6	0.0	3.1	-132.7
402	912060.11	5022435.94	109.02	0	D	A	86.8	18.8	0.0	0.0	0.0	68.0	10.4	-3.2	0.0	0.0	8.0	0.0	0.0	22.4
402	912060.11	5022435.94	109.02	0	N	A	86.8	18.8	0.0	0.0	0.0	68.0	10.4	-3.2	0.0	0.0	8.0	0.0	0.0	22.4
402	912060.11	5022435.94	109.02	0	E	A	-33.2	18.8	0.0	0.0	0.0	68.0	10.4	-3.2	0.0	0.0	8.0	0.0	0.0	-97.6
407	911914.05	5022335.69	107.50	0	D	A	86.8	11.3	0.0	0.0	0.0	69.9	11.5	-3.4	0.0	0.0	0.0	0.0	0.0	20.0
407	911914.05	5022335.69	107.50	0	N	A	86.8	11.3	0.0	0.0	0.0	69.9	11.5	-3.4	0.0	0.0	0.0	0.0	0.0	20.0
407	911914.05	5022335.69	107.50	0	E	A	-33.2	11.3	0.0	0.0	0.0	69.9	11.5	-3.4	0.0	0.0	0.0	0.0	0.0	-100.0

Receiver
Name: R08
ID: R08
X: 912686.47 m
Y: 5022765.42 m
Z: 115.28 m

Point Source, ISO 9613, Name: "Processing Plant", ID: "BrCVS_C1_unmit"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
55	912566.43	5022897.59	100.50	0	D	A	122.5	0.0	0.0	0.0	0.0	56.1	1.9	-1.2	0.0	0.0	17.4	0.0	0.0	48.3
55	912566.43	5022897.59	100.50	0	N	A	122.5	0.0	-188.0	0.0	0.0	56.1	1.9	-1.2	0.0	0.0	17.4	0.0	0.0	-139.7
55	912566.43	5022897.59	100.50	0	E	A	122.5	0.0	-188.0	0.0	0.0	56.1	1.9	-1.2	0.0	0.0	17.4	0.0	0.0	-139.7

Point Source, ISO 9613, Name: "Excavator", ID: "BrEXC_C1"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
62	912642.72	5022888.94	100.00	0	D	A	111.1	0.0	0.0	0.0	0.0	53.4	0.7	0.0	0.0	0.0	23.6	0.0	0.0	33.3
62	912642.72	5022888.94	100.00	0	N	A	111.1	0.0	0.0	0.0	0.0	53.4	0.7	0.0	0.0	0.0	23.6	0.0	0.0	33.3
62	912642.72	5022888.94	100.00	0	E	A	111.1	0.0	-188.0	0.0	0.0	53.4	0.7	0.0	0.0	0.0	23.6	0.0	0.0	-154.7

Point Source, ISO 9613, Name: "Front-end Loader", ID: "BrFEL_C1"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
75	912636.73	5022880.26	99.50	0	D	A	106.4	0.0	0.0	0.0	0.0	53.0	0.9	1.2	0.0	0.0	20.3	0.0	0.0	31.0
75	912636.73	5022880.26	99.50	0	N	A	106.4	0.0	0.0	0.0	0.0	53.0	0.9	1.2	0.0	0.0	20.3	0.0	0.0	31.0
75	912636.73	5022880.26	99.50	0	E	A	106.4	0.0	-188.0	0.0	0.0	53.0	0.9	1.2	0.0	0.0	20.3	0.0	0.0	-157.0

Point Source, ISO 9613, Name: "Two Front-end Loaders", ID: "BrFEL_C1"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
83	912558.76	5022902.49	99.50	0	D	A	109.4	0.0	0.0	0.0	0.0	56.5	1.2	-1.1	0.0	0.0	13.9	0.0	0.0	39.0
83	912558.76	5022902.49	99.50	0	N	A	109.4	0.0	0.0	0.0	0.0	56.5	1.2	-1.1	0.0	0.0	13.9	0.0	0.0	39.0
83	912558.76	5022902.49	99.50	0	E	A	109.4	0.0	-188.0	0.0	0.0	56.5	1.2	-1.1	0.0	0.0	13.9	0.0	0.0	-149.0

Point Source, ISO 9613, Name: "Additional Screens", ID: "BrSCR_C1_unmit"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
102	912568.83	5022888.17	100.50	0	D	A	109.5	0.0	0.0	0.0	0.0	55.6	1.1	-1.0	0.0	0.0	15.6	0.0	0.0	38.1
102	912568.83	5022888.17	100.50	0	N	A	109.5	0.0	-188.0	0.0	0.0	55.6	1.1	-1.0	0.0	0.0	15.6	0.0	0.0	-149.9
102	912568.83	5022888.17	100.50	0	E	A	109.5	0.0	-188.0	0.0	0.0	55.6	1.1	-1.0	0.0	0.0	15.6	0.0	0.0	-149.9

Line Source, ISO 9613, Name: "Delivery Trucks", ID: "BrTrkC1"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
109	912433.60	5022831.75	99.50	0	D	A	86.8	10.3	0.0	0.0	0.0	59.4	6.1	-1.9	0.0	0.0	14.5	0.0	0.0	19.0
109	912433.60	5022831.75	99.50	0	N	A	86.8	10.3	0.0	0.0	0.0	59.4	6.1	-1.9	0.0	0.0	14.5	0.0	0.0	19.0
109	912433.60	5022831.75	99.50	0	E	A	-33.2	10.3	0.0	0.0	0.0	59.4	6.1	-1.9	0.0	0.0	14.5	0.0	0.0	-101.0
117	912431.47	5022837.45	99.50	0	D	A	86.8	1.9	0.0	0.0	0.0	59.5	6.1	-2.0	0.0	0.0	18.4	0.0	0.0	6.6
117	912431.47	5022837.45	99.50	0	N	A	86.8	1.9	0.0	0.0	0.0	59.5	6.1	-2.0	0.0	0.0	18.4	0.0	0.0	6.6
117	912431.47	5022837.45	99.50	0	E	A	-33.2	1.9	0.0	0.0	0.0	59.5	6.1	-2.0	0.0	0.0	18.4	0.0	0.0	-113.4
121	912421.74	5022863.49	99.50	0	D	A	86.8	17.3	0.0	0.0	0.0	60.0	6.3	-2.2	0.0	0.0	18.1	0.0	0.0	21.8
121	912421.74	5022863.49	99.50	0	N	A	86.8	17.3	0.0	0.0	0.0	60.0	6.3	-2.2	0.0	0.0	18.1	0.0	0.0	21.8
121	912421.74	5022863.49	99.50	0	E	A	-33.2	17.3	0.0	0.0	0.0	60.0	6.3	-2.2	0.0	0.0	18.1	0.0	0.0	-98.2
128	912346.01	5022622.36	115.15	0	D	A	86.8	20.0	0.0	0.0	0.0	62.3	7.4	-1.0	0.0	0.0	5.8	0.0	0.0	32.1
128	912346.01	5022622.36	115.15	0	N	A	86.8	20.0	0.0	0.0	0.0	62.3	7.4	-1.0	0.0	0.0	5.8	0.0	0.0	32.1
128	912346.01	5022622.36	115.15	0	E	A	-33.2	20.0	0.0	0.0	0.0	62.3	7.4	-1.0	0.0	0.0	5.8	0.0	0.0	-87.9
149	912534.80	5022883.72	99.50	0	D	A	86.8	14.7	0.0	0.0	0.0	56.7	5.0	-1.7	0.0	0.0	20.2	0.0	0.0	21.3
149	912534.80	5022883.72	99.50	0	N	A	86.8	14.7	0.0	0.0	0.0	56.7	5.0	-1.7	0.0	0.0	20.2	0.0	0.0	21.3
149	912534.80	5022883.72	99.50	0	E	A	-33.2	14.7	0.0	0.0	0.0	56.7	5.0	-1.7	0.0	0.0	20.2	0.0	0.0	-98.7
159	912251.22	5022561.80	112.98	0	D	A	86.8	21.0	0.0	0.0	0.0	64.6	8.6	-1.5	0.0	0.0	6.2	0.0	0.0	29.8
159	912251.22	5022561.80	112.98	0	N	A	86.8	21.0	0.0	0.0	0.0	64.6	8.6	-1.5	0.0	0.0	6.2	0.0	0.0	29.8

Line Source, ISO 9613, Name: "Delivery Trucks", ID: "BrTrkC1"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
159	912251.22	5022561.80	112.98	0	E	A	-33.2	21.0	0.0	0.0	0.0	64.6	8.6	-1.5	0.0	0.0	6.2	0.0	0.0	-90.2
162	912490.18	5022915.83	99.50	0	D	A	86.8	15.6	0.0	0.0	0.0	58.9	5.8	-2.3	0.0	0.0	19.1	0.0	0.0	20.9
162	912490.18	5022915.83	99.50	0	N	A	86.8	15.6	0.0	0.0	0.0	58.9	5.8	-2.3	0.0	0.0	19.1	0.0	0.0	20.9
162	912490.18	5022915.83	99.50	0	E	A	-33.2	15.6	0.0	0.0	0.0	58.9	5.8	-2.3	0.0	0.0	19.1	0.0	0.0	-99.1
167	912510.41	5022892.03	99.50	0	D	A	86.8	14.2	0.0	0.0	0.0	57.7	5.4	-1.9	0.0	0.0	19.6	0.0	0.0	20.1
167	912510.41	5022892.03	99.50	0	N	A	86.8	14.2	0.0	0.0	0.0	57.7	5.4	-1.9	0.0	0.0	19.6	0.0	0.0	20.1
167	912510.41	5022892.03	99.50	0	E	A	-33.2	14.2	0.0	0.0	0.0	57.7	5.4	-1.9	0.0	0.0	19.6	0.0	0.0	-99.9
170	912462.09	5022932.23	99.50	0	D	A	86.8	15.5	0.0	0.0	0.0	59.9	6.3	-2.5	0.0	0.0	18.4	0.0	0.0	20.1
170	912462.09	5022932.23	99.50	0	N	A	86.8	15.5	0.0	0.0	0.0	59.9	6.3	-2.5	0.0	0.0	18.4	0.0	0.0	20.1
170	912462.09	5022932.23	99.50	0	E	A	-33.2	15.5	0.0	0.0	0.0	59.9	6.3	-2.5	0.0	0.0	18.4	0.0	0.0	-99.9
178	912429.66	5022921.63	99.50	0	D	A	86.8	15.8	0.0	0.0	0.0	60.6	6.6	-2.6	0.0	0.0	17.8	0.0	0.0	20.2
178	912429.66	5022921.63	99.50	0	N	A	86.8	15.8	0.0	0.0	0.0	60.6	6.6	-2.6	0.0	0.0	17.8	0.0	0.0	20.2
178	912429.66	5022921.63	99.50	0	E	A	-33.2	15.8	0.0	0.0	0.0	60.6	6.6	-2.6	0.0	0.0	17.8	0.0	0.0	-99.8
192	912427.84	5022744.68	99.87	0	D	A	86.8	14.5	0.0	0.0	0.0	59.3	6.0	-0.4	0.0	0.0	17.6	0.0	0.0	18.6
192	912427.84	5022744.68	99.87	0	N	A	86.8	14.5	0.0	0.0	0.0	59.3	6.0	-0.4	0.0	0.0	17.6	0.0	0.0	18.6
192	912427.84	5022744.68	99.87	0	E	A	-33.2	14.5	0.0	0.0	0.0	59.3	6.0	-0.4	0.0	0.0	17.6	0.0	0.0	-101.4
196	912144.36	5022493.45	110.37	0	D	A	86.8	21.1	0.0	0.0	0.0	66.7	9.7	-1.7	0.0	0.0	6.5	0.0	0.0	26.7
196	912144.36	5022493.45	110.37	0	N	A	86.8	21.1	0.0	0.0	0.0	66.7	9.7	-1.7	0.0	0.0	6.5	0.0	0.0	26.7
196	912144.36	5022493.45	110.37	0	E	A	-33.2	21.1	0.0	0.0	0.0	66.7	9.7	-1.7	0.0	0.0	6.5	0.0	0.0	-93.3
198	912420.49	5022718.72	103.14	0	D	A	86.8	14.2	0.0	0.0	0.0	59.6	6.2	-0.2	0.0	0.0	16.1	0.0	0.0	19.3
198	912420.49	5022718.72	103.14	0	N	A	86.8	14.2	0.0	0.0	0.0	59.6	6.2	-0.2	0.0	0.0	16.1	0.0	0.0	19.3
198	912420.49	5022718.72	103.14	0	E	A	-33.2	14.2	0.0	0.0	0.0	59.6	6.2	-0.2	0.0	0.0	16.1	0.0	0.0	-100.7
200	912437.74	5022784.09	99.50	0	D	A	86.8	13.3	0.0	0.0	0.0	59.0	5.9	-1.2	0.0	0.0	14.2	0.0	0.0	22.3
200	912437.74	5022784.09	99.50	0	N	A	86.8	13.3	0.0	0.0	0.0	59.0	5.9	-1.2	0.0	0.0	14.2	0.0	0.0	22.3
200	912437.74	5022784.09	99.50	0	E	A	-33.2	13.3	0.0	0.0	0.0	59.0	5.9	-1.2	0.0	0.0	14.2	0.0	0.0	-97.7
220	912439.17	5022804.61	99.50	0	D	A	86.8	12.9	0.0	0.0	0.0	59.0	5.9	-1.6	0.0	0.0	14.7	0.0	0.0	21.7
220	912439.17	5022804.61	99.50	0	N	A	86.8	12.9	0.0	0.0	0.0	59.0	5.9	-1.6	0.0	0.0	14.7	0.0	0.0	21.7
220	912439.17	5022804.61	99.50	0	E	A	-33.2	12.9	0.0	0.0	0.0	59.0	5.9	-1.6	0.0	0.0	14.7	0.0	0.0	-98.3
224	912406.43	5022677.64	112.04	0	D	A	86.8	13.6	0.0	0.0	0.0	60.4	6.5	-0.5	0.0	0.0	5.8	0.0	0.0	28.2
224	912406.43	5022677.64	112.04	0	N	A	86.8	13.6	0.0	0.0	0.0	60.4	6.5	-0.5	0.0	0.0	5.8	0.0	0.0	28.2
224	912406.43	5022677.64	112.04	0	E	A	-33.2	13.6	0.0	0.0	0.0	60.4	6.5	-0.5	0.0	0.0	5.8	0.0	0.0	-91.8
227	912414.15	5022697.08	107.96	0	D	A	86.8	12.9	0.0	0.0	0.0	60.0	6.3	-0.3	0.0	0.0	12.4	0.0	0.0	21.3
227	912414.15	5022697.08	107.96	0	N	A	86.8	12.9	0.0	0.0	0.0	60.0	6.3	-0.3	0.0	0.0	12.4	0.0	0.0	21.3
227	912414.15	5022697.08	107.96	0	E	A	-33.2	12.9	0.0	0.0	0.0	60.0	6.3	-0.3	0.0	0.0	12.4	0.0	0.0	-98.7
231	912433.97	5022765.78	99.50	0	D	A	86.8	12.0	0.0	0.0	0.0	59.1	5.9	-0.8	0.0	0.0	18.2	0.0	0.0	16.4
231	912433.97	5022765.78	99.50	0	N	A	86.8	12.0	0.0	0.0	0.0	59.1	5.9	-0.8	0.0	0.0	18.2	0.0	0.0	16.4
231	912433.97	5022765.78	99.50	0	E	A	-33.2	12.0	0.0	0.0	0.0	59.1	5.9	-0.8	0.0	0.0	18.2	0.0	0.0	-103.6
263	912394.38	5022658.60	114.90	0	D	A	86.8	13.6	0.0	0.0	0.0	60.9	6.7	-1.0	0.0	0.0	5.9	0.0	0.0	27.9
263	912394.38	5022658.60	114.90	0	N	A	86.8	13.6	0.0	0.0	0.0	60.9	6.7	-1.0	0.0	0.0	5.9	0.0	0.0	27.9
263	912394.38	5022658.60	114.90	0	E	A	-33.2	13.6	0.0	0.0	0.0	60.9	6.7	-1.0	0.0	0.0	5.9	0.0	0.0	-92.1
278	911973.77	5022377.21	108.04	0	D	A	86.8	21.2	0.0	0.0	0.0	69.2	11.1	-2.4	0.0	0.0	7.2	0.0	0.0	22.9
278	911973.77	5022377.21	108.04	0	N	A	86.8	21.2	0.0	0.0	0.0	69.2	11.1	-2.4	0.0	0.0	7.2	0.0	0.0	22.9
278	911973.77	5022377.21	108.04	0	E	A	-33.2	21.2	0.0	0.0	0.0	69.2	11.1	-2.4	0.0	0.0	7.2	0.0	0.0	-97.1
289	912413.51	5022899.20	99.50	0	D	A	86.8	13.2	0.0	0.0	0.0	60.7	6.6	-2.5	0.0	0.0	17.7	0.0	0.0	17.5
289	912413.51	5022899.20	99.50	0	N	A	86.8	13.2	0.0	0.0	0.0	60.7	6.6	-2.5	0.0	0.0	17.7	0.0	0.0	17.5
289	912413.51	5022899.20	99.50	0	E	A	-33.2	13.2	0.0	0.0	0.0	60.7	6.6	-2.5	0.0	0.0	17.7	0.0	0.0	-102.5
291	912437.23	5022820.62	99.50	0	D	A	86.8	11.1	0.0	0.0	0.0	59.2	6.0	-1.8	0.0	0.0	14.7	0.0	0.0	19.8
291	912437.23	5022820.62	99.50	0	N	A	86.8	11.1	0.0	0.0	0.0	59.2	6.0	-1.8	0.0	0.0	14.7	0.0	0.0	19.8
291	912437.23	5022820.62	99.50	0	E	A	-33.2	11.1	0.0	0.0	0.0	59.2	6.0	-1.8	0.0	0.0	14.7	0.0	0.0	-100.2
295	912060.11	5022435.94	109.02	0	D	A	86.8	18.8	0.0	0.0	0.0	68.0	10.4	-2.1	0.0	0.0	6.9	0.0	0.0	22.4
295	912060.11	5022435.94	109.02	0	N	A	86.8	18.8	0.0	0.0	0.0	68.0	10.4	-2.1	0.0	0.0	6.9	0.0	0.0	22.4
295	912060.11	5022435.94	109.02	0	E	A	-33.2	18.8	0.0	0.0	0.0	68.0	10.4	-2.1	0.0	0.0	6.9	0.0	0.0	-97.6
298	911914.05	5022335.69	107.50	0	D	A	86.8	11.3	0.0	0.0	0.0	69.9	11.5	-2.6	0.0	0.0	7.3	0.0	0.0	11.8
298	911914.05	5022335.69	107.50	0	N	A	86.8	11.3	0.0	0.0	0.0	69.9	11.5	-2.6	0.0	0.0	7.3	0.0	0.0	11.8
298	911914.05	5022335.69	107.50	0	E	A	-33.2	11.3	0.0	0.0	0.0	69.9	11.5	-2.6	0.0	0.0	7.3	0.0	0.0	-108.2

Receiver
Name: R08
ID: R08
X: 912686.47 m
Y: 5022765.42 m
Z: 115.28 m

Point Source, ISO 9613, Name: "Processing Plant", ID: "DrCVS_PRCS"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
8	912448.77	5023314.62	100.50	0	D	A	122.5	0.0	0.0	0.0	0.0	66.5	4.3	-3.6	0.0	0.0	14.0	0.0	0.0	41.3
8	912448.77	5023314.62	100.50	0	N	A	122.5	0.0	-188.0	0.0	0.0	66.5	4.3	-3.6	0.0	0.0	14.0	0.0	0.0	-146.7
8	912448.77	5023314.62	100.50	0	E	A	122.5	0.0	-188.0	0.0	0.0	66.5	4.3	-3.6	0.0	0.0	14.0	0.0	0.0	-146.7

Point Source, ISO 9613, Name: "Two Front-end Loaders", ID: "DrFEL_PRCS"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
33	912450.35	5023307.10	99.50	0	D	A	109.4	0.0	0.0	0.0	0.0	66.4	2.3	-3.1	0.0	0.0	12.1	0.0	0.0	31.6
33	912450.35	5023307.10	99.50	0	N	A	109.4	0.0	0.0	0.0	0.0	66.4	2.3	-3.1	0.0	0.0	12.1	0.0	0.0	31.6
33	912450.35	5023307.10	99.50	0	E	A	109.4	0.0	-188.0	0.0	0.0	66.4	2.3	-3.1	0.0	0.0	12.1	0.0	0.0	-156.4

Point Source, ISO 9613, Name: "Front-end Loader", ID: "DrFEL_TYP"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
140	912421.08	5023398.87	99.50	0	D	A	106.4	0.0	0.0	0.0	0.0	67.7	2.5	-3.2	0.0	0.0	11.3	0.0	0.0	28.0
140	912421.08	5023398.87	99.50	0	N	A	106.4	0.0	0.0	0.0	0.0	67.7	2.5	-3.2	0.0	0.0	11.3	0.0	0.0	28.0
140	912421.08	5023398.87	99.50	0	E	A	106.4	0.0	-188.0	0.0	0.0	67.7	2.5	-3.2	0.0	0.0	11.3	0.0	0.0	-160.0

Point Source, ISO 9613, Name: "Excavator", ID: "DrExc"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
251	912471.92	5023369.38	99.50	0	D	A	101.9	0.0	0.0	0.0	0.0	67.1	3.0	-3.4	0.0	0.0	17.0	0.0	0.0	18.2
251	912471.92	5023369.38	99.50	0	N	A	101.9	0.0	0.0	0.0	0.0	67.1	3.0	-3.4	0.0	0.0	17.0	0.0	0.0	18.2
251	912471.92	5023369.38	99.50	0	E	A	101.9	0.0	-188.0	0.0	0.0	67.1	3.0	-3.4	0.0	0.0	17.0	0.0	0.0	-169.8

Line Source, ISO 9613, Name: "Delivery Trucks", ID: "DrTrk"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
54	912148.62	5022985.31	108.50	0	D	A	83.7	20.8	0.0	0.0	0.0	66.3	9.5	-3.4	0.0	0.0	0.0	0.0	0.0	32.2
54	912148.62	5022985.31	108.50	0	N	A	83.7	20.8	0.0	0.0	0.0	66.3	9.5	-3.4	0.0	0.0	0.0	0.0	0.0	32.2
54	912148.62	5022985.31	108.50	0	E	A	-33.2	20.8	0.0	0.0	0.0	66.3	9.5	-3.4	0.0	0.0	0.0	0.0	0.0	-84.8
102	912191.47	5023013.38	108.50	1	D	A	83.7	12.4	0.0	0.0	0.0	66.2	9.4	-3.7	0.0	0.0	26.7	0.0	4.0	-6.6
102	912191.47	5023013.38	108.50	1	N	A	83.7	12.4	0.0	0.0	0.0	66.2	9.4	-3.7	0.0	0.0	26.7	0.0	4.0	-6.6
102	912191.47	5023013.38	108.50	1	E	A	-33.2	12.4	0.0	0.0	0.0	66.2	9.4	-3.7	0.0	0.0	26.7	0.0	4.0	-123.6
108	912177.48	5023004.22	108.50	1	D	A	83.7	12.1	0.0	0.0	0.0	66.4	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-7.1
108	912177.48	5023004.22	108.50	1	N	A	83.7	12.1	0.0	0.0	0.0	66.4	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-7.1
108	912177.48	5023004.22	108.50	1	E	A	-33.2	12.1	0.0	0.0	0.0	66.4	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-124.1
119	912192.70	5023014.19	108.50	1	D	A	83.7	11.6	0.0	0.0	0.0	66.4	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-7.6
119	912192.70	5023014.19	108.50	1	N	A	83.7	11.6	0.0	0.0	0.0	66.4	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-7.6
119	912192.70	5023014.19	108.50	1	E	A	-33.2	11.6	0.0	0.0	0.0	66.4	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-124.6
123	912181.65	5023006.95	108.50	1	D	A	83.7	10.8	0.0	0.0	0.0	66.5	9.6	-3.7	0.0	0.0	26.7	0.0	4.0	-8.6
123	912181.65	5023006.95	108.50	1	N	A	83.7	10.8	0.0	0.0	0.0	66.5	9.6	-3.7	0.0	0.0	26.7	0.0	4.0	-8.6
123	912181.65	5023006.95	108.50	1	E	A	-33.2	10.8	0.0	0.0	0.0	66.5	9.6	-3.7	0.0	0.0	26.7	0.0	4.0	-125.5
128	912140.90	5022980.25	108.50	1	D	A	83.7	19.3	0.0	0.0	0.0	66.9	9.8	-3.7	0.0	0.0	26.7	0.0	4.1	-0.7
128	912140.90	5022980.25	108.50	1	N	A	83.7	19.3	0.0	0.0	0.0	66.9	9.8	-3.7	0.0	0.0	26.7	0.0	4.1	-0.7
128	912140.90	5022980.25	108.50	1	E	A	-33.2	19.3	0.0	0.0	0.0	66.9	9.8	-3.7	0.0	0.0	26.7	0.0	4.1	-117.7
130	912101.88	5022954.68	108.50	1	D	A	83.7	9.0	0.0	0.0	0.0	67.4	10.0	-3.7	0.0	0.0	26.6	0.0	4.2	-11.7
130	912101.88	5022954.68	108.50	1	N	A	83.7	9.0	0.0	0.0	0.0	67.4	10.0	-3.7	0.0	0.0	26.6	0.0	4.2	-11.7
130	912101.88	5022954.68	108.50	1	E	A	-33.2	9.0	0.0	0.0	0.0	67.4	10.0	-3.7	0.0	0.0	26.6	0.0	4.2	-128.7
133	912128.82	5022972.33	108.50	1	D	A	83.7	12.6	0.0	0.0	0.0	67.2	10.0	-3.7	0.0	0.0	26.6	0.0	6.9	-10.6
133	912128.82	5022972.33	108.50	1	N	A	83.7	12.6	0.0	0.0	0.0	67.2	10.0	-3.7	0.0	0.0	26.6	0.0	6.9	-10.6
133	912128.82	5022972.33	108.50	1	E	A	-33.2	12.6	0.0	0.0	0.0	67.2	10.0	-3.7	0.0	0.0	26.6	0.0	6.9	-127.6

Line Source, ISO 9613, Name: "Delivery Trucks", ID: "DrTrk"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
136	912109.87	5022959.92	108.50	1	D	A	83.7	14.3	0.0	0.0	0.0	67.4	10.1	-3.8	0.0	0.0	26.6	0.0	7.0	-9.3
136	912109.87	5022959.92	108.50	1	N	A	83.7	14.3	0.0	0.0	0.0	67.4	10.1	-3.8	0.0	0.0	26.6	0.0	7.0	-9.3
136	912109.87	5022959.92	108.50	1	E	A	-33.2	14.3	0.0	0.0	0.0	67.4	10.1	-3.8	0.0	0.0	26.6	0.0	7.0	-126.3
159	912231.64	5023042.42	109.49	0	D	A	83.7	19.1	0.0	0.0	0.0	65.5	9.0	-3.5	0.0	0.0	0.0	0.0	0.0	31.8
159	912231.64	5023042.42	109.49	0	N	A	83.7	19.1	0.0	0.0	0.0	65.5	9.0	-3.5	0.0	0.0	0.0	0.0	0.0	31.8
159	912231.64	5023042.42	109.49	0	E	A	-33.2	19.1	0.0	0.0	0.0	65.5	9.0	-3.5	0.0	0.0	0.0	0.0	0.0	-85.2
176	912256.21	5023060.55	110.23	1	D	A	83.7	12.6	0.0	0.0	0.0	65.7	9.1	-3.6	0.0	0.0	26.8	0.0	3.9	-5.5
176	912256.21	5023060.55	110.23	1	N	A	83.7	12.6	0.0	0.0	0.0	65.7	9.1	-3.6	0.0	0.0	26.8	0.0	3.9	-5.5
176	912256.21	5023060.55	110.23	1	E	A	-33.2	12.6	0.0	0.0	0.0	65.7	9.1	-3.6	0.0	0.0	26.8	0.0	3.9	-122.5
184	912223.83	5023036.66	109.25	1	D	A	83.7	18.0	0.0	0.0	0.0	65.9	9.3	-3.6	0.0	0.0	26.8	0.0	3.9	-0.5
184	912223.83	5023036.66	109.25	1	N	A	83.7	18.0	0.0	0.0	0.0	65.9	9.3	-3.6	0.0	0.0	26.8	0.0	3.9	-0.5
184	912223.83	5023036.66	109.25	1	E	A	-33.2	18.0	0.0	0.0	0.0	65.9	9.3	-3.6	0.0	0.0	26.8	0.0	3.9	-117.5
188	912200.95	5023019.79	108.57	1	D	A	83.7	3.1	0.0	0.0	0.0	66.3	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-16.0
188	912200.95	5023019.79	108.57	1	N	A	83.7	3.1	0.0	0.0	0.0	66.3	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-16.0
188	912200.95	5023019.79	108.57	1	E	A	-33.2	3.1	0.0	0.0	0.0	66.3	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-133.0
192	912199.41	5023018.65	108.52	1	D	A	83.7	2.5	0.0	0.0	0.0	66.3	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-16.6
192	912199.41	5023018.65	108.52	1	N	A	83.7	2.5	0.0	0.0	0.0	66.3	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-16.6
192	912199.41	5023018.65	108.52	1	E	A	-33.2	2.5	0.0	0.0	0.0	66.3	9.5	-3.7	0.0	0.0	26.7	0.0	4.0	-133.6
195	912055.26	5022922.89	108.11	0	D	A	83.7	20.2	0.0	0.0	0.0	67.3	10.0	-3.4	0.0	0.0	0.0	0.0	0.0	30.1
195	912055.26	5022922.89	108.11	0	N	A	83.7	20.2	0.0	0.0	0.0	67.3	10.0	-3.4	0.0	0.0	0.0	0.0	0.0	30.1
195	912055.26	5022922.89	108.11	0	E	A	-33.2	20.2	0.0	0.0	0.0	67.3	10.0	-3.4	0.0	0.0	0.0	0.0	0.0	-86.9
217	912064.63	5022929.31	108.19	1	D	A	83.7	12.5	0.0	0.0	0.0	68.1	10.5	-3.8	0.0	0.0	26.5	0.0	7.3	-12.3
217	912064.63	5022929.31	108.19	1	N	A	83.7	12.5	0.0	0.0	0.0	68.1	10.5	-3.8	0.0	0.0	26.5	0.0	7.3	-12.3
217	912064.63	5022929.31	108.19	1	E	A	-33.2	12.5	0.0	0.0	0.0	68.1	10.5	-3.8	0.0	0.0	26.5	0.0	7.3	-129.3
240	912086.83	5022944.48	108.39	1	D	A	83.7	14.5	0.0	0.0	0.0	67.5	10.1	-3.8	0.0	0.0	26.6	0.0	4.2	-6.4
240	912086.83	5022944.48	108.39	1	N	A	83.7	14.5	0.0	0.0	0.0	67.5	10.1	-3.8	0.0	0.0	26.6	0.0	4.2	-6.4
240	912086.83	5022944.48	108.39	1	E	A	-33.2	14.5	0.0	0.0	0.0	67.5	10.1	-3.8	0.0	0.0	26.6	0.0	4.2	-123.4
242	912063.73	5022928.69	108.18	1	D	A	83.7	14.4	0.0	0.0	0.0	67.8	10.3	-3.8	0.0	0.0	26.6	0.0	4.2	-6.9
242	912063.73	5022928.69	108.18	1	N	A	83.7	14.4	0.0	0.0	0.0	67.8	10.3	-3.8	0.0	0.0	26.6	0.0	4.2	-6.9
242	912063.73	5022928.69	108.18	1	E	A	-33.2	14.4	0.0	0.0	0.0	67.8	10.3	-3.8	0.0	0.0	26.6	0.0	4.2	-123.9
244	912094.56	5022949.77	108.46	1	D	A	83.7	9.9	0.0	0.0	0.0	67.6	10.2	-3.8	0.0	0.0	26.6	0.0	7.1	-14.1
244	912094.56	5022949.77	108.46	1	N	A	83.7	9.9	0.0	0.0	0.0	67.6	10.2	-3.8	0.0	0.0	26.6	0.0	7.1	-14.1
244	912094.56	5022949.77	108.46	1	E	A	-33.2	9.9	0.0	0.0	0.0	67.6	10.2	-3.8	0.0	0.0	26.6	0.0	7.1	-131.0
245	912079.17	5022939.25	108.32	1	D	A	83.7	14.4	0.0	0.0	0.0	67.8	10.3	-3.8	0.0	0.0	26.6	0.0	7.1	-9.8
245	912079.17	5022939.25	108.32	1	N	A	83.7	14.4	0.0	0.0	0.0	67.8	10.3	-3.8	0.0	0.0	26.6	0.0	7.1	-9.8
245	912079.17	5022939.25	108.32	1	E	A	-33.2	14.4	0.0	0.0	0.0	67.8	10.3	-3.8	0.0	0.0	26.6	0.0	7.1	-126.8
246	912054.84	5022922.61	108.10	1	D	A	83.7	15.0	0.0	0.0	0.0	68.0	10.4	-3.8	0.0	0.0	26.5	0.0	4.3	-6.8
246	912054.84	5022922.61	108.10	1	N	A	83.7	15.0	0.0	0.0	0.0	68.0	10.4	-3.8	0.0	0.0	26.5	0.0	4.3	-6.8
246	912054.84	5022922.61	108.10	1	E	A	-33.2	15.0	0.0	0.0	0.0	68.0	10.4	-3.8	0.0	0.0	26.5	0.0	4.3	-123.8
248	912026.92	5022903.52	107.85	1	D	A	83.7	15.6	0.0	0.0	0.0	68.3	10.6	-3.8	0.0	0.0	26.5	0.0	4.4	-6.6
248	912026.92	5022903.52	107.85	1	N	A	83.7	15.6	0.0	0.0	0.0	68.3	10.6	-3.8	0.0	0.0	26.5	0.0	4.4	-6.6
248	912026.92	5022903.52	107.85	1	E	A	-33.2	15.6	0.0	0.0	0.0	68.3	10.6	-3.8	0.0	0.0	26.5	0.0	4.4	-123.6
249	912291.23	5023085.04	110.49	0	D	A	83.7	18.1	0.0	0.0	0.0	65.1	8.8	-3.6	0.0	0.0	0.0	0.0	0.0	31.5
249	912291.23	5023085.04	110.49	0	N	A	83.7	18.1	0.0	0.0	0.0	65.1	8.8	-3.6	0.0	0.0	0.0	0.0	0.0	31.5
249	912291.23	5023085.04	110.49	0	E	A	-33.2	18.1	0.0	0.0	0.0	65.1	8.8	-3.6	0.0	0.0	0.0	0.0	0.0	-85.5
252	911953.51	5022856.97	106.78	0	D	A	83.7	17.9	0.0	0.0	0.0	68.4	10.6	-3.5	0.0	0.0	0.0	0.0	0.0	26.2
252	911953.51	5022856.97	106.78	0	N	A	83.7	17.9	0.0	0.0	0.0	68.4	10.6	-3.5	0.0	0.0	0.0	0.0	0.0	26.2
252	911953.51	5022856.97	106.78	0	E	A	-33.2	17.9	0.0	0.0	0.0	68.4	10.6	-3.5	0.0	0.0	0.0	0.0	0.0	-90.8
259	911973.51	5022868.74	106.99	1	D	A	83.7	12.0	0.0	0.0	0.0	68.9	10.9	-3.9	0.0	0.0	26.4	0.0	4.5	-11.1
259	911973.51	5022868.74	106.99	1	N	A	83.7	12.0	0.0	0.0	0.0	68.9	10.9	-3.9	0.0	0.0	26.4	0.0	4.5	-11.1
259	911973.51	5022868.74	106.99	1	E	A	-33.2	12.0	0.0	0.0	0.0	68.9	10.9	-3.9	0.0	0.0	26.4	0.0	4.5	-128.1
261	911963.34	5022862.76	106.88	1	D	A	83.7	8.9	0.0	0.0	0.0	69.0	11.0	-3.9	0.0	0.0	26.3	0.0	4.5	-14.4
261	911963.34	5022862.76	106.88	1	N	A	83.7	8.9	0.0	0.0	0.0	69.0	11.0	-3.9	0.0	0.0	26.3	0.0	4.5	-14.4
261	911963.34	5022862.76	106.88	1	E	A	-33.2	8.9	0.0	0.0	0.0	69.0	11.0	-3.9	0.0	0.0	26.3	0.0	4.5	-131.3
262	911950.39	5022855.14	106.75	1	D	A	83.7	13.5	0.0	0.0	0.0	69.2	11.1	-3.9	0.0	0.0	26.3	0.0	4.5	-10.0
262	911950.39	5022855.14	106.75	1	N	A	83.7	13.5	0.0	0.0	0.0	69.2	11.1	-3.9	0.0	0.0	26.3	0.0	4.5	-10.0
262	911950.39	5022855.14	106.75	1	E	A	-33.2	13.5	0.0	0.0	0.0	69.2	11.1	-3.9	0.0	0.0	26.3	0.0	4.5	-127.0
263	912337.79	5023221.92	99.50	0	D	A	83.7	14.4	0.0	0.0	0.0	66.2	9.4	-3.8	0.0	0.0	16.4	0.0	0.0	10.0
263	912337.79	5023221.92	99.50	0	N	A	83.7	14.4	0.0	0.0	0.0	66.2	9.4	-3.8	0.0	0.0	16.4	0.0	0.0	10.0
263	912337.79	5023221.92	99.50	0	E	A	-33.2	14.4	0.0	0.0	0.0	66.2	9.4	-3.8	0.0	0.0	16.4	0.0	0.0	-107.0
266	912407.77	5023320.51	99.50	0	D	A	83.7	15.1	0.0	0.0	0.0	66.9	9.8	-3.9	0.0	0.0	15.3	0.0	0.0	10.8
266	912407.77	5023320.51	99.50	0	N	A	83.7	15.1	0.0	0.0	0.0	66.9	9.8	-3.9	0.0	0.0	15.3	0.0	0.0	10.8

Line Source, ISO 9613, Name: "Delivery Trucks", ID: "DrTrk"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
266	912407.77	5023320.51	99.50	0	E	A	-33.2	15.1	0.0	0.0	0.0	66.9	9.8	-3.9	0.0	0.0	15.3	0.0	0.0	-106.2
272	912415.03	5023319.09	99.50	2	D	A	83.7	7.1	0.0	0.0	0.0	66.8	9.7	-3.9	0.0	0.0	27.0	0.0	74.9	-83.6
272	912415.03	5023319.09	99.50	2	N	A	83.7	7.1	0.0	0.0	0.0	66.8	9.7	-3.9	0.0	0.0	27.0	0.0	74.9	-83.6
272	912415.03	5023319.09	99.50	2	E	A	-33.2	7.1	0.0	0.0	0.0	66.8	9.7	-3.9	0.0	0.0	27.0	0.0	74.9	-200.6
277	911996.15	5022883.02	107.39	0	D	A	83.7	15.8	0.0	0.0	0.0	67.9	10.3	-3.4	0.0	0.0	0.0	0.0	0.0	24.7
277	911996.15	5022883.02	107.39	0	N	A	83.7	15.8	0.0	0.0	0.0	67.9	10.3	-3.4	0.0	0.0	0.0	0.0	0.0	24.7
277	911996.15	5022883.02	107.39	0	E	A	-33.2	15.8	0.0	0.0	0.0	67.9	10.3	-3.4	0.0	0.0	0.0	0.0	0.0	-92.3
279	912008.03	5022890.73	107.63	1	D	A	83.7	9.7	0.0	0.0	0.0	68.5	10.7	-3.8	0.0	0.0	26.4	0.0	4.4	-12.8
279	912008.03	5022890.73	107.63	1	N	A	83.7	9.7	0.0	0.0	0.0	68.5	10.7	-3.8	0.0	0.0	26.4	0.0	4.4	-12.8
279	912008.03	5022890.73	107.63	1	E	A	-33.2	9.7	0.0	0.0	0.0	68.5	10.7	-3.8	0.0	0.0	26.4	0.0	4.4	-129.8
282	911992.22	5022880.47	107.31	1	D	A	83.7	14.5	0.0	0.0	0.0	68.7	10.8	-3.8	0.0	0.0	26.4	0.0	4.4	-8.3
282	911992.22	5022880.47	107.31	1	N	A	83.7	14.5	0.0	0.0	0.0	68.7	10.8	-3.8	0.0	0.0	26.4	0.0	4.4	-8.3
282	911992.22	5022880.47	107.31	1	E	A	-33.2	14.5	0.0	0.0	0.0	68.7	10.8	-3.8	0.0	0.0	26.4	0.0	4.4	-125.2
286	912359.81	5023170.60	101.48	0	D	A	83.7	12.9	0.0	0.0	0.0	65.3	8.9	-3.8	0.0	0.0	19.2	0.0	0.0	6.9
286	912359.81	5023170.60	101.48	0	N	A	83.7	12.9	0.0	0.0	0.0	65.3	8.9	-3.8	0.0	0.0	19.2	0.0	0.0	6.9
286	912359.81	5023170.60	101.48	0	E	A	-33.2	12.9	0.0	0.0	0.0	65.3	8.9	-3.8	0.0	0.0	19.2	0.0	0.0	-110.1
289	912360.67	5023174.65	101.07	1	D	A	83.7	10.5	0.0	0.0	0.0	65.4	9.0	-3.7	0.0	0.0	27.8	0.0	61.7	-66.0
289	912360.67	5023174.65	101.07	1	N	A	83.7	10.5	0.0	0.0	0.0	65.4	9.0	-3.7	0.0	0.0	27.8	0.0	61.7	-66.0
289	912360.67	5023174.65	101.07	1	E	A	-33.2	10.5	0.0	0.0	0.0	65.4	9.0	-3.7	0.0	0.0	27.8	0.0	61.7	-183.0
290	912359.07	5023167.08	101.83	1	D	A	83.7	6.5	0.0	0.0	0.0	65.3	8.9	-3.7	0.0	0.0	27.9	0.0	61.2	-69.3
290	912359.07	5023167.08	101.83	1	N	A	83.7	6.5	0.0	0.0	0.0	65.3	8.9	-3.7	0.0	0.0	27.9	0.0	61.2	-69.3
290	912359.07	5023167.08	101.83	1	E	A	-33.2	6.5	0.0	0.0	0.0	65.3	8.9	-3.7	0.0	0.0	27.9	0.0	61.2	-186.3
295	912343.93	5023129.59	107.23	0	D	A	83.7	11.1	0.0	0.0	0.0	65.0	8.8	-3.7	0.0	0.0	13.1	0.0	0.0	11.7
295	912343.93	5023129.59	107.23	0	N	A	83.7	11.1	0.0	0.0	0.0	65.0	8.8	-3.7	0.0	0.0	13.1	0.0	0.0	11.7
295	912343.93	5023129.59	107.23	0	E	A	-33.2	11.1	0.0	0.0	0.0	65.0	8.8	-3.7	0.0	0.0	13.1	0.0	0.0	-105.3
297	912339.41	5023123.33	108.10	0	D	A	83.7	4.2	0.0	0.0	0.0	65.0	8.7	-3.7	0.0	0.0	8.5	0.0	0.0	9.5
297	912339.41	5023123.33	108.10	0	N	A	83.7	4.2	0.0	0.0	0.0	65.0	8.7	-3.7	0.0	0.0	8.5	0.0	0.0	9.5
297	912339.41	5023123.33	108.10	0	E	A	-33.2	4.2	0.0	0.0	0.0	65.0	8.7	-3.7	0.0	0.0	8.5	0.0	0.0	-107.5
307	912389.89	5023323.54	99.50	0	D	A	83.7	6.3	0.0	0.0	0.0	67.0	9.8	-3.9	0.0	0.0	16.3	0.0	0.0	0.8
307	912389.89	5023323.54	99.50	0	N	A	83.7	6.3	0.0	0.0	0.0	67.0	9.8	-3.9	0.0	0.0	16.3	0.0	0.0	0.8
307	912389.89	5023323.54	99.50	0	E	A	-33.2	6.3	0.0	0.0	0.0	67.0	9.8	-3.9	0.0	0.0	16.3	0.0	0.0	-116.2
308	912382.70	5023323.39	99.50	0	D	A	83.7	10.0	0.0	0.0	0.0	67.1	9.9	-3.9	0.0	0.0	17.2	0.0	0.0	3.5
308	912382.70	5023323.39	99.50	0	N	A	83.7	10.0	0.0	0.0	0.0	67.1	9.9	-3.9	0.0	0.0	17.2	0.0	0.0	3.5
308	912382.70	5023323.39	99.50	0	E	A	-33.2	10.0	0.0	0.0	0.0	67.1	9.9	-3.9	0.0	0.0	17.2	0.0	0.0	-113.4
317	912372.40	5023323.18	99.50	0	D	A	83.7	10.2	0.0	0.0	0.0	67.1	9.9	-3.9	0.0	0.0	21.2	0.0	0.0	-0.3
317	912372.40	5023323.18	99.50	0	N	A	83.7	10.2	0.0	0.0	0.0	67.1	9.9	-3.9	0.0	0.0	21.2	0.0	0.0	-0.3
317	912372.40	5023323.18	99.50	0	E	A	-33.2	10.2	0.0	0.0	0.0	67.1	9.9	-3.9	0.0	0.0	21.2	0.0	0.0	-117.3
346	912433.69	5023313.94	99.50	0	D	A	83.7	13.3	0.0	0.0	0.0	66.6	9.6	-3.9	0.0	0.0	16.3	0.0	0.0	8.4
346	912433.69	5023313.94	99.50	0	N	A	83.7	13.3	0.0	0.0	0.0	66.6	9.6	-3.9	0.0	0.0	16.3	0.0	0.0	8.4
346	912433.69	5023313.94	99.50	0	E	A	-33.2	13.3	0.0	0.0	0.0	66.6	9.6	-3.9	0.0	0.0	16.3	0.0	0.0	-108.6
361	912317.96	5023234.61	99.50	0	D	A	83.7	13.0	0.0	0.0	0.0	66.5	9.6	-3.9	0.0	0.0	14.7	0.0	0.0	9.9
361	912317.96	5023234.61	99.50	0	N	A	83.7	13.0	0.0	0.0	0.0	66.5	9.6	-3.9	0.0	0.0	14.7	0.0	0.0	9.9
361	912317.96	5023234.61	99.50	0	E	A	-33.2	13.0	0.0	0.0	0.0	66.5	9.6	-3.9	0.0	0.0	14.7	0.0	0.0	-107.0
367	911874.41	5022819.85	106.50	0	D	A	83.7	15.7	0.0	0.0	0.0	69.2	11.1	-3.5	0.0	0.0	0.0	0.0	0.0	22.6
367	911874.41	5022819.85	106.50	0	N	A	83.7	15.7	0.0	0.0	0.0	69.2	11.1	-3.5	0.0	0.0	0.0	0.0	0.0	22.6
367	911874.41	5022819.85	106.50	0	E	A	-33.2	15.7	0.0	0.0	0.0	69.2	11.1	-3.5	0.0	0.0	0.0	0.0	0.0	-94.4
372	912333.69	5023117.28	108.85	0	D	A	83.7	11.5	0.0	0.0	0.0	64.9	8.7	-3.7	0.0	0.0	0.0	0.0	0.0	25.2
372	912333.69	5023117.28	108.85	0	N	A	83.7	11.5	0.0	0.0	0.0	64.9	8.7	-3.7	0.0	0.0	0.0	0.0	0.0	25.2
372	912333.69	5023117.28	108.85	0	E	A	-33.2	11.5	0.0	0.0	0.0	64.9	8.7	-3.7	0.0	0.0	0.0	0.0	0.0	-91.8
379	912323.31	5023107.82	109.98	0	D	A	83.7	11.5	0.0	0.0	0.0	65.0	8.8	-3.7	0.0	0.0	0.0	0.0	0.0	25.2
379	912323.31	5023107.82	109.98	0	N	A	83.7	11.5	0.0	0.0	0.0	65.0	8.8	-3.7	0.0	0.0	0.0	0.0	0.0	25.2
379	912323.31	5023107.82	109.98	0	E	A	-33.2	11.5	0.0	0.0	0.0	65.0	8.8	-3.7	0.0	0.0	0.0	0.0	0.0	-91.8
388	912350.63	5023141.18	105.45	0	D	A	83.7	11.5	0.0	0.0	0.0	65.0	8.8	-3.7	0.0	0.0	19.1	0.0	0.0	6.0
388	912350.63	5023141.18	105.45	0	N	A	83.7	11.5	0.0	0.0	0.0	65.0	8.8	-3.7	0.0	0.0	19.1	0.0	0.0	6.0
388	912350.63	5023141.18	105.45	0	E	A	-33.2	11.5	0.0	0.0	0.0	65.0	8.8	-3.7	0.0	0.0	19.1	0.0	0.0	-111.0
409	912355.69	5023154.36	103.42	0	D	A	83.7	11.6	0.0	0.0	0.0	65.2	8.9	-3.7	0.0	0.0	22.4	0.0	0.0	2.7
409	912355.69	5023154.36	103.42	0	N	A	83.7	11.6	0.0	0.0	0.0	65.2	8.9	-3.7	0.0	0.0	22.4	0.0	0.0	2.7
409	912355.69	5023154.36	103.42	0	E	A	-33.2	11.6	0.0	0.0	0.0	65.2	8.9	-3.7	0.0	0.0	22.4	0.0	0.0	-114.3
423	912362.57	5023187.05	100.01	0	D	A	83.7	11.5	0.0	0.0	0.0	65.5	9.0	-3.8	0.0	0.0	19.8	0.0	0.0	4.7
423	912362.57	5023187.05	100.01	0	N	A	83.7	11.5	0.0	0.0	0.0	65.5	9.0	-3.8	0.0	0.0	19.8	0.0	0.0	4.7
423	912362.57	5023187.05	100.01	0	E	A	-33.2	11.5	0.0	0.0	0.0	65.5	9.0	-3.8	0.0	0.0	19.8	0.0	0.0	-112.3
433	912341.63	5023313.26	99.50	0	D	A	83.7	13.2	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	15.5	0.0	0.0	8.1

Line Source, ISO 9613, Name: "Delivery Trucks", ID: "DrTrk"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
433	912341.63	5023313.26	99.50	0	N	A	83.7	13.2	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	15.5	0.0	0.0	8.1
433	912341.63	5023313.26	99.50	0	E	A	-33.2	13.2	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	15.5	0.0	0.0	-108.8
459	912350.23	5023317.36	99.50	2	D	A	83.7	2.3	0.0	0.0	0.0	67.9	10.4	-4.2	0.0	0.0	9.0	0.0	7.0	-4.1
459	912350.23	5023317.36	99.50	2	N	A	83.7	2.3	0.0	0.0	0.0	67.9	10.4	-4.2	0.0	0.0	9.0	0.0	7.0	-4.1
459	912350.23	5023317.36	99.50	2	E	A	-33.2	2.3	0.0	0.0	0.0	67.9	10.4	-4.2	0.0	0.0	9.0	0.0	7.0	-121.1
468	912342.39	5023313.62	99.50	2	D	A	83.7	12.0	0.0	0.0	0.0	68.0	10.4	-4.2	0.0	0.0	13.4	0.0	8.6	-0.5
468	912342.39	5023313.62	99.50	2	N	A	83.7	12.0	0.0	0.0	0.0	68.0	10.4	-4.2	0.0	0.0	13.4	0.0	8.6	-0.5
468	912342.39	5023313.62	99.50	2	E	A	-33.2	12.0	0.0	0.0	0.0	68.0	10.4	-4.2	0.0	0.0	13.4	0.0	8.6	-117.5
491	912335.04	5023310.12	99.50	2	D	A	83.7	-2.4	0.0	0.0	0.0	68.0	10.4	-4.2	0.0	0.0	13.3	0.0	8.6	-14.8
491	912335.04	5023310.12	99.50	2	N	A	83.7	-2.4	0.0	0.0	0.0	68.0	10.4	-4.2	0.0	0.0	13.3	0.0	8.6	-14.8
491	912335.04	5023310.12	99.50	2	E	A	-33.2	-2.4	0.0	0.0	0.0	68.0	10.4	-4.2	0.0	0.0	13.3	0.0	8.6	-131.8
581	911794.66	5022763.68	106.00	0	D	A	83.7	15.8	0.0	0.0	0.0	70.0	11.6	-3.5	0.0	0.0	0.0	0.0	0.0	21.4
581	911794.66	5022763.68	106.00	0	N	A	83.7	15.8	0.0	0.0	0.0	70.0	11.6	-3.5	0.0	0.0	0.0	0.0	0.0	21.4
581	911794.66	5022763.68	106.00	0	E	A	-33.2	15.8	0.0	0.0	0.0	70.0	11.6	-3.5	0.0	0.0	0.0	0.0	0.0	-95.6
585	912355.41	5023211.13	99.50	0	D	A	83.7	11.6	0.0	0.0	0.0	65.9	9.2	-3.8	0.0	0.0	17.9	0.0	0.0	6.0
585	912355.41	5023211.13	99.50	0	N	A	83.7	11.6	0.0	0.0	0.0	65.9	9.2	-3.8	0.0	0.0	17.9	0.0	0.0	6.0
585	912355.41	5023211.13	99.50	0	E	A	-33.2	11.6	0.0	0.0	0.0	65.9	9.2	-3.8	0.0	0.0	17.9	0.0	0.0	-110.9
592	912313.28	5023295.12	99.50	0	D	A	83.7	12.8	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	12.8	0.0	0.0	10.5
592	912313.28	5023295.12	99.50	0	N	A	83.7	12.8	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	12.8	0.0	0.0	10.5
592	912313.28	5023295.12	99.50	0	E	A	-33.2	12.8	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	12.8	0.0	0.0	-106.5
599	912362.07	5023200.23	99.50	0	D	A	83.7	11.0	0.0	0.0	0.0	65.7	9.1	-3.8	0.0	0.0	19.2	0.0	0.0	4.5
599	912362.07	5023200.23	99.50	0	N	A	83.7	11.0	0.0	0.0	0.0	65.7	9.1	-3.8	0.0	0.0	19.2	0.0	0.0	4.5
599	912362.07	5023200.23	99.50	0	E	A	-33.2	11.0	0.0	0.0	0.0	65.7	9.1	-3.8	0.0	0.0	19.2	0.0	0.0	-112.5
605	911915.80	5022835.47	106.50	0	D	A	83.7	13.9	0.0	0.0	0.0	68.8	10.8	-3.5	0.0	0.0	0.0	0.0	0.0	21.5
605	911915.80	5022835.47	106.50	0	N	A	83.7	13.9	0.0	0.0	0.0	68.8	10.8	-3.5	0.0	0.0	0.0	0.0	0.0	21.5
605	911915.80	5022835.47	106.50	0	E	A	-33.2	13.9	0.0	0.0	0.0	68.8	10.8	-3.5	0.0	0.0	0.0	0.0	0.0	-95.5
607	912360.30	5023320.81	99.50	0	D	A	83.7	11.6	0.0	0.0	0.0	67.2	9.9	-4.0	0.0	0.0	20.6	0.0	0.0	1.6
607	912360.30	5023320.81	99.50	0	N	A	83.7	11.6	0.0	0.0	0.0	67.2	9.9	-4.0	0.0	0.0	20.6	0.0	0.0	1.6
607	912360.30	5023320.81	99.50	0	E	A	-33.2	11.6	0.0	0.0	0.0	67.2	9.9	-4.0	0.0	0.0	20.6	0.0	0.0	-115.4
608	912352.22	5023318.13	99.50	0	D	A	83.7	4.2	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	15.8	0.0	0.0	-1.1
608	912352.22	5023318.13	99.50	0	N	A	83.7	4.2	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	15.8	0.0	0.0	-1.1
608	912352.22	5023318.13	99.50	0	E	A	-33.2	4.2	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	15.8	0.0	0.0	-118.1
614	912356.94	5023319.69	99.50	2	D	A	83.7	5.5	0.0	0.0	0.0	67.9	10.4	-4.2	0.0	0.0	25.2	0.0	10.1	-20.2
614	912356.94	5023319.69	99.50	2	N	A	83.7	5.5	0.0	0.0	0.0	67.9	10.4	-4.2	0.0	0.0	25.2	0.0	10.1	-20.2
614	912356.94	5023319.69	99.50	2	E	A	-33.2	5.5	0.0	0.0	0.0	67.9	10.4	-4.2	0.0	0.0	25.2	0.0	10.1	-137.2
636	912353.13	5023318.43	99.50	2	D	A	83.7	6.5	0.0	0.0	0.0	67.9	10.4	-4.2	0.0	0.0	9.0	0.0	7.0	0.2
636	912353.13	5023318.43	99.50	2	N	A	83.7	6.5	0.0	0.0	0.0	67.9	10.4	-4.2	0.0	0.0	9.0	0.0	7.0	0.2
636	912353.13	5023318.43	99.50	2	E	A	-33.2	6.5	0.0	0.0	0.0	67.9	10.4	-4.2	0.0	0.0	9.0	0.0	7.0	-116.8
668	912300.61	5023257.21	99.50	0	D	A	83.7	11.3	0.0	0.0	0.0	66.9	9.8	-4.0	0.0	0.0	13.1	0.0	0.0	9.1
668	912300.61	5023257.21	99.50	0	N	A	83.7	11.3	0.0	0.0	0.0	66.9	9.8	-4.0	0.0	0.0	13.1	0.0	0.0	9.1
668	912300.61	5023257.21	99.50	0	E	A	-33.2	11.3	0.0	0.0	0.0	66.9	9.8	-4.0	0.0	0.0	13.1	0.0	0.0	-107.9
673	911770.35	5022741.34	105.06	0	D	A	83.7	14.5	0.0	0.0	0.0	70.2	11.7	-3.5	0.0	0.0	0.0	0.0	0.0	19.8
673	911770.35	5022741.34	105.06	0	N	A	83.7	14.5	0.0	0.0	0.0	70.2	11.7	-3.5	0.0	0.0	0.0	0.0	0.0	19.8
673	911770.35	5022741.34	105.06	0	E	A	-33.2	14.5	0.0	0.0	0.0	70.2	11.7	-3.5	0.0	0.0	0.0	0.0	0.0	-97.2
679	912299.31	5023270.45	99.50	0	D	A	83.7	11.3	0.0	0.0	0.0	67.1	9.9	-3.9	0.0	0.0	12.7	0.0	0.0	9.3
679	912299.31	5023270.45	99.50	0	N	A	83.7	11.3	0.0	0.0	0.0	67.1	9.9	-3.9	0.0	0.0	12.7	0.0	0.0	9.3
679	912299.31	5023270.45	99.50	0	E	A	-33.2	11.3	0.0	0.0	0.0	67.1	9.9	-3.9	0.0	0.0	12.7	0.0	0.0	-107.7
700	912306.36	5023245.99	99.50	0	D	A	83.7	10.9	0.0	0.0	0.0	66.7	9.7	-3.9	0.0	0.0	13.7	0.0	0.0	8.5
700	912306.36	5023245.99	99.50	0	N	A	83.7	10.9	0.0	0.0	0.0	66.7	9.7	-3.9	0.0	0.0	13.7	0.0	0.0	8.5
700	912306.36	5023245.99	99.50	0	E	A	-33.2	10.9	0.0	0.0	0.0	66.7	9.7	-3.9	0.0	0.0	13.7	0.0	0.0	-108.5
703	912306.36	5023245.99	99.50	1	D	A	83.7	10.9	0.0	0.0	0.0	66.8	9.7	-3.9	0.0	0.0	27.0	0.0	72.5	-77.4
703	912306.36	5023245.99	99.50	1	N	A	83.7	10.9	0.0	0.0	0.0	66.8	9.7	-3.9	0.0	0.0	27.0	0.0	72.5	-77.4
703	912306.36	5023245.99	99.50	1	E	A	-33.2	10.9	0.0	0.0	0.0	66.8	9.7	-3.9	0.0	0.0	27.0	0.0	72.5	-194.4
708	912326.35	5023305.14	99.50	0	D	A	83.7	11.4	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	13.4	0.0	0.0	8.5
708	912326.35	5023305.14	99.50	0	N	A	83.7	11.4	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	13.4	0.0	0.0	8.5
708	912326.35	5023305.14	99.50	0	E	A	-33.2	11.4	0.0	0.0	0.0	67.2	10.0	-4.0	0.0	0.0	13.4	0.0	0.0	-108.5
716	912302.95	5023282.99	99.50	0	D	A	83.7	11.2	0.0	0.0	0.0	67.2	9.9	-4.0	0.0	0.0	12.5	0.0	0.0	9.2
716	912302.95	5023282.99	99.50	0	N	A	83.7	11.2	0.0	0.0	0.0	67.2	9.9	-4.0	0.0	0.0	12.5	0.0	0.0	9.2
716	912302.95	5023282.99	99.50	0	E	A	-33.2	11.2	0.0	0.0	0.0	67.2	9.9	-4.0	0.0	0.0	12.5	0.0	0.0	-107.7
721	911849.26	5022812.68	106.50	0	D	A	83.7	11.9	0.0	0.0	0.0	69.5	11.3	-3.5	0.0	0.0	0.0	0.0	0.0	18.4
721	911849.26	5022812.68	106.50	0	N	A	83.7	11.9	0.0	0.0	0.0	69.5	11.3	-3.5	0.0	0.0	0.0	0.0	0.0	18.4
721	911849.26	5022812.68	106.50	0	E	A	-33.2	11.9	0.0	0.0	0.0	69.5	11.3	-3.5	0.0	0.0	0.0	0.0	0.0	-98.6

Line Source, ISO 9613, Name: "Delivery Trucks", ID: "DrTrk"																				
Nr.	X	Y	Z	Refl.	DEN	Freq.	Lw	l/a	Optime	K0	Di	Adiv	Aatm	Agr	Afol	Ahous	Abar	Cmet	RL	Lr
	(m)	(m)	(m)			(Hz)	dB(A)	dB	dB	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)
724	911898.60	5022827.00	106.50	0	D	A	83.7	11.4	0.0	0.0	0.0	69.0	10.9	-3.5	0.0	0.0	0.0	0.0	0.0	18.7
724	911898.60	5022827.00	106.50	0	N	A	83.7	11.4	0.0	0.0	0.0	69.0	10.9	-3.5	0.0	0.0	0.0	0.0	0.0	18.7
724	911898.60	5022827.00	106.50	0	E	A	-33.2	11.4	0.0	0.0	0.0	69.0	10.9	-3.5	0.0	0.0	0.0	0.0	0.0	-98.3
739	911823.50	5022795.11	106.50	0	D	A	83.7	12.1	0.0	0.0	0.0	69.7	11.4	-3.5	0.0	0.0	0.0	0.0	0.0	18.3
739	911823.50	5022795.11	106.50	0	N	A	83.7	12.1	0.0	0.0	0.0	69.7	11.4	-3.5	0.0	0.0	0.0	0.0	0.0	18.3
739	911823.50	5022795.11	106.50	0	E	A	-33.2	12.1	0.0	0.0	0.0	69.7	11.4	-3.5	0.0	0.0	0.0	0.0	0.0	-98.7
751	911820.00	5022790.41	106.50	1	D	A	83.7	6.7	0.0	0.0	0.0	70.6	11.9	-4.0	0.0	0.0	26.0	0.0	9.0	-23.1
751	911820.00	5022790.41	106.50	1	N	A	83.7	6.7	0.0	0.0	0.0	70.6	11.9	-4.0	0.0	0.0	26.0	0.0	9.0	-23.1
751	911820.00	5022790.41	106.50	1	E	A	-33.2	6.7	0.0	0.0	0.0	70.6	11.9	-4.0	0.0	0.0	26.0	0.0	9.0	-140.1
759	911813.52	5022782.60	106.50	0	D	A	83.7	11.9	0.0	0.0	0.0	69.8	11.5	-3.5	0.0	0.0	0.0	0.0	0.0	17.9
759	911813.52	5022782.60	106.50	0	N	A	83.7	11.9	0.0	0.0	0.0	69.8	11.5	-3.5	0.0	0.0	0.0	0.0	0.0	17.9
759	911813.52	5022782.60	106.50	0	E	A	-33.2	11.9	0.0	0.0	0.0	69.8	11.5	-3.5	0.0	0.0	0.0	0.0	0.0	-99.1
762	911813.63	5022782.72	106.50	1	D	A	83.7	11.9	0.0	0.0	0.0	70.7	12.0	-4.0	0.0	0.0	26.0	0.0	9.0	-18.1
762	911813.63	5022782.72	106.50	1	N	A	83.7	11.9	0.0	0.0	0.0	70.7	12.0	-4.0	0.0	0.0	26.0	0.0	9.0	-18.1
762	911813.63	5022782.72	106.50	1	E	A	-33.2	11.9	0.0	0.0	0.0	70.7	12.0	-4.0	0.0	0.0	26.0	0.0	9.0	-135.0
780	911744.63	5022720.63	104.50	0	D	A	83.7	11.3	0.0	0.0	0.0	70.5	11.9	-3.5	0.0	0.0	0.0	0.0	0.0	16.1
780	911744.63	5022720.63	104.50	0	N	A	83.7	11.3	0.0	0.0	0.0	70.5	11.9	-3.5	0.0	0.0	0.0	0.0	0.0	16.1
780	911744.63	5022720.63	104.50	0	E	A	-33.2	11.3	0.0	0.0	0.0	70.5	11.9	-3.5	0.0	0.0	0.0	0.0	0.0	-100.9
787	911837.26	5022807.37	106.50	0	D	A	83.7	10.3	0.0	0.0	0.0	69.6	11.3	-3.5	0.0	0.0	0.0	0.0	0.0	16.6
787	911837.26	5022807.37	106.50	0	N	A	83.7	10.3	0.0	0.0	0.0	69.6	11.3	-3.5	0.0	0.0	0.0	0.0	0.0	16.6
787	911837.26	5022807.37	106.50	0	E	A	-33.2	10.3	0.0	0.0	0.0	69.6	11.3	-3.5	0.0	0.0	0.0	0.0	0.0	-100.4
795	911754.99	5022728.21	104.56	0	D	A	83.7	10.9	0.0	0.0	0.0	70.4	11.8	-3.5	0.0	0.0	0.0	0.0	0.0	15.9
795	911754.99	5022728.21	104.56	0	N	A	83.7	10.9	0.0	0.0	0.0	70.4	11.8	-3.5	0.0	0.0	0.0	0.0	0.0	15.9
795	911754.99	5022728.21	104.56	0	E	A	-33.2	10.9	0.0	0.0	0.0	70.4	11.8	-3.5	0.0	0.0	0.0	0.0	0.0	-101.1
800	911734.48	5022714.49	104.50	0	D	A	83.7	10.1	0.0	0.0	0.0	70.6	11.9	-3.5	0.0	0.0	0.0	0.0	0.0	14.8
800	911734.48	5022714.49	104.50	0	N	A	83.7	10.1	0.0	0.0	0.0	70.6	11.9	-3.5	0.0	0.0	0.0	0.0	0.0	14.8
800	911734.48	5022714.49	104.50	0	E	A	-33.2	10.1	0.0	0.0	0.0	70.6	11.9	-3.5	0.0	0.0	0.0	0.0	0.0	-102.1
805	911830.47	5022803.24	106.50	0	D	A	83.7	7.2	0.0	0.0	0.0	69.7	11.4	-3.5	0.0	0.0	0.0	0.0	0.0	13.4
805	911830.47	5022803.24	106.50	0	N	A	83.7	7.2	0.0	0.0	0.0	69.7	11.4	-3.5	0.0	0.0	0.0	0.0	0.0	13.4
805	911830.47	5022803.24	106.50	0	E	A	-33.2	7.2	0.0	0.0	0.0	69.7	11.4	-3.5	0.0	0.0	0.0	0.0	0.0	-103.6

Traffic Noise Assessment

Half Moon Bay South

Phase 5

Proposed Residential Development

In the vicinity of Greenbank Road and Dundonald Drive
City of Ottawa

February 1, 2019
Project: 108-363-300

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0.1	February 1, 2019	Initial draft

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Traffic Noise Assessment

Half Moon Bay South

Phase 5

Proposed Residential Development

In the vicinity of Greenbank Road and Dundonald Drive
City of Ottawa

EXECUTIVE SUMMARY

Valcoustics Canada Ltd. (VCL) has been retained to prepare a Traffic Noise Assessment for Phase 5 of the Half Moon Bay South development in the City of Ottawa. The development consists of 67 detached dwellings (Lots 1 to 67) and 18 townhouse blocks (Blocks 68 to 85). All dwellings will be provided with grade-level rear yard amenity areas.

The significant traffic noise source in the vicinity is road traffic on Realigned Greenbank Road and Kilbirnie Drive.

The sound levels on site have been determined and compared to the applicable Ministry of the Environment, Conservation and Parks (MECP) noise guidelines and the City of Ottawa Environmental noise Control Guidelines (ENCG) to determine the need for noise mitigation.

Based on the predicted sound levels, the following mitigation measures are recommended:

- Mandatory air conditioning at the dwellings closest to Realigned Greenbank Road (Lots 1 to 4 and 50 to 59 as well as Block 83);
- The provision for adding air conditioning at the dwellings in the vicinity of Realigned Greenbank Road (Lots 5 to 11, 28 to 31 and 39 to 49, as well as Blocks 81 and 82);
- Sound barriers at dwellings with rear yards exposed to Realigned Greenbank Road (Lots 1 to 7, 40, 49, 50 and 59 as well as Block 83); and
- Upgraded wall and/or window construction may be required at the dwellings closest to Realigned Greenbank Road (Lots 1 to 4 and 50 to 59 as well as Block 83). The requirements should be determined once the building plans are available.

1.0 INTRODUCTION

1.1 INTRODUCTION

Valcoustics Canada Ltd. (VCL) previously prepared a Stationary Noise Source Study, dated May 3, 2018, to address the noise impact of operations at the sand and gravel pits to the west of Realigned Greenbank Road onto Phase 5 of the Half Moon Bay South development in Ottawa. This report has been prepared to address the impact of the transportation (road traffic) noise sources onto the proposed development. The potential sound levels, due to road traffic noise, and mitigation measures needed to comply with the MECP and City of Ottawa noise guidelines are outlined herein.

1.2 THE SITE AND SURROUNDING AREA

The proposed development is bounded by:

- A community park and future residential dwellings in Phase 4 of the Half Moon Bay South development to the north;
- Alex Polowin Street, with future residential dwellings in Phase 4 of the Half Moon Bay South development beyond, to the east;
- Future residential dwellings, with Kilbirnie Drive beyond, to the south; and
- Realigned Greenbank Road, with future commercial development in Phase 7 of the Half Moon Bay South development beyond, to the west.

Figure 1 shows a Key Plan. The assessment is based on the Draft Plan of Subdivision, prepared by J.D. Barnes, with a date plotted of January 24, 2019. The Draft Plan of Subdivision is shown (in reduced form) as Figure 2.

1.3 THE PROPOSED DEVELOPMENT

The development consists of 67 detached dwellings (Lots 1 to 67) and 18 townhouse blocks (Blocks 68 to 85). All dwellings will be provided with grade-level rear yard amenity areas.

2.0 ENVIRONMENTAL NOISE ASSESSMENT

2.1 NOISE SENSITIVE RECEPTORS

The noise sensitive receptors as defined by the MECP Publication NPC-300, *"Stationary and Transportation Sources - Approval and Planning"* (see Appendix B), and the City of Ottawa Environmental Noise Control Guidelines (ENCG), are all residential units within the development.

2.2 NOISE SOURCES

The main noise source with potential for impact on Phase 5 of the proposed development will be road traffic on Realigned Greenbank Road and Kilbirnie Drive.

Standard ultimate traffic volumes and compositions were used. These volumes were obtained from the City of Ottawa ENCG Appendix B: Table of Traffic Parameters To Be Used for Sound Level Predictions.

Bus traffic volumes for the dedicated bus lanes on Realigned Greenbank Road were obtained via email from the City of Ottawa.

The road traffic data is summarized in Table 1.

The site is well outside of the NEF/NEP 25 aircraft noise contour and the Ottawa Airport Operating Influence Zone. Thus, aircraft noise is not a concern and is not considered further.

2.3 ENVIRONMENTAL NOISE GUIDELINES

City of Ottawa has implemented the "Environmental Noise Control Guideline" (ENCG) for use in the planning applications. With a few exceptions, the current version of the ENCG, dated January 2016, is based on the MECP Publication NPC-300, *"Stationary and Transportation Sources - Approval and Planning"*. The environmental noise guidelines in NPC-300, as well as some items in the ENCG which are distinct from NPC-300, are described below.

2.3.1 MECP Publication NPC-300

In accordance with NPC-300, if the daytime sound level, $L_{eq\ Day}$, at the exterior plane of living/dining room windows is greater than 65 dBA, or if the nighttime sound level, $L_{eq\ Night}$, at the exterior plane of bedroom windows is greater than 60 dBA, means must be provided so that windows can be kept closed for noise control purposes and central air conditioning is required. For daytime sound levels greater than 55 dBA and less than or equal to 65 dBA, or for nighttime sound levels greater than 50 dBA and less than or equal to 60 dBA, there need only be the provision for adding air conditioning at a later date. For single family and townhouse dwellings, the provision is typically in the form of a ducted ventilation system suitably sized to permit the addition of central air conditioning by the occupant. A warning clause advising the occupants of the potential interference with some activities is also required.

For outdoor amenity areas ("Outdoor Living Areas" - OLAs), the design goal is 55 dBA $L_{eq\ Day}$, with an excess not exceeding 5 dBA considered acceptable if it is technically not practicable to achieve the 55 dBA objective, provided warning clauses are registered on title.

Note that for road traffic sources, a balcony is not considered an OLA, unless it is the only OLA for the occupant and it is:

- at least 4 m in depth; and
- unenclosed.

For indoor areas, the daytime guideline for living and dining rooms is $L_{eq\ Day} \leq 45$ dBA for road traffic sound sources. The nighttime guideline for bedrooms is $L_{eq\ Night} \leq 40$ dBA for road traffic sound sources.

2.3.2 City of Ottawa

The City of Ottawa requires that the noise analysis use standard ultimate road traffic volumes, subject to the road type and number of lanes. The ultimate daily traffic volumes listed in the ENCG Appendix B: Table of Traffic and Road Parameters To Be Used For Sound Level Predictions. The Table is included in Appendix A of this report.

The City of Ottawa also requires that the use of the 5 dB allowable excess in OLA sound levels be justified. For this purpose, the City requires an analysis of the sound levels for various alternative planning and engineering options (including setbacks, grades and calculated barrier height options) in increments of one dB from Leq Day 55 to 60 dBA.

Warning clauses are required whenever noise is expected to meet or exceed 55 dBA during the daytime (Leq,16hr) in the outdoor living area or plane of window of any living space prior to mitigation.

The City of Ottawa has a minimum sound barrier fence height requirement of 2.2 m. The maximum sound barrier fence height is 2.5 m, unless otherwise indicated by the City.

2.4 NOISE IMPACT ASSESSMENT

Using the road traffic data in Table 1, the sound levels, in terms of $L_{eq\ Day}$ and $L_{eq\ Night}$, were determined using STAMSON V5.04 – ORNAMENT, the computerized road traffic noise prediction model of the MECP.

As per Table 2.2b of the ENCG, the indoor criteria for road noise are:

- Living rooms, dining rooms, etc; daytime or nighttime: 45 dBA
- Sleeping quarters; daytime (0700 to 2300 hours): 45 dBA
- Sleeping quarters; nighttime (2300 to 0700 hours): 40 dBA

The predicted sound levels at the upper storey of a dwelling (where the bedrooms are typically located) are generally expected to be higher than the sound levels at the lower storey (where the living rooms are typically located) due to ground attenuation effects. Thus, to ensure that the daytime and nighttime criteria will be met for both living rooms and bedrooms, the sound levels at all dwellings were assessed at a top-storey plane of window height of 4.5 m above grade, for both the daytime and nighttime cases.

For OLA calculations, a receptor height of 1.5 m above grade was used (representing a standing height).

Inherent screening of each building face due to its orientation to the noise source was taken into account. Screening from the future dwellings to the south of the site, between south property line and Kilbirnie Drive, was also included in the assessment.

The highest *unmitigated daytime* sound level of 73 dBA is predicted to occur at the west facade of Lot 1 and Block 83, closest to Realigned Greenbank Road. The highest *unmitigated nighttime* sound level of 66 dBA is predicted to occur at the same locations.

Table 2 summarizes the predicted sound levels outdoors at specific locations. Sound level calculations for all receptor locations are presented in Appendix C.

3.0 NOISE ABATEMENT REQUIREMENTS

The noise control measures can generally be classified into two categories which are interrelated, but which the designer can treat separately for the most part:

(a) Architectural elements to achieve acceptable indoor noise guidelines;

(b) Design features to protect the OLA's.

Noise abatement requirements are summarized in Table 3 and the notes to Table 3.

3.1 INDOORS

The indoor noise exposure guidelines can be achieved by using appropriate construction for exterior walls, windows and doors. The specific STC requirements of these building components will depend on the wall and window areas relative to the floor areas of the associated rooms. Since building plans have not yet been established for this phase of the development, it is not possible to calculate the specific STC requirements at this time. However, based on the predicted sound levels, upgraded exterior wall and window construction is anticipated at all dwellings in proximity to Realigned Greenbank Road. Specific STC requirements for walls and windows should be determined once architectural plans are available. This would likely be a condition of site plan approval or a condition of building permit.

To assess the feasibility of meeting the indoor noise criteria, a sample calculation was done at a worst-case location (Lot 1) adjacent to Realigned Greenbank Road. The daytime sound level at the west facade of Lot 1 (with full exposure to the roadway) is predicted to be 73 dBA. The daytime sound level at the south facade (with half exposure to the roadway) would be 3 dB lower. Based on typical assumptions, a corner bedroom with windows on both the northwest and northeast facades could be expected to have wall and window areas that are 80% and 30%, respectively, of the associated floor area, on each facade.

Based on the analysis procedures outlined in Building Practice Note BPN 56*, "Controlling Sound Transmission Into Buildings"*, as well as the assumptions outlined above, the STC requirements for elements of the building envelope were assessed. To meet the indoor noise criteria, exterior wall construction meeting STC 54 (e.g. brick veneer) and exterior window construction meeting STC 31 can be used. It is noted that windows with higher STC ratings may be required if the wall and window dimensions are greater than those used in this sample calculation, or if exterior walls with a lower STC rating are used. It is anticipated that dwellings farther setback from the roadway would have lower STC requirements due to the lower sound levels at the building facades.

Calculation details, as well as example window configurations and their STC ratings are shown in Appendix D.

As outlined in NPC-300, where the sound level on the outside of a window is greater than 60 dBA during the night or 65 dBA during the day, ventilation provisions must be made to permit the windows to remain closed. A commonly used technique is to provide central air conditioning. Table 3 indicates which dwellings would require mandatory air conditioning.

Where the nighttime sound levels are between 51 dBA and 60 dBA (or the daytime sound level is between 56 dBA and 65 dBA), the provision for the addition of air conditioning at the occupant's discretion is required. Table 3 indicates which dwellings would require the provision for the addition of air conditioning. In practice, this means forced air heating with adequately sized ductwork.

3.2 OUTDOORS

Without additional noise mitigation, the MECP and ENCG outdoor noise guideline of 55 dBA is predicted to be exceeded in the OLA's at the dwellings that side onto Realigned Greenbank Road. The ENGC requires that noise mitigation options, including increased setback, intervening non-noise sensitive land uses and earthen berms, be investigated prior to recommending sound barriers.

In extraordinary cases, the ENCG may allow a minor excess (up to 5 dBA) over the provincial guideline for outdoor receptors. The minor excess may be acceptable if further mitigation is not technically or economically feasible.

The City of Ottawa ENCG has a minimum sound barrier fence height requirement of 2.2 m and a maximum of 2.5 m, unless otherwise indicated by the City. For sound barriers in excess of 2.5 m the use of earth berms or retaining wall structures may be required.

For Phases 7 and 8 of the Half Moon Bay North development, the City has indicated that sound barriers up to 3.0 m in height are permitted without implementing earth berms or retaining walls. For consistency of appearance with the Half Moon Bay North development, subject to approval by the City, 3.0 m has been used as the maximum fence height for Half Moon Bay South Phase 5 dwellings adjacent to Realigned Greenbank Road.

In all cases, where the outdoor sound level exceeds 55 dBA, warning clauses will need to registered on title. Lots which require warning clauses are shown in Table 3.

3.2.1 Dwellings Close to Realigned Greenbank Road

For those dwellings adjacent to Realigned Greenbank Road, the lot layout has been formulated to minimize the number of lots which are close to the road noise source. The single-family dwellings are provided with a "window street" to increase the setback from the road noise source to the nearest façade of the dwellings. Moreover, the window street design screens the majority of rear yard OLA's from the road noise source. As is typical in this design, a small number of dwellings must side towards the road noise source with reduced setback compared to those that front the window street. In these cases (unlike those dwellings fronting onto the window street), additional setback distance and building orientation are not available as mitigation measures to further reduce the outdoor sound level in the rear yard. Mitigation options on a lot-by-lot basis are provided below for those affected units.

- At Lot 1, the unmitigated daytime sound level is predicted to be 69 dBA in the rear yard outdoor amenity area ("Outdoor Living Area" - OLA's). A sound barrier 3.9 m in height would be required to meet the 55 dBA design objective (clearly, this exceeds the ENCG barrier height requirement). A 3.0 m high sound barrier is expected to mitigate the sound level in the rear yard OLA to 58 dBA. The inclusion of a 0.9 m high earth berm with a 3:1 slope on each side would reduce the usable width of the rear yard of the dwelling by 5.9 m (3*0.9 m slope on the road side + 0.5 m on top + 3*0.9 m on the dwelling side = 5.9 m). The width of the rear yard for Lot 1 is approximately 9.3 m, meaning that the berm would occupy more than half of the rear yard (see Appendix E for graphical representation). Therefore, a 3.0 m high acoustic fence along the property line is recommended at this location. Warning clauses advising of the elevated sound levels should be registered on title for this dwelling.
- At Lot 2, the unmitigated daytime sound level at the rear yard OLA is predicted to be 65 dBA. A sound barrier 4.2 m in height would be required to meet the 55 dBA design objective (note that sound barrier height is greater for Lot 2 than Lot 1 because of the increased barrier-receiver distance). The inclusion of a 1.2 m high earth berm with a 3:1 slope on each side would reduce the usable width of the rear yard of the dwelling by 7.7 m (3*1.2 m slope on the road side + 0.5 m on top + 3*1.2 m on the dwelling side = 7.7 m). This berm would be required along the property lines of both Lots 1 and 2 to be effective. As discussed above, this berm would not be feasible, as it would occupy the majority of the rear yard space (see Appendix E for graphical representation). A 3.0 m high acoustic fence along the property line would mitigate the sound level at the rear yard OLA to 58 dBA and is recommended. Warning clauses advising of the elevated sound levels should be registered on title for this dwelling.

- At Lot 3, the unmitigated daytime sound level at the rear yard OLA is predicted to be 63 dBA. A sound barrier 3.7 m in height would be required to meet the 55 dBA design objective. The inclusion of a 0.7 m high earth berm with a 3:1 slope on each side would reduce the usable width of the rear yard of the dwelling by 4.7 m (3*0.7 m slope on the road side + 0.5 m on top + 3*0.7 m on the dwelling side = 4.7 m). This berm would be required along the property lines of Lot 1 to 3 to be effective. As the berm would occupy half of the rear yard space for these units, it is not considered feasible (see Appendix E for graphical representation). A 3.0 m high acoustic fence along the property line would mitigate the sound level at the rear yard OLA to 57 dBA and is recommended. Warning clauses advising of the elevated sound levels should be registered on title for this dwelling.
- At Lot 4, the unmitigated daytime sound level at the rear yard OLA is predicted to be 61 dBA. A sound barrier 3.1 m in height would be required to meet the 55 dBA design objective. A 3.0 m high acoustic fence would mitigate the sound level at the rear yard to 55 dBA. The 1 dB difference in sound level would not be audible to the human ear and is considered acoustically insignificant. A 3.0 m high acoustic fence is therefore recommended at this location to be consistent with Lots 1 to 4. Warning clauses advising of the elevated sound levels should be registered on title for this dwelling.
- At Block 83 (the westernmost unit), the unmitigated daytime sound level is predicted to be 73 dBA in the rear yard OLA. A sound barrier 4.1 m in height would be required to meet the 55 dBA design objective. The inclusion of an earth berm with a height of 1.1 m and a 3:1 slope on each side would reduce the usable width of the rear yard of the dwelling by 7.1 m (3*1.1 m on the road side + 0.5 m on top + 3*1.1 m on the dwelling side = 7.1 m). The width of this berm would likely be greater than the width of the rear yard of the westerly unit (see Appendix E for graphical representation). A 3.0 m high sound barrier is expected to mitigate the sound level in the rear yard to 59 dBA (the sound levels would be further reduced at the units farther east in Blocks 82 and 83). Therefore, a 3.0 m high barrier sound barrier is recommended at this location. Warning clauses advising of the elevated sound levels should be registered on title for this dwelling.

  Note, the sound barrier for Block 83 is assumed to continue south and tie in to the future dwelling to the south, as it is assumed that the future development to the south will be built before Realigned Greenbank Road is in use.

3.2.2 Dwellings at a Greater Setback from Realigned Greenbank Road

- At Lot 5, the unmitigated daytime OLA sound level is predicted to be 60 dBA. A 2.3 m high acoustic fence at Lot 5 will mitigate the daytime OLA sound level at this lot to 55 dBA and is recommended.
- At Lots 6 and 7, the unmitigated daytime OLA sound level is predicted to be 59 dBA and 58 dBA, respectively. A 2.2 m high acoustic fence at Lots 6 and 7 will mitigate the daytime OLA sound levels at these lots to 54 dBA. These fences will also provide screening to Lots 8 and 9 such that the mitigated daytime OLA sound levels at these locations are 55 dBA. Thus, 2.2 m high acoustic fences are recommended at these locations.
- At Lots 40 and 49, the unmitigated daytime OLA sound levels are predicted to be 60 dBA. The OLA's at Lots 50 and 59 (adjacent to the rear property line of Lots 40 and 49) are further screened from road traffic noise and would therefore have lower sound levels. A 2.2 m high acoustic fence at Lots 40, 49, 50 and 59 will mitigate the daytime OLA sound levels at these lots to 54 dBA or lower. Thus, 2.2 m high acoustic fences are recommended at these locations.

3.2.3 Notes Regarding Barriers

- The assessment was based on flat topography (i.e. the grade of the rear yard, base of the barrier and the roadway were all assumed to be zero). The assessment should be updated once the grading plan in available.

- Where possible, the site grading should be designed with higher grades along the property lines, relative to the rear yards. This may result in mitigated sound levels that are lower than the levels discussed in Section 3.2.1 above.

- The sound barriers may be designed with acoustic gates to provide access to the rear yard while ensuring that the acoustic performance of the barrier is not compromised. A sample detail for the acoustic gate is included in this report.

- Table 3 summarizes the required mitigation. Additionally, Table 4 provides the mitigated sound levels based on recommended mitigation as well as the mitigation required to achieve the 55 dBA guideline limit. Table 5 indicates the sound barrier heights required to achieve the range of 55 dBA to 60 dBA in one decibel increments.

3.3 WARNING CLAUSES

Where the sound level guidelines are exceeded, appropriate warning clauses should be registered on title and included on Offers of Purchase and Sale to make future occupants aware of the potential noise situation. Lots requiring warning clauses and the wording for the City of Ottawa warning clauses are given in Table 3 and the notes to Table 3. Note, warning clauses in the ENCG have ventilation and sound barrier requirements grouped together. The ventilation and sound barrier requirements have been separated for use in Table 3 but the wording has been maintained.

As noted above, exact calculations of wall and window requirements cannot be completed at this point as architectural plans are not available, although a sample calculation based on typical room dimensions indicates that it will feasible to meet the indoor noise criteria. Reviews of building components (wall and window constructions) will be done prior to the application for building permit with dwelling-specific building component requirements to be included in the building permit application package.

Where upgraded wall and/or window constructions are anticipated, warning clauses include language indicating that building components have been designed to provide sound isolation performance that will result in the indoor sound level limits being met when windows and exterior doors are closed.

4.0 CONCLUSIONS

Based on the predicted sound levels, the mitigation requirements for the proposed development are:

- Mandatory air conditioning at Lots 1 to 4 and 50 to 50, as well as Block 83;
- The provision for adding air conditioning at Lots 5 to 11, 28 to 31 and 39 to 49, as well as Blocks 81 and 82;
- Upgraded exterior wall and/or window construction is expected at Lots 1 to 4 and 50 to 50, as well as Block 83;

- Upgraded exterior wall and/or window construction may be required at Lots 1 to 4 and 50 to 50, as well as Block 83;
- The following acoustic fences are required:
    - 3.0 m high acoustic fences at Lots 1 to 4 and Block 83;
    - 2.3 m high acoustic fences at Lot 5;
    - 2.2 m high acoustic fences at Lots 6, 7, 40, 49, 50 and 59.

With the incorporation of the recommendations above, the indoor noise guidelines will be met at all units. None of the sound levels at the OLA's will exceed the 5 dB excess allowed by the MECP guidelines with the mitigation that is indicated as the minimum requirement. Future occupants will be made aware of the potential noise situation through warning clauses, as per MECP guidelines.

5.0 REFERENCES

1. "PC STAMSON 5.04 Computer Program for Road Traffic Noise Assessment", Ontario Ministry of the Environment.

2. Building Practice Note No. 56: "Controlling Sound Transmission into Buildings", by J. D. Quirt, Division of Building Research, National Council of Canada, September, 1985.

3. Environmental Noise Guideline NPC-300, "Stationary and Transportation Noise Sources - Approval and Planning", Ontario Ministry of the Environment and Climate Change, August 2013.

4. "Road and Rail Noise: Effects on Housing", Canada Mortgage and Housing Corporation, Publication NHA 5156, 81/10.

5. "City of Ottawa Environmental Noise Control Guidelines", January 2016.

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TABLE 1: ROAD TRAFFIC DATA

Roadway	Classification	Ultimate AADT	% Trucks		Speed Limit (kph)	Day / Night Split (%)
			Medium	Heavy		
Realigned Greenbank Road(1)	4-UAD	35,000	7	5	70	92/8
Greenbank BRT(2)	Bus Rapid Transit Lane	270	100	0	80	74/26
Kilbirnie Drive(1)	2-UCU	8,000	7	5	50	92/8

Notes:

(1) As per Appendix B of the City of Ottawa "Environmental Noise Control Guidelines", dated January 2016.

(2) Provided in an email from the City of Ottawa.

TABLE 2: PREDICTED UNMITIGATED SOUND LEVELS OUTDOORS DUE TO ROAD TRAFFIC

Location(1)	Source	Distance (m)	Leq Day	Leq Night
Lot 1 (West Façade)	Realigned Greenbank Road	22	73	66
	Greenbank BRT	22	58	56
	TOTAL	**-**	**73**	**66**
Lot 2 (South Façade)	Realigned Greenbank Road	31	69	61
	Greenbank BRT	31	53	52
	TOTAL	**-**	**69**	**62**
Lot 3 (South Façade)	Realigned Greenbank Road	42	68	60
	Greenbank BRT	42	52	51
	TOTAL	**-**	**68**	**60**
Lot 4 (South Façade)	Realigned Greenbank Road	53	65	58
	Greenbank BRT	53	50	48
	TOTAL	**-**	**66**	**58**
Lot 5 (South Façade)	Realigned Greenbank Road	65	63	56
	Greenbank BRT	65	48	47
	TOTAL	**-**	**64**	**56**
Lot 5 (North Façade)	Realigned Greenbank Road	65	61	53
	Greenbank BRT	65	45	44
	TOTAL	**-**	**61**	**54**
Lot 8 (South Façade)	Realigned Greenbank Road	110	58	50
	Greenbank BRT	110	42	41
	TOTAL	**-**	**58**	**51**
Lot 11 (South Façade)	Realigned Greenbank Road	146	56	48
	Greenbank BRT	146	50	39
	TOTAL	**-**	**56**	**48**
Lot 11 (North Façade)	Realigned Greenbank Road	146	55	48
	Greenbank BRT	146	39	38
	TOTAL	**-**	**55**	**48**

Location[1]	Source	Distance (m)	Leq Day	Leq Night
Lot 12 (South Façade)	Realigned Greenbank Road	157	55	48
	Greenbank BRT	157	40	38
	TOTAL	**-**	**55**	**48**
Lot 27 (North Façade)	Realigned Greenbank Road	157	55	47
	Greenbank BRT	157	40	38
	TOTAL	**-**	**55**	**48**
Lot 28 (North Façade)	Realigned Greenbank Road	145	56	49
	Greenbank BRT	145	41	39
	TOTAL	**-**	**56**	**49**
Lot 31 (North Façade)	Realigned Greenbank Road	111	58	51
	Greenbank BRT	111	43	41
	TOTAL	**-**	**58**	**51**
Lot 32 (West Façade)	Realigned Greenbank Road	113	53	45
	Greenbank BRT	113	37	35
	TOTAL	**-**	**53**	**45**
Lot 39 (South Façade)	Realigned Greenbank Road	113	57	49
	Greenbank BRT	113	41	40
	TOTAL	**-**	**57**	**50**
Lot 40 (South Façade)	Realigned Greenbank Road	70	61	54
	Greenbank BRT	70	46	44
	TOTAL	**-**	**61**	**54**
Lot 45 (West Façade)	Realigned Greenbank Road	70	57	49
	Greenbank BRT	70	41	40
	TOTAL	**-**	**57**	**49**
Lot 49 (North Façade)	Realigned Greenbank Road	70	62	54
	Greenbank BRT	70	46	44
	TOTAL	**-**	**62**	**55**
Lot 54 (West Façade)	Realigned Greenbank Road	41	70	63
	Greenbank BRT	41	55	53
	TOTAL	**-**	**70**	**63**
Block 81 (North Façade)	Realigned Greenbank Road	109	58	50
	Greenbank BRT	109	42	41
	TOTAL	**-**	**58**	**51**
Block 82 (North Façade)	Realigned Greenbank Road	65	63	55
	Greenbank BRT	65	48	46
	TOTAL	**-**	**63**	**56**
Block 83 (West Façade)	Realigned Greenbank Road	22	73	66
	Greenbank BRT	22	58	45
	TOTAL	**-**	**73**	**66**
Block 83 (South Façade)	Realigned Greenbank Road	22	70	63
	Greenbank BRT	22	55	53
	Kilbirnie Drive	45	58	50
	TOTAL	**-**	**71**	**63**
Block 84 (South Façade)	Realigned Greenbank Road	142	54	47
	Greenbank BRT	142	39	38
	TOTAL	**-**	**55**	**47**
Lot 1 (OLA)	Realigned Greenbank Road	26	69	-
	Greenbank BRT	26	53	-
	TOTAL	**-**	**69**	**-**
Lot 2 (OLA)	Realigned Greenbank Road	35	65	-
	Greenbank BRT	35	50	-
	TOTAL	**-**	**65**	**-**
Lot 3	Realigned Greenbank Road	45	63	-

Location[(1)]	Source	Distance (m)	Leq Day	Leq Night
(OLA)	Greenbank BRT	45	48	-
	TOTAL	**-**	**63**	**-**
Lot 4 (OLA)	Realigned Greenbank Road	56	61	-
	Greenbank BRT	56	46	-
	TOTAL	**-**	**61**	**-**
Lot 5 (OLA)	Realigned Greenbank Road	68	60	-
	Greenbank BRT	68	45	-
	TOTAL	**-**	**60**	**-**
Lot 6 (OLA)	Realigned Greenbank Road	81	59	-
	Greenbank BRT	81	43	-
	TOTAL	**-**	**59**	**-**
Lot 7 (OLA)	Realigned Greenbank Road	94	58	-
	Greenbank BRT	94	42	-
	TOTAL	**-**	**58**	**-**
Lot 8 (OLA)	Realigned Greenbank Road	113	56	-
	Greenbank BRT	113	41	-
	TOTAL	**-**	**56**	**-**
Lot 9 (OLA)	Realigned Greenbank Road	126	56	-
	Greenbank BRT	126	40	-
	TOTAL	**-**	**56**	**-**
Lot 10 (OLA)	Realigned Greenbank Road	139	55	-
	Greenbank BRT	139	39	-
	TOTAL	**-**	**55**	**-**
Lot 40 (OLA)	Realigned Greenbank Road	67	60	-
	Greenbank BRT	67	44	-
	TOTAL	**-**	**60**	**-**
Lot 49 (OLA)	Realigned Greenbank Road	67	60	-
	Greenbank BRT	67	44	-
	TOTAL	**-**	**60**	**-**
Block 81 Westerly Unit (OLA)	Realigned Greenbank Road	112	51	-
	Greenbank BRT	112	36	-
	Kilbirnie Drive	42	50	-
	TOTAL	**-**	**54**	**-**
Block 82 Westerly Unit (OLA)	Realigned Greenbank Road	68	55	-
	Greenbank BRT	68	40	-
	Kilbirnie Drive	42	50	-
	TOTAL	**-**	**57**	**-**
Block 83 Westerly Unit (OLA)	Realigned Greenbank Road	25	69	-
	Greenbank BRT	25	54	-
	Kilbirnie Drive	42	58	-
	TOTAL	**-**	**69**	**-**
Block 83 2nd Westerly Unit (OLA)	Realigned Greenbank Road	31	66	-
	Greenbank BRT	31	50	-
	Kilbirnie Drive	42	57	-
	TOTAL	**-**	**66**	**-**

Notes:

(1) See Appendix C for figures showing distances and angles to roadways.

(2) Daytime and nighttime sound levels at the building facades were assessed at a height of 4.5 m above grade. Daytime sound levels at the OLA's were assessed at a height of 1.5 m above grade.

TABLE 3: NOISE ABATEMENT MEASURES

Location	Air Conditioning	Exterior Wall and Window	Sound Barrier	Warning Clauses
Lots 1 to 4	Mandatory	Upgraded construction expected	3.0 m high	A + B + D + E
Lot 5	Provision for adding	Upgraded construction may be required	2.3 m high	A + B + C + E
Lots 6, 7, 40 and 49	Provision for adding	Upgraded construction may be required	2.2 m high	A + B + C + E
Lots 8 and 9	Provision for adding	Upgraded construction may be required	OLA's screened by barriers at Lots 1 o 7	A + C
Lots 10, 11, 28 to 31, 39 and 41 to 48 Block 81 and 82	Provision for adding	Upgraded construction may be required	None	A + C
Lots 50 and 59	Mandatory	Upgraded construction expected	2.2 m high	A + B + D + E
Lots 51 to 58	Mandatory	Upgraded construction expected	None	A + D
Block 83	Mandatory	Upgraded construction expected	3.0 m high at westerly unit (ties in to dwelling to the south)	A + B + D + E
All other units	No special noise abatement measures required			

For notes to this table, see following page.

NOTES TO TABLE 3

(1) Where means must be provided to allow windows to remain closed for noise control purposes, a commonly used technique is that of central air conditioning. Where possible, air cooled condenser units, if any, should be located in a noise insensitive area.

Provision for air conditioning would correspond to a ducted, forced air heating system, which would allow the addition of central air conditioning at a later date by the occupant.

(2) STC - Sound Transmission Class Rating (Reference ASTM-E413). Values, where shown, are based on assumed areas. Requirements should be checked once building plans become available.

(3) STC - Sound Transmission Class Rating (Reference ASTM-E413). A sliding glass walkout door should be considered as a window and be included in the percentage of glazing. Values shown are based on assumed areas. Requirements should be checked once building plans become available.

(4) Sound barriers must be of solid construction having a minimum face density of 20 kg/m^2 with no gaps or cracks. Earthen berms, solid fences or combinations of berms/fences are acceptable.

(5) Warning clauses to be registered on title and be included in Offers of Purchase and Sale for designated lots:

A. "The Transferee, for himself, his heirs, executors, administrators, successors and assigns acknowledge being advised that despite the inclusion of noise control features in the development and/or within the building unit sound levels due to increasing road traffic may occasionally interfere with some indoor and/or outdoor activities of the dwelling occupants as the sound levels may at times exceed the sound level limits of the City of Ottawa and the Ministry of the Environment, Conservation and Parks noise criteria."

"This development includes a number of measures to help reduce noise impacts, listed below. To ensure that provincial and municipal sound level limits are not exceeded and/or to keep sound levels as low as possible it is important to maintain the sound attenuation features provided."

"This development includes building and street orientation to help increase setback distances to major noise sources and shield some rear yards from excessive noise levels."

B. "This development includes an acoustic barrier to help reduce the sound levels within the rear yard of this and other nearby units."

C. "This dwelling unit has been designed with the provision for adding central air conditioning at the occupant's discretion. Installation of central air conditioning by the occupant will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment and Climate Change."

"The building components of this dwelling unit (walls, windows and exterior doors) have been designed to provide acoustic insulation so that, when windows and exterior doors are closed, the indoor sound levels are within the sound level limits of the City of Ottawa and the Ministry of Environment and Climate Change. The details of this building component design are available by contacting the builder of this unit."

D. "This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the City and the Ministry of the Environment, Conservation and Parks."

"The building components of this dwelling unit (walls, windows and exterior doors) have been designed to provide acoustic insulation so that, when windows and exterior doors are closed, the indoor sound levels are within the sound level limits of the City of Ottawa and the Ministry of Environment, Conservation and Parks. The details of this building component design are available by contacting the builder of this unit."

E. "The Transferee, for himself, his heirs, executors, administrators, successors and assigns acknowledge being additionally advised that the installed acoustic barrier is on private property and must be maintained and kept in good repair by the property owner. Any maintenance, repair or replacement is the responsibility of the owner and shall be the same material or to the same standards, having the same colour, appearance and function of the original."

(6) Conventional ventilated attic roof construction meeting OBC requirements is satisfactory.

(7) All exterior doors shall be fully weatherstripped.

TABLE 4: OLA(1) MITIGATION OPTIONS

OLA Location(2)	Sound Barrier Height (m) Required to Mitigate to Sound Levels ($L_{eq\ 16}$) (dBA)					
	60	59	58	57	56	55
Lot 1	2.5	2.7	2.9	3.2	3.5	3.9
Lot 2	2.2	2.5	2.9	3.3	3.7	4.2
Lot 3	2.2(3)	2.2(3)	2.2	2.8	3.2	3.7
Lot 4	2.2(3)	2.2(3)	2.2(3)	2.2	2.5	3.1
Lot 5	-	2.2(3)	2.2(3)	2.2(3)	2.2(3)	2.3
Lot 6	-	-	2.2(3)	2.2(3)	2.2(3)	2.2(3)
Lot 7	-	-	-	2.2(3)	2.2(3)	2.2(3)
Lot 8	-	-	-	-	-	2.2(3,4)
Lot 9	-	-	-	-	-	2.2(3,4)
Lots 40 and 49(5)	-	2.2(3)	2.2(3)	2.2(3)	2.2(3)	2.2(3)
Block 83	2.6	2.8	3.1	3.4	3.7	4.1

Notes:

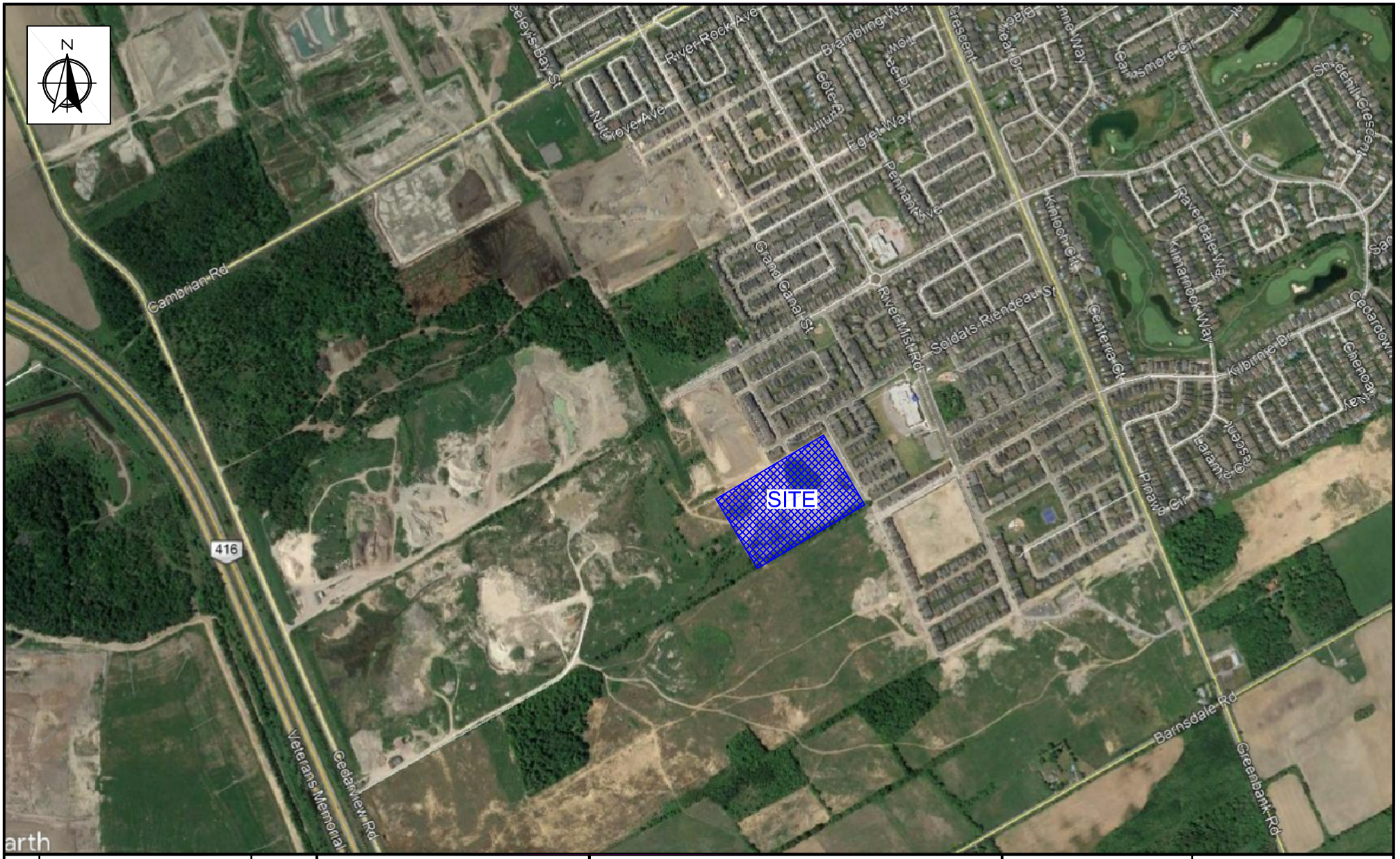
(1) OLA - Outdoor Living Area.

(2) See Figure 2.

(3) Minimum 2.2 m acoustic fence height as specified in the ENCG.

(4) Screening from sound barriers at Lots 1 to 7.

(5) The OLA's at Lots 50 and 49 are more screened from road traffic noise by the building facades. The sound barrier requirements at these locations are therefore determined by Lots 40 and 49.



No.	Revision/Issue	Date

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Title
Key Plan

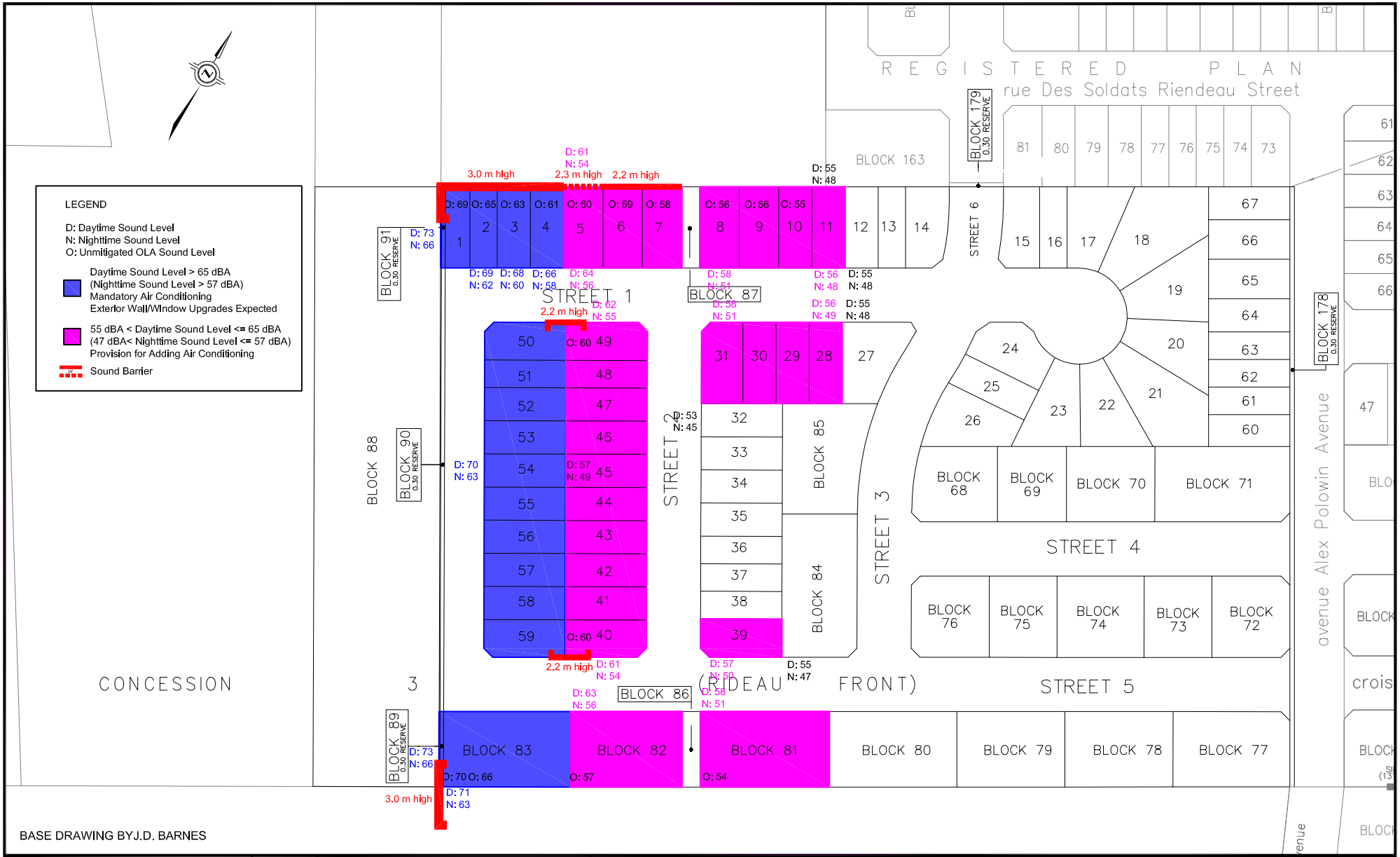
Project No.
108-363-300

Date
Jan. 31, 2019

Project Name
Half Moon Bay South - Phase 5

Scale
N.T.S.

Figure
1



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Title
Draft Plan of Subdivision and Mitigation Requirements

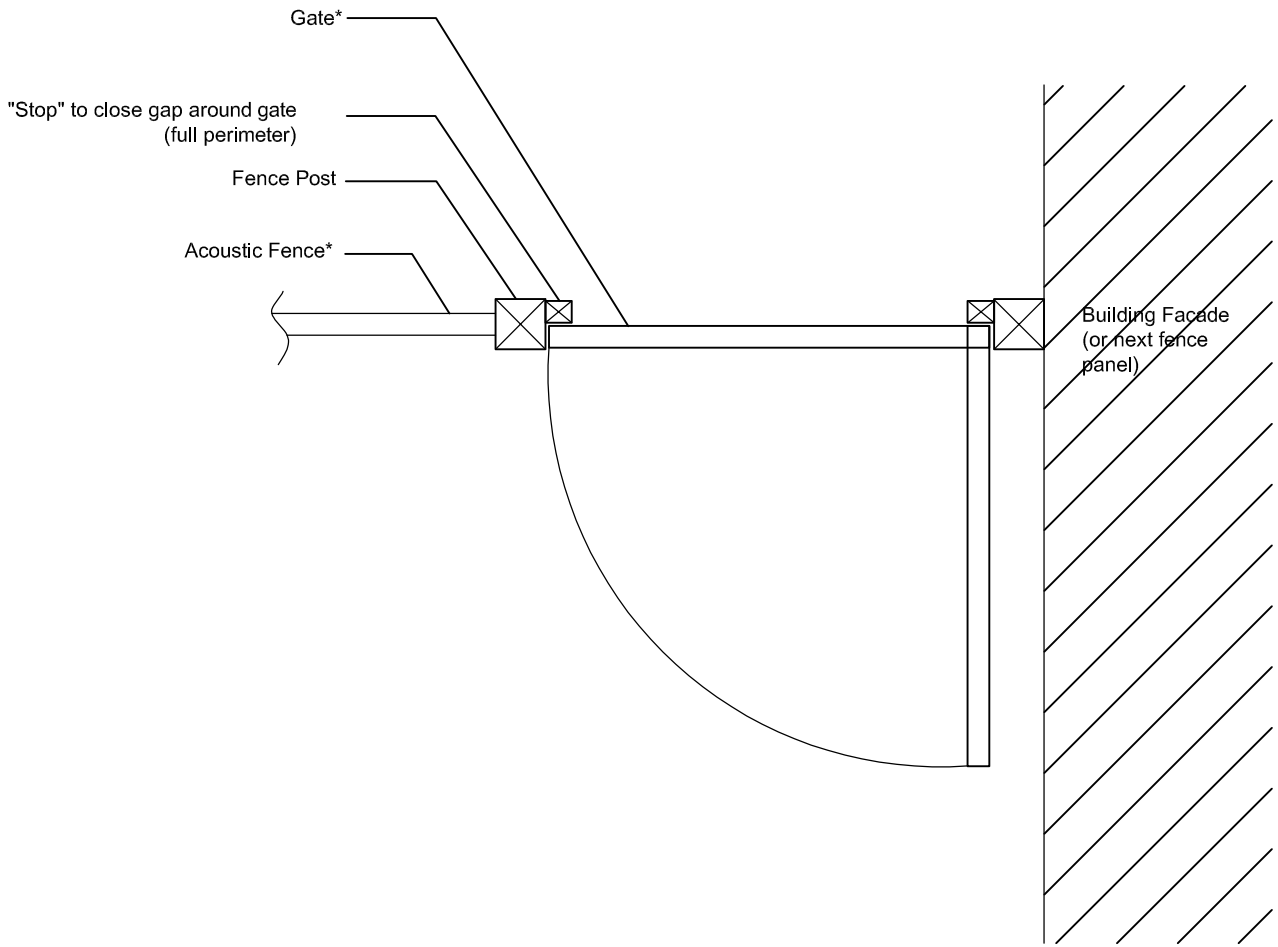
Project No.
108-363-300

Date
Jan. 31, 2019

Project Name
Half Moon Bay South - Phase 5

Scale
N.T.S.

Figure
2



* Acoustic Fence including gate must be of solid construction having a minimum face density of 20 kg/m² with no gaps or cracks.

Note: Bottom edge of gate must be no more than 25 mm above grade, if required for drainage.
The acoustic gates should be placed as close to the building facade as practical.

No.	Revision/Issue	Date

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Title
Acoustic Gate Concept

Project No.
108-363-300

Date
Feb. 1, 2019

Project Name
Half Moon Bay South - Phase 8

Scale
N.T.S.

Figure
3

APPENDIX A
ROAD TRAFFIC

APPENDIX B

MECP NOISE GUIDELINES

APPENDIX B

ENVIRONMENTAL NOISE GUIDELINES

MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS (MECP)

Reference: MECP Publication NPC-300, October 2013: *"Environmental Noise Guideline, Stationary and Transportation Source – Approval and Planning"*.

SPACE	SOURCE	TIME PERIOD	CRITERION
Living/dining, den areas of residences, hospitals, nursing homes, schools, daycare centres, etc.	Road	07:00 to 23:00	45 dBA
	Rail	07:00 to 23:00	40 dBA
	Aircraft	24-hour period	NEF/NEP 5
Living/dining, den areas of residences, hospitals, nursing homes, etc. (except schools or daycare centres)	Road	23:00 to 07:00	45 dBA
	Rail	23:00 to 07:00	40 dBA
	Aircraft	24-hour period	NEF/NEP 5
Sleeping quarters	Road	07:00 to 23:00	45 dBA
	Rail	07:00 to 23:00	40 dBA
	Aircraft	24-hour period	NEF/NEP 0
Sleeping quarters	Road	23:00 to 07:00	40 dBA
	Rail	23:00 to 07:00	35 dBA
	Aircraft	24-hour period	NEF/NEP 0
Outdoor Living Areas	Road and Rail	07:00 to 23:00	55 dBA
Outdoor Point of Reception	Aircraft	24-hour period	NEF/NEP 30[#]
	Stationary Source		
	Class 1 Area	07:00 to 19:00[(1)]	50[*] dBA
		19:00 to 23:00[(1)]	50[*] dBA
	Class 2 Area	07:00 to 19:00[(2)]	50[*] dBA
		19:00 to 23:00[(2)]	45[*] dBA
	Class 3 Area	07:00 to 19:00[(3)]	45[*] dBA
		19:00 to 23:00[(3)]	40[*] dBA
	Class 4 Area	07:00 to 19:00[(4)]	55[*] dBA
		19:00 to 23:00[(4)]	55[*] dBA

…./cont'd

SPACE	SOURCE	TIME PERIOD	CRITERION
Plane of a Window of Noise Sensitive Spaces	Stationary Source		
	Class 1 Area	07:00 to 19:00(1)	50* dBA
		19:00 to 23:00(1)	50* dBA
		23:00 to 07:00(1)	45* dBA
	Class 2 Area	07:00 to 19:00(2)	50* dBA
		19:00 to 23:00(2)	50* dBA
		23:00 to 07:00(2)	45* dBA
	Class 3 Area	07:00 to 19:00(3)	45* dBA
		19:00 to 23:00(3)	45* dBA
		23:00 to 07:00(3)	40* dBA
	Class 4 Area	07:00 to 19:00(4)	60* dBA
		19:00 to 23:00(4)	60* dBA
		23:00 to 07:00(4)	55* dBA

\# may not apply to in-fill or re-development.
* or the minimum hourly background sound exposure $L_{eq(1)}$, due to road traffic, if higher.
(1) Class 1 Area: Urban.
(2) Class 2 Area: Urban during day; rural-like evening and night.
(3) Class 3 Area: Rural.
(4) Class 4 Area: Subject to land use planning authority's approval.

Reference: MECP Publication ISBN 0-7729-2804-5, 1987: *"Environmental Noise Assessment in Land-Use Planning"*.

EXCESS ABOVE RECOMMENDED SOUND LEVEL LIMITS (dBA)	CHANGE IN SUBJECTIVE LOUDNESS ABOVE	MAGNITUDE OF THE NOISE PROBLEM	NOISE CONTROL MEASURES (OR ACTION TO BE TAKEN)
No excess (<55 dBA)	—	No expected noise problem	None
1 to 5 inclusive (56 to 60 dBA)	Noticeably louder	Slight noise impact	If no physical measures are taken, then prospective purchasers or tenants should be made aware by suitable warning clauses.
6 to 10 inclusive (61 - 65 dBA)	Almost twice as loud	Definite noise impact	Recommended.
11 to 15 inclusive (66 - 70 dBA)	Almost three times as loud	Serious noise impact	Strongly Recommended.
16 and over (>70 dBA)	Almost four times as loud	Very serious noise impact	Strongly Recommended (may be mandatory).

APPENDIX C

STAMSON CALCULATIONS

REPORT

ASSESSMENT OF DUST IMPACTS FROM AGGREGATE PITS ON MINTO COMMUNITIES CANADA AND MATTAMY HOMES PROPOSED DEVELOPMENTS

Minto and Mattamy Dust Study

Submitted to:

Hugo Lalonde and Melissa Pettem
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Submitted by:

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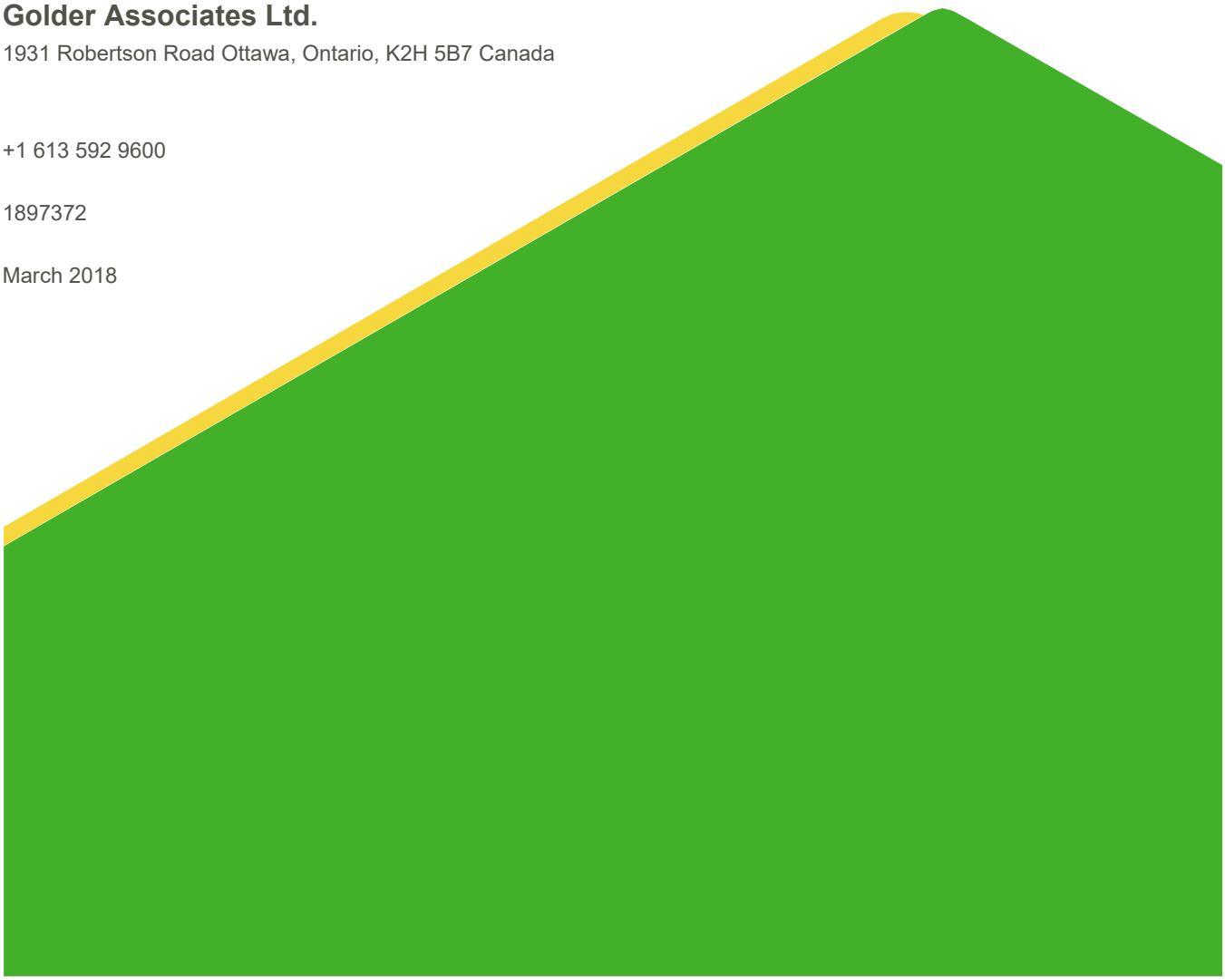
March 2018



Distribution List

e-copy: Minto Communities Canada, Ottawa

e-copy: Mattamy Homes, Ottawa

e-copy: Golder Associates Ltd., Ottawa

Executive Summary

Golder Associates Ltd. (Golder) was retained by Minto Communities Canada Inc. (Minto) and Mattamy Homes (Mattamy) to prepare a dust study (Dust Assessment) to assess potential impacts from aggregate pits located to the west and northwest of the proposed Minto and Mattamy residential subdivisions in the township of Nepean, Ottawa, Ontario.

The Dust Assessment supports a compatibility assessment under the Ontario Ministry of the Environment and Climate Change (MOECC) Publication D-6. The Dust Assessment was prepared based on the methodology and analysis procedure followed for a previous Dust Assessment completed for Mattamy (June 2013) for the same area. The Dust Assessment evaluates the impacts from the operation of the existing adjacent sand pits on the proposed Minto and Mattamy residential subdivision to the east, northeast and southeast of these sand pits.

The proposed Minto Subdivision will be located west of Greenbank Road on Lots 6 and 7 of Concession 3 in Ottawa, Ontario. The proposed Mattamy Subdivision will be located to the west of Greenbank Road on Lots 8 and 9 of Concession 3 in Ottawa, Ontario.

Both the Marcel Brazeau Pit and Scott Drummond Pit (the Pits) are located along the western boundary of the proposed Mattamy Subdivision and northwest of the proposed Minto Subdivision. The study is required in support of approval of the Subdivisions.

This Dust Assessment (March 2018) for the Minto and Mattamy Subdivisions includes the updated layout of the proposed residential subdivisions, grading for the proposed Subdivisions, and updated operating hours for the Brazeau Pit.

Based on the assessment conducted in accordance with the published MOECC guidance to obtain approval under the Environmental Protection Act (EPA) Section 9 for the operations of the Pits, there are no anticipated dust impacts on the proposed Minto and Mattamy Subdivisions.

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Minto Communities Canada Inc. (Minto) and Mattamy Homes (Mattamy) to prepare a dust study (Dust Assessment) to assess potential impacts from aggregate pits located to the west and northwest of the proposed Minto and Mattamy residential subdivisions in the township of Nepean, Ottawa, Ontario. The Dust Assessment evaluates the impacts from the operation of the existing open pits (Marcel Brazeau Pit – 3089 Borrisokane Road and Scott Drummond Pit – 3717 Borrisokane Road) (the Pits) on the proposed Minto and Mattamy residential subdivisions to the east, northeast and southeast of the Pits.

The Mattamy Subdivision is proposed to be located to the west of Greenbank Road on Lots 8 and 9, Concession 3 in Ottawa, Ontario. The Minto Subdivision is proposed to be located west of Greenbank Road on Lots 6 and 7, Concession 3 in Ottawa, Ontario. Both Pits are located along the western boundary of the Mattamy Subdivision and northeast and southeast of the Minto Subdivision. This study Dust Assessment was prepared in support of a site plan approval of the Subdivisions.

Golder's analysis is based on a previous Golder Report "Dust Assessment, Proposed Subdivision Development, Parts of Lots 8 and 9, Concession 3, Ottawa, Ontario" dated June 2013 completed for Mattamy. Since the issuance of the June 2013 report, there have been various changes in the project design, as well as operations at the Pits. Specifically, this Dust Assessment includes the following:

- addition of the new proposed Minto Subdivision (including the existing Minto development known as Quinn's Pointe Stage 1)
- revised and expanded proposed Mattamy Subdivision area
- review and update (as required) the Pits operations to reflect current operations, including updated hours of operations and height of portable screen at the Brazeau Pit (obtained from Marcel Brazeau by Golder during a phone conversation on March 6, 2018)

2.0 OPERATIONS

The Pits are sand extraction pits, both of which operate under licenses from the Ontario Ministry of Natural Resources (MNR). The daily operations of the pits vary depending on the demand for specific products.

Both pits are licensed to extract below the water table; however, based on information provided by the operators, the costs associated with extraction below water would make this scenario unlikely.

Identification of potential air sources were originally completed during a site visit on June 22, 2010, and through subsequent information provided by the Pit operators in January 2013. Revisions to the dust emissions sources were completed based on the information obtained in March 2018 and are provided in the sections below.

Both Pits provided their current typical hours of operations as of March 2018; the Brazeau Pit operates 12 hours per day, whereas the Drummond Pit typically operates 10 hours per day.

2.1 Brazeau Pit – 3809 Borrisokane Road, Ottawa

The extraction and processing of the Brazeau Pit is proposed to move west, away from the proposed Mattamy and Minto Subdivisions towards Borrisokane Road. The current extraction is about 450 m east of the proposed Mattamy Subdivision property line at a depth down to the water table, which is approximately 10 to 11 m below existing grade. The Pit is permitted to extract below the water table; however, as per phone conversations with the Brazeau Pit, it is not anticipated that extraction will occur below the water table. This site typically operates between 6:00 AM and 6:00 PM. The following pieces of equipment are used onsite:

- Screen and conveyor system – three (3) screens and one (1) conveyor system are used on site. This system was not operational at the time of site visit. Site personnel informed Golder that this system is operated a maximum of twice a week based on demand.
- Loaders – four (4) 950 Caterpillar loaders are regularly used on site; however, occasionally a maximum of five (5) loaders are used.
- Shipping – during an hour, up to six (6) trucks could cross the site.
- Portable crusher – one (1) portable crusher may be used on site occasionally as required (on demand). There is no portable crusher on a regular day to day operation.

2.2 Drummond Pit – 3717 Borrisokane Road, Ottawa

The extraction and processing of the Drummond Pit is also proposed to move west, away from the proposed Mattamy and Minto Subdivisions towards Borrisokane Road. The current extraction is about 300 m east of the proposed Mattamy Subdivision property line at a depth down to the water table, which is approximately 10 to 11 m below the current grade. As with the Brazeau Pit, extraction is permitted below the water table. This site typically operates between 7:00 AM and 5:00 PM. Site personnel also indicated that the Pit has approximately five (5) additional years of operational life remaining. The following pieces of equipment are used on site:

- Excavator – one (1) Caterpillar excavator is used on site based on demand. Screen and Conveyor system - one (1) 628 Trommel screener and conveyor system is used on site, along with 2 small screens. This system was not operational at the time of site visit. Site personnel informed Golder that this system is operated a maximum of twice a week based on demand.
- Loaders and graders – one (1) CAT 966G loader, one (1) CAT 988 loader; one (1) CAT 950 loader, and one (1) CAT D6R grader could be used onsite.
- Shipping – a maximum of 200 truck loads are shipped daily. During 1-hour a maximum of 20 to 25 trucks could cross the site.

3.0 CRITERIA AND GUIDELINES

The Ontario Ministry of the Environment and Climate Change (MOECC) Publication D-6 is a guideline that is intended to apply when a change in land use is proposed to minimize the encroachment of sensitive land use upon industrial land use and vice versa. This guideline categorizes industrial facilities into three Classes. As per the D-6 Guideline, quarry and pits can be categorized as a Class II facility. A Class II industrial facility can be described as follows:

> *A place of business for medium scale processing and manufacturing with outdoor storage of wastes or materials (i.e., it has an open process) and/or there are periodic outputs of minor annoyance. There are occasional outputs of either point source or fugitive emissions for any of the following: noise, odour, dust and/or vibration, and low probability of fugitive emissions. Shift operations are permitted and there is frequent movement of products and/or heavy trucks during daytime hours.*

Specifically, the D-6 Guideline requires that fugitive air emission studies be carried out for sensitive development within 300 m of a Class II facility. The D-6 Guideline applies to all types of proposed, committed and/or existing industrial land uses which have the potential to produce point source and/or fugitive air emissions such as noise, vibration, odour, dust and others, either through normal operations, procedures, maintenance or storage activities, and/or from associated traffic/transportation.

Emissions of particulate matter are addressed through the *Environmental Protection Act* (EPA), in particular Section 9 and Regulation 419/05 (Air Pollution – Local Air Quality).

In addition, the MNR publication "*Mineral Aggregate Resource Reference Manual*", dated January 2001, suggests some mitigation options where potential conflicts are identified. These options include:

1) Identification of development restriction in the zone of influence – using compatibility analysis (i.e., as outlined in MOECC Publication D-6 above), specific building or activity restriction may be developed (e.g., no habitable buildings permitted within certain metres of a licensed site).

2) Lot relocation or redesign – where a subdivision is involved, lots can sometimes be relocated or reconfigured to reduce potential conflict. In the case of Subdivisions, the majority of the proposed residential development includes a set back from the Pits. An allowance for a road, a school and a community park has been provided in the lands between the Pits and residential development area.

3) Avoidance of truck traffic in road design – where options exist, access to public roads from a subdivision (or vice versa) should be directed to portions of the road system less likely to be used by trucks transporting aggregate materials. In the case of the Marcel Brazeau Pit and the Scott Drummond Pit, the products from both pits are shipped through Borrisokane Road, which is well away from the Subdivisions.

   - Working with owner of the mineral aggregate – to reduce the impact, the owner could redesign the phase schedule such that material close to the proposed development is removed first; modify internal operations to reduce dust generation; establish landscape buffers or berm as necessary. In the case of the Marcel Brazeau Pit and the Scott Drummond Pit, the extraction moves away from the Subdivisions as the resource located closest to the Subdivisions has already been removed.

   - Removal of aggregate prior to development – if conflicts exists, parties involved may discuss the possibility of removing aggregate at locations closer to development prior to development. In this case, the aggregate resource located closest to the Subdivisions has already been removed down to the water table.

The following sections discuss the relevant City of Ottawa and MOECC guidelines.

4.0 DUST ASSESSMENT

Golder conducted a general dust assessment to assess potential air quality impacts from the operations of the Brazeau and Drummond Pits on the proposed Minto and Mattamy Subdivisions. For the purposes of this report, dust is the collective term used for particulate matter. For air quality assessments in Ontario related to fugitive dust, particulate matter is typically categorized into the following three categories:

- total suspended particulate (TSP) – particles nominally less than 44 µm in diameter
- particles nominally smaller than 10 µm in diameter (PM_{10})
- particles nominally smaller than 2.5 µm in diameter ($PM_{2.5}$)

Particulate matter is typically associated with airborne dust from vehicles travelling on paved roads and unpaved roads/haul routes, as well as material loading and unloading activities, crushing, screening and wind erosion of storage piles.

In Ontario, under the guidelines to apply for a Section 9 approval, limits and guidelines for regulating air quality are established under O.Reg. 419/05 (Air Pollution – Local Air Quality). These include standards, guidelines and ambient air quality criteria (AAQC) for various compounds. The AAQC are commonly used in assessments of general air quality in a community, and the potential for causing an adverse effect, whereas the standards and guidelines are used to assess specific impacts of an individual facility for compliance and permitting requirements. The MOECC does not have limits for PM_{10} and $PM_{2.5}$, therefore these have been excluded from the evaluation. Fugitive dust from pit operations excluding combustion sources are primarily emitted as TSP.

This dust assessment included the following steps:

- development of air inventory for all relevant sources at each of the Pits
- prediction of air quality impacts of the combined emissions from the Pits on the proposed Minto and Mattamy Subdivisions
- comparison of predicted concentrations of particulate matter to its standard as outlined in O.Reg. 419/05

Respirable crystalline silica concentrations were not assessed as a part of this Dust Assessment as the percentage of silica in the dust is not available for the Pits. The Dust Assessment did not include the Pits' mobile or road traffic sources of emission as these are excluded from O.Reg. 419/05. In accordance with MOECC procedures, exclusion of the road sources is acceptable as long as the aggregate facilities have implemented a fugitive dust Best Management Practices (BMP) Plan that includes the road emissions. The operators of the Pits have confirmed that a BMP Plan is in place at each of the Pits. In the case of the Subdivisions, the extraction from both the Pits progresses away from the proposed Mattamy and Minto Subdivisions; therefore, the length of the haul routes is expected to decrease over time, which is expected to result in lower impact from road traffic on the Subdivisions. The air emission sources included in the assessment for each of the Pits are summarized in Table 1.

Table 1: Summary of Air Emission Sources at the Pits

Equipment	Brazeau Pit	Drummond Pit
Storage Piles	Yes	Yes
Screeners	Yes	Yes
Vehicle Movements – Shipping	N/A	N/A
Material Transfers	Yes	Yes

N/A – Not applicable, not subject to Section 9 permitting requirements.

5.0 METHODOLOGY

For the purpose of this assessment, information collected from pit operators on emission sources was used to estimate emissions from the site. Emission rates are based on maximum predicted production rates from the site. Operations vary by hour of day and month of year, thus the use of maximum production rates is a conservative approach in assessing the impact of the Pits. Table 2 lists the estimated daily emission rates for each of the Pits used for the Dust Assessment.

Table 2: Existing Daily Emissions at the Pits

Pit	Maximum Daily Emission Rate [g/s]	Percent of Total
Brazeau	0.59	52%
Drummond	0.55	48%

The operation of the Pits will gradually move westward and, therefore, further away from the proposed Minto and Mattamy Subdivision. To maintain conservatism, the Pits operations were modelled based on current location and, therefore, are expected to overestimate impact on the proposed Minto and Mattamy Subdivisions. Further, the area where the Pits operations take place will become deeper which would reduce impact on the proposed Minto and Mattamy Subdivisions. The reduced grading is an increase to grade differential between the bottom of the existing Pits and the surrounding proposed Minto and Mattamy Subdivisions. This reduced grading was not included in the modelling to maintain conservatism.

The Dust Assessment was modelled using the AERMOD dispersion model using a five (5) year meteorological crops data set provided by the MOECC for the Eastern Region (Ottawa Regional Airport and Maniwaki). The dust sources associated with the Pits were modelled using a combination of area and volume sources. The model was run using uniform Cartesian grid encompassing the Pits and the proposed Minto and Mattamy Subdivisions.

6.0 RESULTS AND DISCUSSION

The proposed Minto and Mattamy Subdivisions plan indicates that the lands adjacent to the Scott Drummond Pit will be used for a secondary school and part of the lands adjacent to the Marcel Brazeau Pit will be used for residential and commercial land uses. Figure 1 presents the Minto and Mattamy Draft Subdivision Plan current as of March 2018.

The maximum predicted 24-hour concentration of TSP for the combined pit operations is provided in Table 3 and presented on Figure 2 as the Point of Impingement (POI). The predicted value is **below** the MOECC Schedule 3 standard of 120 µg/m^3 at all receptor locations in the proposed Subdivisions, indicating that the Pits can operate within the limit for TSP as set by the MOECC.

Table 3: Maximum Predicted Concentrations for Dust

Pit	Maximum Predicted TSP Concentration [µg/m³]	MOECC Limit [µg/m³]	Percent of Limit	Location of Maximum
Combined Pit Operations	27.1	120	22.6%	North of the Pits

In addition to evaluating the impact of operations at the Pits, existing background air quality conditions were considered. There is no current ambient monitoring to determine background concentration levels for TSP in Ontario. All ambient monitoring is limited to the $PM_{2.5}$ size fraction. A conservative estimate of the background TSP concentration was evaluated from the $PM_{2.5}$ measurements. The closest air monitoring station to the site is Ottawa Central Station (45°22'57.1 N, 75°42'51.1 W). The maximum predicted impact of the Pits operations including background air quality is presented in Table 4.

Table 4: Fugitive Dust Levels (24-hr average concentrations) Including Background

Pit	Maximum Predicted TSP Concentration [µg/m³]	Background TSP Concentration [µg/m³]	Operations + Background [µg/m³]	Percent of Limit
Combined Pit Operations	27.1	29.3*	56.4	47.0%

* 90th percentile $PM_{2.5}$ concentration was converted to TSP value by assuming that PM_{10} is 50% of TSP and $PM_{2.5}$ is 50% of PM_{10}; 90th percentile $PM_{2.5}$ concentration for 2015 was obtained from the MOECC's publication Air Quality in Ontario – 2015 Report[1].

7.0 CONCLUSIONS AND LIMITATIONS

7.1 Conclusions

Golder was retained by Minto and Mattamy to prepare a dust study (Dust Assessment) to assess potential impacts from aggregate pits located to the west and northwest of the proposed Minto and Mattamy residential subdivisions.

Based on the assessment of the Pits operation conducted in accordance with published MOECC guidance to obtain approval under the Section 9 of the EPA, the estimated dust emissions were below the Schedule 3 TSP limit at the proposed Subdivisions. Provided the Pits continue to operate in a similar manner and implement their BMP Plan to minimize dust migration off-site, the dust levels from future Pits operations are unlikely to reach the MOECC limit for TSP at the proposed residential subdivisions. The concentrations from the Pits will decrease as the Pits operations continue to move further away from the Minto and Mattamy residential subdivisions.

The proposed Minto and Mattamy Subdivisions would be considered as compatible land uses based on the guidance of MOECC Publication D-6, provided that the Pits continue to implement their fugitive dust BMP Plan.

[1] MOECC. (2017). Air Quality in Ontario – 2015 Report. Obtained from: http://www.airqualityontario.com/downloads/AirQualityInOntarioReportAndAppendix2015.pdf

7.2 Limitations

As indicated in the report, the information related to the Pit operations were obtained from the Pit operators and their onsite personnel during a site visit on June 22, 2010, conversations and email confirmations from the pit owners in June 2013, and updated operations information obtained in March 2018 based on conversation or email confirmation from the pit owners. Golder has acted in good faith and used the information collected and accepts no responsibility for any deficiency, misstatements, or inaccuracies contained in this report as a result of omissions, misinterpretations or fraudulent acts of the persons involved.

Respirable crystalline silica concentrations were not assessed as a part of this study as the percentage of silica in the dust is not available for this site.

Golder prepared this dust study using its commercially reasonable best efforts consistent with the level and skill ordinarily exercised by members of the profession currently practicing under similar conditions, while ensuring that the study was prepared in general conformance with regulatory and guideline requirements.

This report was prepared for the exclusive use of Minto and Mattamy. Persons other than Minto and/or Mattamy using this report or observations, or conclusions stated within, may do so at their own discretion.

Signature Page

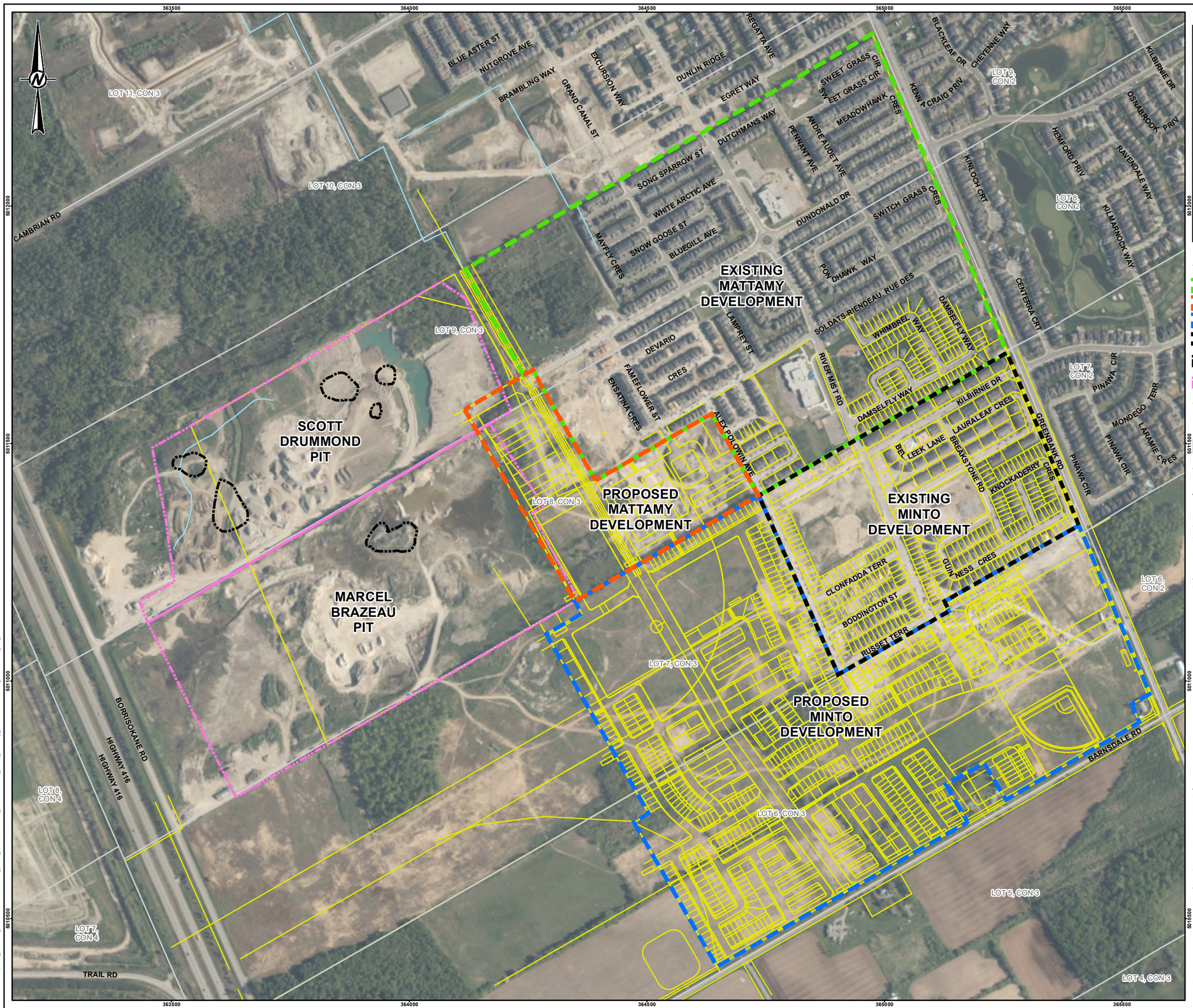
We trust this report meets with your current requirements. If you have any questions regarding this report, please contact the undersigned.

GOLDER ASSOCIATES LTD.

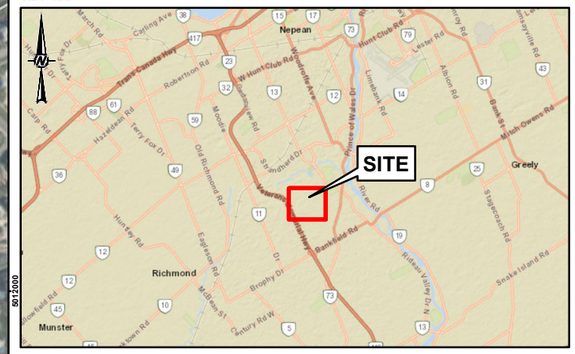
Kate Liubansky, M.Env.Sc.
Air Quality Specialist

Camille S. Taylor, P.Eng.
Senior Air Quality Specialist

KL/CST/md
https://golderassociates.sharepoint.com/sites/1897372/deliverables/report/final/1897372 dust assessment final report_27mar2018.docx



KEY MAP



SCALE 1:400,000

LEGEND

- EXISTING MATTAMY DEVELOPMENT
- PROPOSED MATTAMY DEVELOPMENT
- PROPOSED MINTO DEVELOPMENT
- EXISTING MINTO DEVELOPMENT
- STOCK PILE
- PIT LICENSED BOUNDARY (BASED ON AVAILABLE INFORMATION)
- SUBDIVISION PLAN
- WATERCOURSE
- LOT AND CONCESSION

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. DEVELOPMENT PLAN PROVIDED BY CLIENT IN CAD FORMAT, "2018-02-20_BARRHAVEN SOUTH_DEMONSTATION PLAN_V3.DWG", DATED 2018-02-20; AND "161613795-131-QUINNSPOINTEPH2_D2_C3D.DWG"
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2016
3. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, DELORME, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), MAPMYINDIA, NGCC, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
4. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 80 160 320

1:8,000 METRES

CLIENT

MINTO COMMUNITIES CANADA AND MATTAMY HOMES

PROJECT

MINTO AND MATTAMY DUST STUDY

TITLE

AREA PLAN SHOWING DEVELOPMENTS AND PIT LOCATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2018-03-27
DESIGNED	----
PREPARED	BR
REVIEWED	KL
APPROVED	CST

PROJECT NO.	CONTROL	REV.	FIGURE
1897372	0001	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

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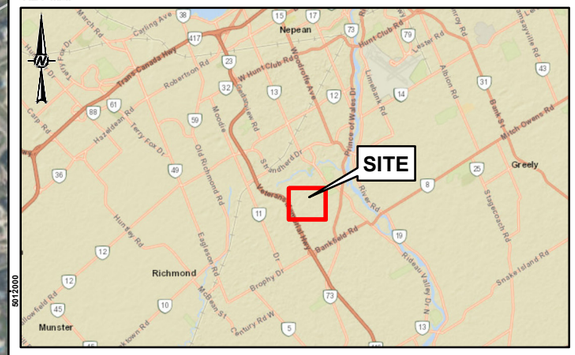
KEY MAP



SCALE 1:400,000

LEGEND

- POINT OF IMPINGEMENT (POI)

MODELLING SOURCES (SHOWN IN THEIR CURRENT LOCATION)

- VOLUME SOURCES
- AREA SOURCES

TOTAL SUSPENDED PARTICULATE CONCENTRATION CONTOUR (µg/m³)

- <10
- 10 - 20
- 20 - 30
- EXISTING MATTAMY DEVELOPMENT
- PROPOSED MATTAMY DEVELOPMENT
- PROPOSED MINTO DEVELOPMENT
- EXISTING MINTO DEVELOPMENT
- STOCK PILE
- PIT LICENSED BOUNDARY (BASED ON AVAILABLE INFORMATION)
- LOT AND CONCESSION

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2016
2. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, DELORME, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), MAPMYINDIA, NGCC, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 80 160 320
1:8,000 METRES

CLIENT
MINTO COMMUNITIES CANADA AND MATTAMY HOMES

PROJECT
MINTO AND MATTAMY DUST STUDY

TITLE
MAXIMUM 24-HOUR TOTAL SUSPENDED PARTICULATE (TSP) CONCENTRATION

CONSULTANT
GOLDER

YYYY-MM-DD	2018-03-27
DESIGNED	----
PREPARED	BR
REVIEWED	KL
APPROVED	CST

PROJECT NO.	CONTROL	REV.	FIGURE
1897372	0001	0	**2**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

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golder.com

3718 Greenbank Road – Half Moon Bay South – Phase 5

Transportation Impact Assessment

Step 1 Screening Report

Step 2 Scoping Report

Step 4 Strategy Report (Draft)

Prepared for:

Mattamy Homes
50 Hines Road, Suite 100
Ottawa, ON K2K 2M5

Prepared by:

CGH TRANSPORTATION
13 Markham Avenue
Nepean, ON K2G 3Z1

January 2019

PN: 2018-32

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Appendix C - Turning Movement Count Data
Appendix D – Collision Data
Appendix E – 2020 Future Background Synchro Worksheets
Appendix F – Cambrian Road and River Mist Road Westbound Left-Turn Lane Warrant
Appendix G – 2025 Future Background Synchro Worksheets
Appendix H – MMLOS Analysis
Appendix I – 2020 Future Total Synchro Worksheets
Appendix J – 2025 Future Total Synchro Worksheets

1 Screening

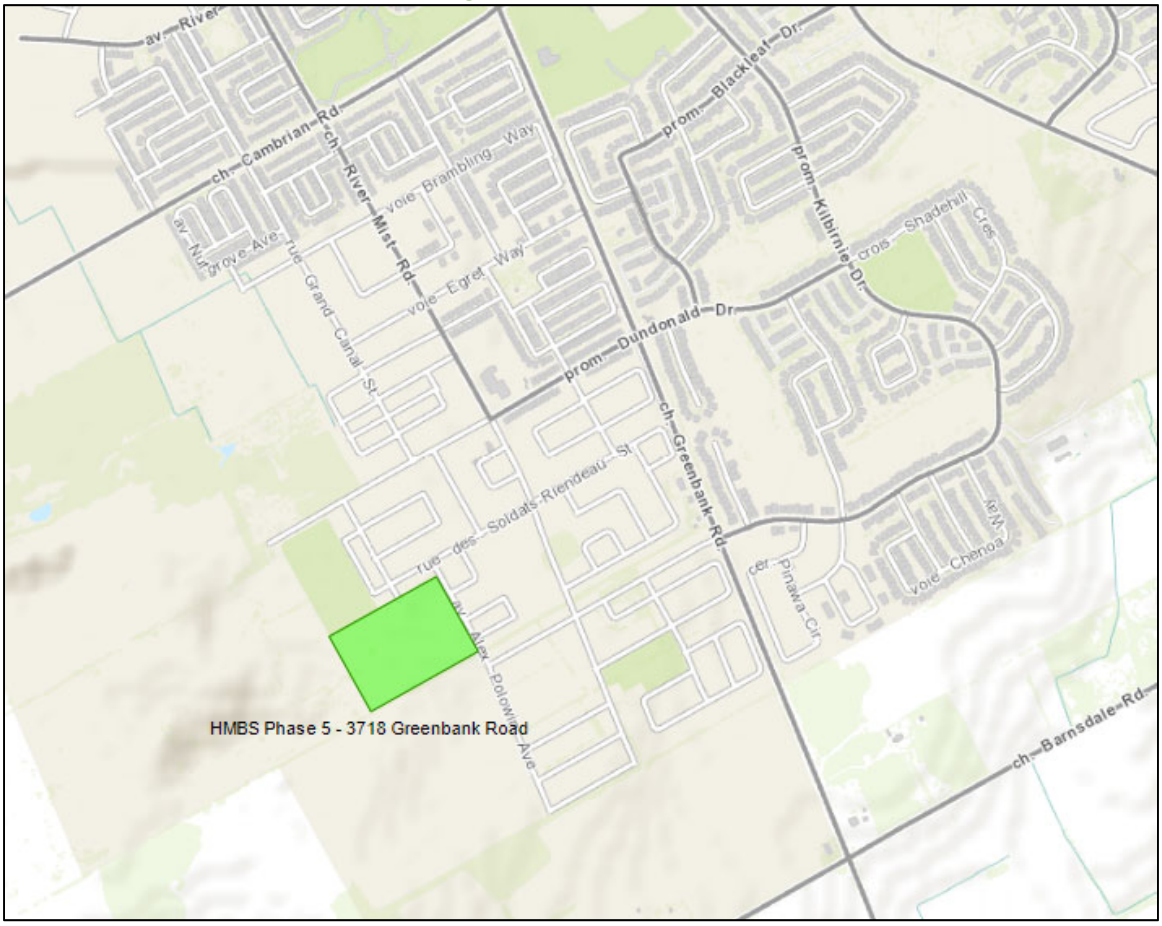
This study has been prepared according to the City of Ottawa's 2017 Transportation Impact Assessment (TIA) Guidelines. Accordingly, a Step 1 Screening Form has been prepared and is included as Appendix A, along with the Certification Form for TIA Study PM. As shown in the Screening Form, a TIA met the Trip Generation and Location triggers and requires the Design Review component and the Network Impact Component.

2 Existing and Planned Conditions

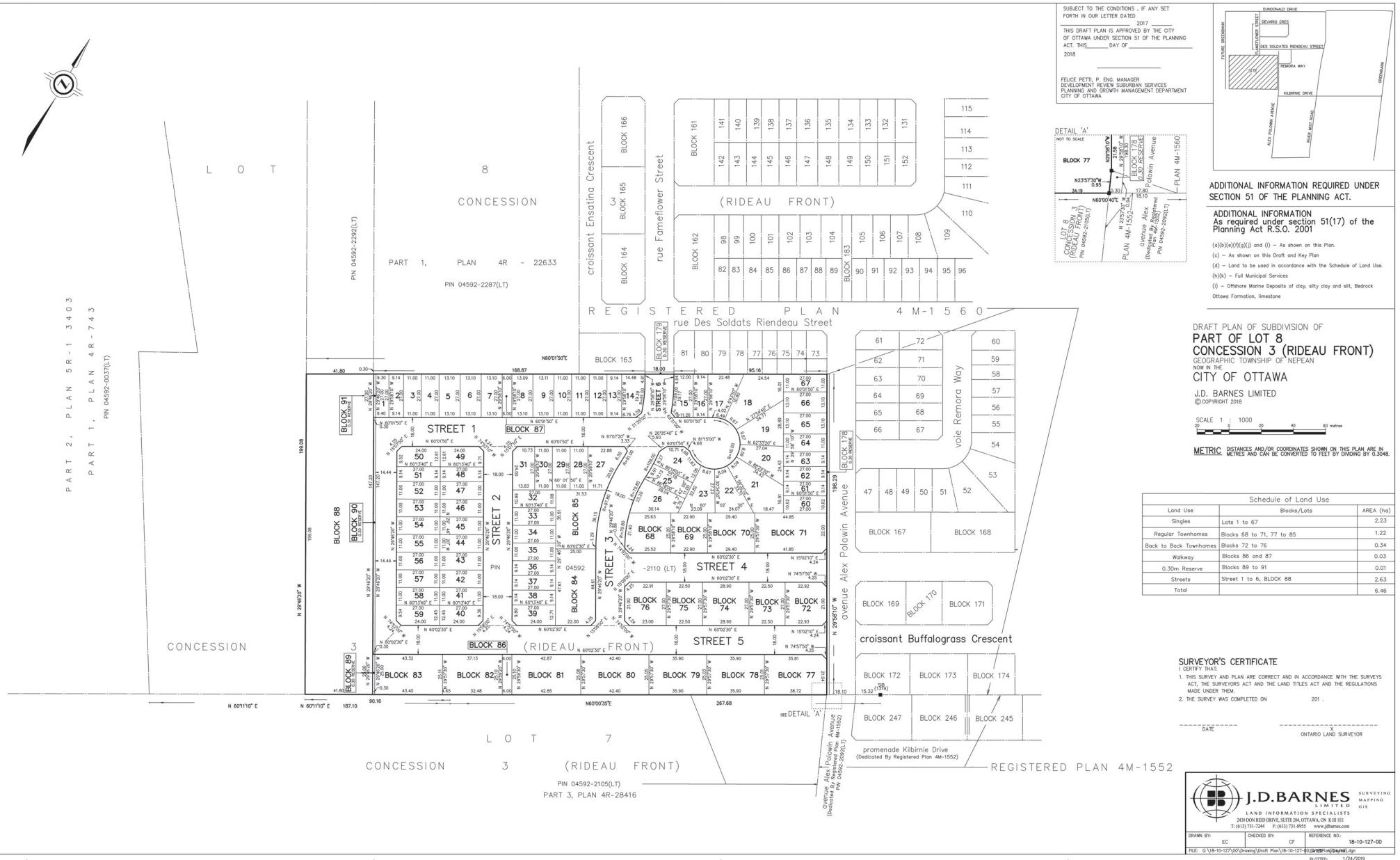
2.1 Proposed Development

The proposed development, located at 3718 Greenbank Road, is currently a greenfield property within the Barrhaven South Expansion Area (BSEA) and would include a total of 165 residential units, 67 single detached and 98 townhomes. It will be the fifth phase of the adjacent development. While currently zoned as Mineral Aggregate (MR), the BSEA CDP will rezone the land within the site boundary as low/medium residential (mix of R1-5). Access to the proposed development will be provided the existing phase of the development, using Soldats Riendeau Street, River Mist Road, Dundonald Drive and Kilbirnie Drive to access the adjacent arterial road network. The future Re-Aligned Greenbank Road will border the western edge of the development but is not anticipated to be completed during the horizons of this study. The anticipated full build-out and occupancy horizon is 2020. Figure 1 illustrates the Study Area Context. Figure 2 illustrates the proposed concept plan.

Figure 1: Area Context Plan



Source: http://maps.ottawa.ca/geoOttawa/ Accessed: November 14, 2018


SUBJECT TO THE CONDITIONS , IF ANY SET FORTH IN OUR LETTER DATED
2017
THIS DRAFT PLAN IS APPROVED BY THE CITY OF OTTAWA UNDER SECTION 51 OF THE PLANNING ACT. THIS DAY OF
2018
FELICE PETTI, P. ENG. MANAGER
DEVELOPMENT REVIEW SUBURBAN SERVICES
PLANNING AND GROWTH MANAGEMENT DEPARTMENT
CITY OF OTTAWA
DETAIL 'A'
NOT TO SCALE
ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51 OF THE PLANNING ACT.
ADDITIONAL INFORMATION
As required under section 51(17) of the Planning Act R.S.O. 2001
(a)(b)(e)(f)(g)(j) and (l) – As shown on this Plan.
(c) – As shown on this Draft and Key Plan
(d) – Land to be used in accordance with the Schedule of Land Use.
(h)(k) – Full Municipal Services
(l) – Offshore Marine Deposits of clay, silty clay and silt, Bedrock Ottawa Formation, Ilmestone
DRAFT PLAN OF SUBDIVISION OF
PART OF LOT 8
CONCESSION 3 (RIDEAU FRONT)
GEOGRAPHIC TOWNSHIP OF NEPEAN
NOW IN THE
CITY OF OTTAWA
J.D. BARNES LIMITED
© COPYRIGHT 2018
SCALE 1 : 1000
METRIC DISTANCES AND/OR COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.
Schedule of Land Use
Land Use | Blocks/Lots | AREA (ha)
Singles | Lots 1 to 67 | 2.23
Regular Townhomes | Blocks 68 to 71, 77 to 85 | 1.22
Back to Back Townhomes | Blocks 72 to 76 | 0.34
Walkway | Blocks 86 and 87 | 0.03
0.30m Reserve | Blocks 89 to 91 | 0.01
Streets | Street 1 to 6, BLOCK 88 | 2.63
Total | | 6.46
SURVEYOR'S CERTIFICATE
I CERTIFY THAT:
1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE LAND TITLES ACT AND THE REGULATIONS MADE UNDER THEM.
2. THE SURVEY WAS COMPLETED ON 201 .
DATE
ONTARIO LAND SURVEYOR
J.D.BARNES LIMITED
SURVEYING MAPPING GIS
LAND INFORMATION SPECIALISTS
2430 DON REID DRIVE, SUITE 204, OTTAWA, ON K1H 1E1
T: (613) 731-7244 F: (613) 731-8955 www.jdbarnes.com
DRAWN BY: EC
CHECKED BY: CF
REFERENCE NO.: 18-10-127-00
FILE: C:\18-10-127\00\Drawing\Draft Plan\18-10-127-00_DRAFTPLAN_2018.dgn
PLOTTED: 1/24/2019
LOT 8
CONCESSION 3
(RIDEAU FRONT)
PART 2, PLAN 5R-13403
PART 1, PLAN 4R-7743
PIN 04592-0037(LT)
PIN 04592-2292(LT)
PART 1, PLAN 4R - 22633
PIN 04592-2287(LT)
croissant Ensatina Crescent
rue Fameflower Street
REGISTERED PLAN 4M-1560
rue Des Soldats Riendeau Street
(RIDEAU FRONT)
voie Remora Way
avenue Alex Polowin Avenue
croissant Buffalograss Crescent
promenade Kilbirnie Drive
(Dedicated By Registered Plan 4M-1552)
REGISTERED PLAN 4M-1552
LOT 7
CONCESSION 3 (RIDEAU FRONT)
PIN 04592-2105(LT)
PART 3, PLAN 4R-28416
avenue Alex Polowin Avenue (Dedicated By Registered Plan 4M-1552) PIN 04592-2292(LT)
DUNDONALD DRIVE
DEVARO CRES
DES SOLDATS RIENDEAU STREET
REMORA WAY
KILBIRNIE DRIVE
ALEX POLOWIN AVENUE
RIVER MIST ROAD
CREEKBANK
FUTURE GREENBANK
BLOCK 77
BLOCK 78
BLOCK 79
BLOCK 80
BLOCK 81
BLOCK 82
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BLOCK 246
BLOCK 245
STREET 1
STREET 2
STREET 3
STREET 4
STREET 5
STREET 6
see DETAIL 'A'

2.2 Existing Conditions

2.2.1 Area Road Network

Greenbank Road: Greenbank Road is a City of Ottawa arterial road with a two-lane urban cross-section including a bike lane in the northbound direction. The posted speed limit is 60 km/h. The Ottawa Official Plan reserves a 37.5 metre right of way.

Cambrian Road: Cambrian Road is a City of Ottawa arterial road with a two-lane urban cross-section and a 50 km/h posted speed limit. The Ottawa Official Plan reserves a 37.5 metre right of way.

Dundonald Drive: Dundonald Drive is a City of Ottawa collector road with a two-lane urban with parking lanes on both sides of the road. The unposted speed limit is 50km/h and the right-of-way is 24.0m.

Kilbirnie Drive: Kilbirnie Drive is a City of Ottawa collector road with a two-lane urban with a parking lane on one side of the road. The unposted speed limit is 50km/h and the right-of-way is 22.0m.

River Mist Road: River Mist Road is a City of Ottawa collector road with a two-lane urban with a parking lane on one side of the road. The unposted speed limit is 50km/h and the right-of-way is 24.0m.

Soldats Riendeau Street: Soldats Riendeau Street is a City of Ottawa local road with a two-lane urban with a parking lane on one side of the road. The unposted speed limit is 50km/h and the right-of-way is 18.0m.

Alex Polowin Avenue: Alex Polowin Avenue is a City of Ottawa local road with a two-lane urban with a parking lane on one side of the road. The unposted speed limit is 50km/h and the right-of-way is 18.0m.

2.2.2 Existing Intersections

Greenbank Road / Dundonald Drive	The intersection of Greenbank Road and Dundonald Drive is a signalized intersection with shared all movement lanes on the east and west bound approaches, and the north and south bound approaches include an auxiliary left-turn lane, a trough lane and an auxiliary right-turn lane. A multi-use pathway signal and cross-ride is provided on the west side of the intersection and the bike lane transitions to sharrows through the intersection for the northbound approach. No turn restrictions were noted.
Greenbank Road / Kilbirnie Drive	The intersection of Greenbank Road and Kilbirnie Drive is a minor stop-controlled intersection. The east and west bound approaches consist if shared all movement lanes, and both the north and south bound approaches consist of an auxiliary left-turn lane, through lane and an auxiliary right-turn lane. A northbound bike lane is provided. No turn restrictions were noted.
Cambrian Road / River Mist Road	The intersection of Cambrian Road and River Mist Road is an all-way stop-controlled intersection with shared movement lanes on all approaches. No turn restrictions were noted.

2.2.3 Existing Driveways

Phase 5 of the Half Moon Bay South development will extend/connect to the local road network from the adjacent phases, with Soldats Riendeau Street bordering the phase on the north side and Alex Polowin Avenue on the east side. As a residential development, private driveways are along Soldats Riendeau Street and Alex Polowin Avenue has local road intersections. Currently these intersections and driveways are the sole contributors to the traffic along the roadways. Relative to this low volume the addition of 163 residential units will increase the traffic on the roadways, although this is not a significant impact to the overall roadway operation and capacity.

Figure 3 illustrates the adjacent driveway and local road intersections and additional site photos have been provided in Appendix B.

Figure 3: Adjacent Driveway and Roadway Locations

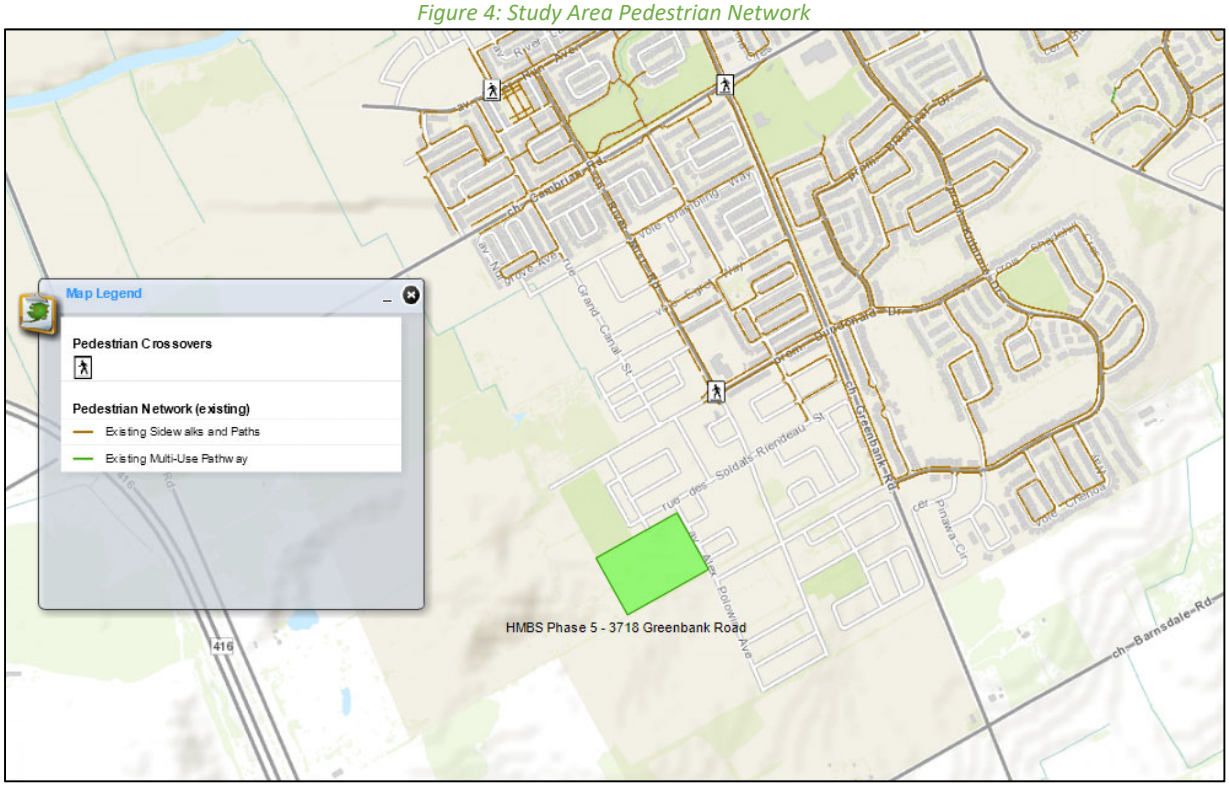
2.2.4 Cycling and Pedestrian Facilities

The adjacent development generally provides a sidewalk on one side of the local roads, with sidewalks on both sides of the roadway on Dundonald Drive and River Mist Road, and Cambrian Road. Greenbank Road has a multi-use pathway on the west side of the road and a sidewalk on the east side. Pedestrian cross-overs are provided at the roundabout intersection of Dundonald Drive and River Mist Road.

The cycling facilities in the area are provided along Greenbank Road with a multi-use pathway on the west side and a northbound bike lane. The future Re-Aligned Greenbank Road and the existing Greenbank Road are designated as spine routes and Cambrian Road, River Mist Road, and Dundonald Drive are designated as local routes.

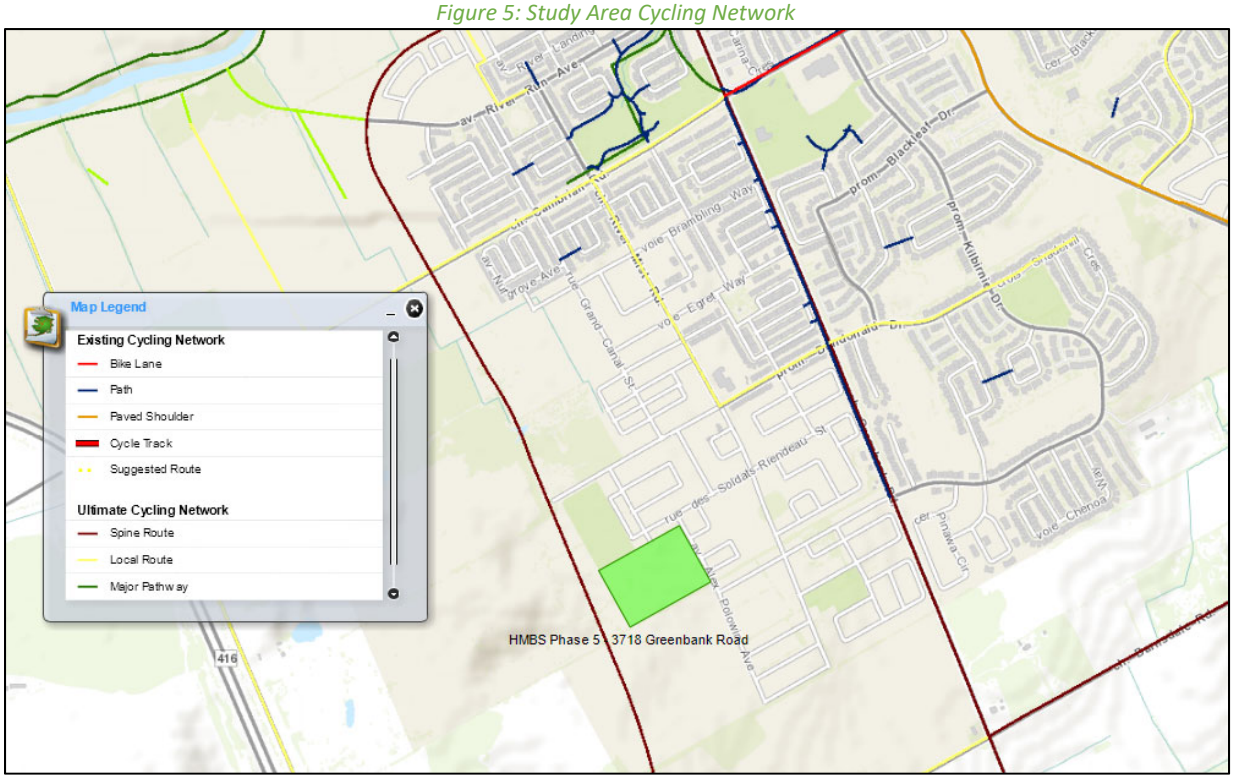
Figure 4 and Figure 5 illustrate the pedestrian and cycling networks in the study area.

Figure 4: Study Area Pedestrian Network



Source: http://maps.ottawa.ca/geoOttawa/ Accessed: November 14, 2018

Figure 5: Study Area Cycling Network

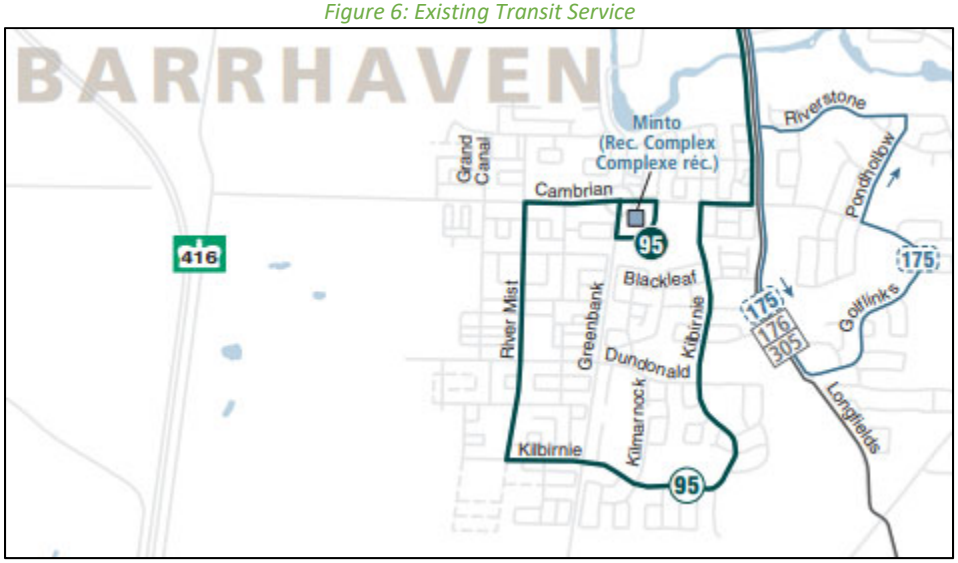


Source: http://maps.ottawa.ca/geoOttawa/ Accessed: November 14, 2018

2.2.5 Existing Transit

The existing transit service is provided by route #95 that runs along Kilbirnie Drive, River Mist Road and Cambrian Road, from the Minto Recreation Complex, through downtown to Trim Road in Orleans. The nearest stops are located at Kilbirnie Drive/River Mist Road, and Dundonald Drive/River Mist Road, and are over a 500m walking distance from the centre of the subject site.

Figure 6: Existing Transit Service



2.2.6 Existing Area Traffic Management Measures

There are no existing area traffic management measures within the Study Area.

2.2.7 Existing Peak Hour Travel Demand

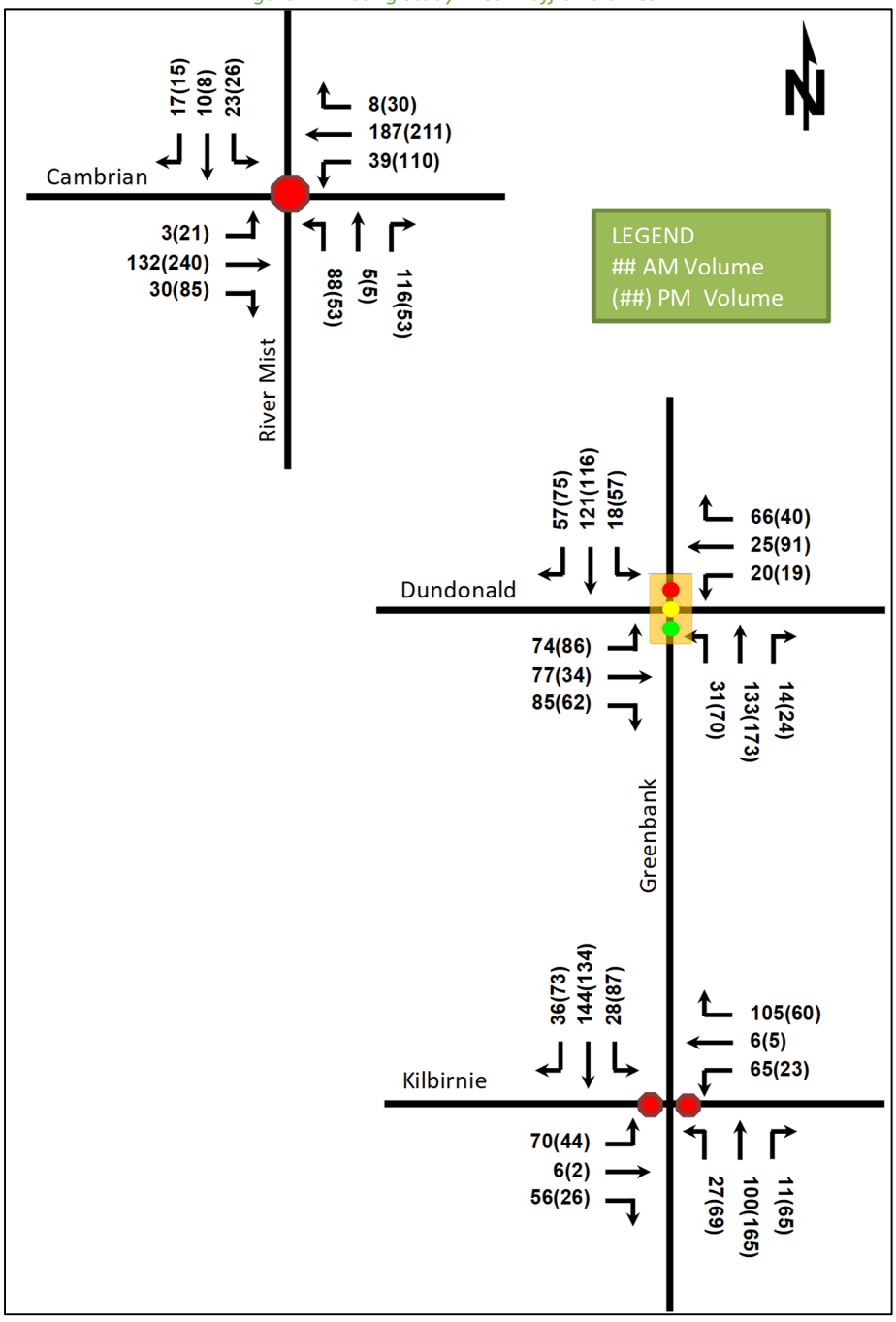
Existing turning movement counts were acquired from area traffic studies for the existing Study Area intersection. Table 1 summarizes the intersection count dates, Figure 7 illustrates the study area traffic volumes.

Table 1: Intersection Count Date

Intersection	Count Date
Greenbank Road & Dundonald Drive	Wednesday, May 24, 2017
Greenbank Road & Kilbirnie Drive	Thursday, November 9, 2017
River Mist Road & Cambrian Road	Wednesday, August 23, 2017

Detailed turning movement count data is included in Appendix C.

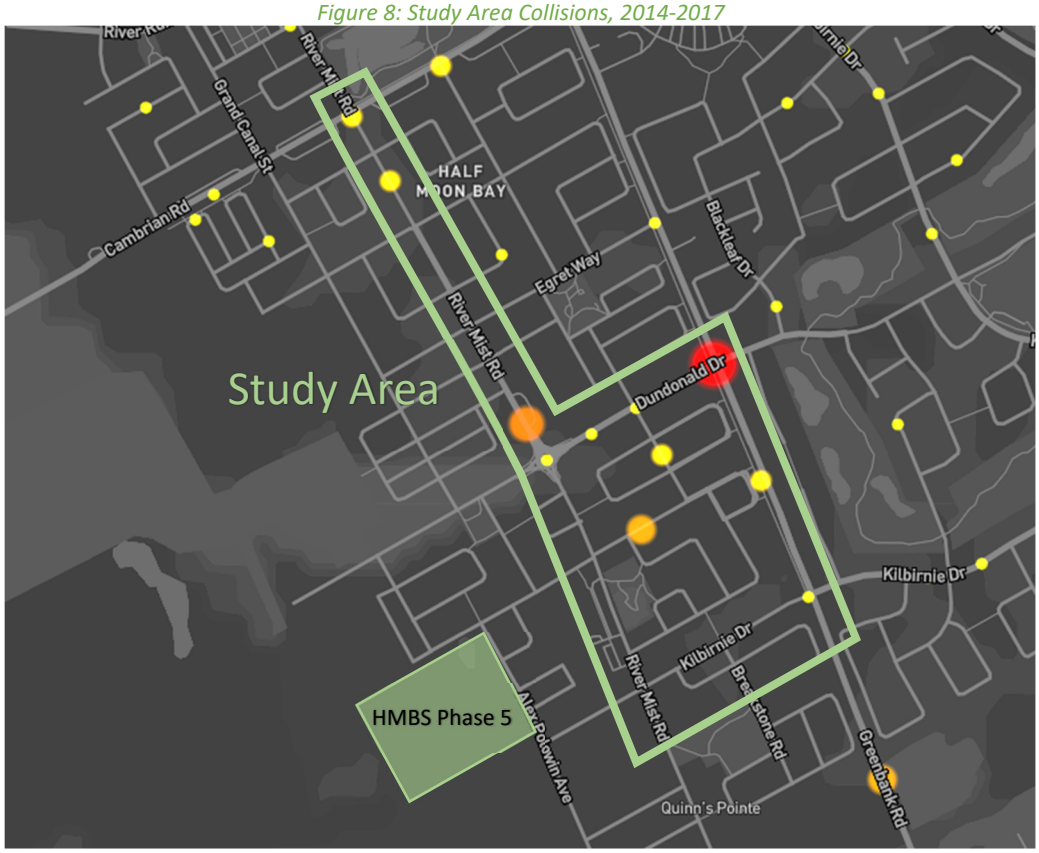
Figure 7: Existing Study Area Traffic Volumes



2.2.8 Collision Analysis

Collision data has been acquired from OpenData Ottawa for four years prior to the commencement of this TIA for the study area. Figure 8 illustrates the study area collisions and Table 2 summarizes the collisions.

Figure 8: Study Area Collisions, 2014-2017



Source: https://maps.bikeottawa.ca/collisions/ Accessed: November 14, 2018

Table 2: Study Area Collision Summary

Total Collisions		Number	%
		36	**100%**
Classification	Fatality	0	0%
	Non-Fatal Injury	4	11%
	Property Damage Only	32	89%
Initial Impact Type	Angle	11	31%
	Rear end	2	6%
	Sideswipe	0	0%
	Turning Movement	3	8%
	SMV Other	2	6%
	SMV Unattended	18	50%
	Other	0	0%
Road Surface Condition	Dry	22	61%
	Wet	6	17%
	Loose Snow	1	3%
	Slush	2	6%
	Packed Snow	2	6%
	Ice	3	8%
Pedestrian Involved		2	6%

Overall, a low volume of collisions is noted at the study area intersections and road segments with majority under 4 total collisions in four years (orange circles). The intersection of Greenbank Road and Dundonald Drive had a total of 7 collisions and is noted to have included a single pedestrian related collision, having occurred prior to the signalization of the intersection. The other pedestrian related collision occurred along Andre Audet Avenue between Dundonald Drive and Soldats Riendeau Street.

Collision data is included in Appendix D.

2.3 Planned Conditions

2.3.1 Changes to the Area Transportation Network

Greenbank Road

The future New Greenbank Road extension, south of Cambrian Road, will pass just east of the proposed development, providing Arterial Road connectivity. However, the timing of this extension is unknown as it is not included in the City of Ottawa's Transportation Master Plan 2031 Affordable Road Network.

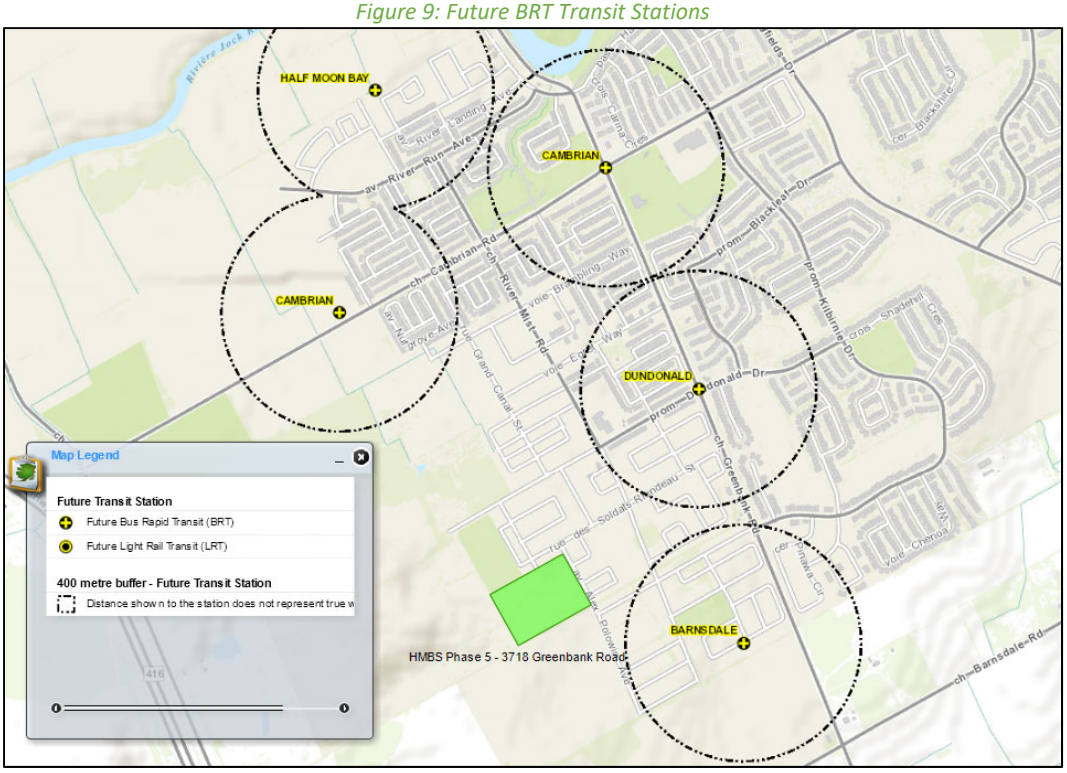
Cambrian Road

The Cambrian Road Widening Environmental Assessment includes a four-lane cross-section along Cambrian Road from Longfields Drive to the future Realigned Greenbank Road. This EA has been approved by Transportation Committee and City Council, but the widening is not considered in the City of Ottawa's Transportation Master Plan 2031 Affordable Road Network and therefore the timing of this widening is unknown.

Bus Rapid Transit

As part of the road widenings and re-alignments, bus rapid transit stations are also planned for the area. The timing of these is also unknown and have been illustrated in Figure 9.

Figure 9: Future BRT Transit Stations



Source: http://maps.ottawa.ca/geoOttawa/ Accessed: November 14, 2018

2.3.2 Other Study Area Developments

Half Moon Bay West

North of the proposed development is the Mattamy Development of Half Moon Bay West. This development will include 518 detached homes and 427 townhouses. Construction has not commenced on this subdivision. The trips generated by this site will be accounted for in the traffic projections.

The Meadows Phase 4

East of the proposed development is the Tamarack Development of the Meadows. Phase 4 has a current development application. This development will not have shared accesses or traffic cross-over but will impact the Study Area intersections. This development will include 50 detached homes and 136 townhouses. The site trips generated by this site will be accounted for in the traffic projections.

The Meadows Phase 5

North of the proposed development is the Tamarack Development of the Meadows. Phase 5 has a current development application. This development will not have shared accesses or traffic cross-over but will impact the Study Are intersections. The site trips generated by this site will be accounted for in the traffic projections.

Barrhaven South Expansion Lands (Quinn's Pointe 2)

To the southeast of the proposed development is the Minto Development of Quinn's Pointe 2. The first phase of this development has been constructed. This development will not have shared accesses and site trips generated by this site will be accounted for in the traffic projections.

3 Study Area and Time Periods

3.1 Study Area

The study area will include the intersections of Greenbank Road/Dundonald Drive, Greenbank Road/Kilbirnie Drive, and Cambrian Road/River Mist Road.

3.2 Time Periods

As the proposed development is composed entirely of residential units the AM and PM peak hours will be examined.

3.3 Horizon Years

The anticipated build-out year is 2020. As a result, the full build-out plus five years horizon year is 2025.

4 Exemption Review

Table 3 summarizes the exemptions for this TIA.

Table 3: Exemption Review

Module	Element	Explanation	Exempt/Required
Design Review Component			
4.1 Development Design	4.1.2 Circulation and Access	Only required for site plans	Exempt
	4.2.3 New Street Networks	Only required for plans of subdivision	**Required**

Module	Element	Explanation	Exempt/Required
4.2 Parking	4.2.1 Parking Supply	Only required for site plans	Exempt
	4.2.2 Spillover Parking	Only required for site plans where parking supply is 15% below unconstrained demand	Exempt
Network Impact Component			
4.5 Transportation Demand Management	All Elements	Not required for site plans expected to have fewer than 60 employees and/or students on location at any given time	**Required**
4.6 Neighbourhood Traffic Management	4.6.1 Adjacent Neighbourhoods	Only required when the development relies on local or collector streets for access and total volumes exceed ATM capacity thresholds	**Required**
4.8 Network Concept		Only required when proposed development generates more than 200 person-trips during the peak hour in excess of equivalent volume permitted by established zoning	Exempt

5 Development Generated Travel Demand

5.1 Trip Generation and Mode Shares

This TIA has been prepared using the vehicle and person trip rates for the residential components using the TRANS Trip Generation Study Report (2009). Table 4 summarizes the person trip rates for the proposed land uses.

Table 4: Trip Generation Person Trip Rates

Dwelling Type	Land Use Code	Peak Hour	Vehicle Trip Rate	Person Trip Rates
Single-Detached	210	AM	0.70	1.27
		PM	0.90	1.41
Townhomes	220	AM	0.54	0.98
		PM	0.71	1.16

Using the above Person Trip rates, the total person trip generation has been estimated. Table 5 below illustrates the total person trip generation by dwelling type.

Table 5: Total Person Trip Generation

Land Use	Units	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Single-Detached	67	25	60	85	57	37	94
Townhomes	98	36	60	96	60	54	114
Total Person Trips		**61**	**120**	**181**	**117**	**91**	**208**

Using the most recent National Capital Region Origin-Destination survey (OD Survey), the existing mode shares for South Nepean were determined and will be applied for the development and are summarized in Table 6.

Table 6: TOD Mode Share

Travel Mode	Mode Share
Auto Driver	80%
Auto Passenger	5%
Transit	10%
Non-Auto	5%
Total	100%

Using the above mode shares and person trip rates the person trips by mode have been projected. Table 7 summarizes the trip generation by mode.

Table 7: Trip Generation by Mode

Travel Mode	Mode Share	In	Out	Total	In	Out	Total
Auto Driver	80%	49	96	145	94	73	166
Auto Passenger	5%	3	6	9	6	5	11
Transit	10%	7	12	19	12	9	20
Non-Auto Modes	5%	3	6	9	6	5	11
Total	100%	61	120	181	117	91	208

As shown above, 145 AM and 166 PM peak hour two-way vehicle trips are projected as a result of the proposed development.

No trip reductions factors (i.e. synergy, pass-by, etc.) have been applied as the subject.

5.2 Trip Distribution

To understand the travel patterns of the subject development the OD Survey has been reviewed to determine the existing travel patterns. Table 8 below summarizes the distribution.

Table 8: OD Survey Existing Mode Share – South Nepean

To/From	Percent of Trips
North	80%
South	5%
East	10%
West	5%
Total	100%

5.3 Trip Assignment

Using the distribution outlined above, turning movement splits, and access to major transportation infrastructure, the trips generated by the site have been assigned to the Study Area road network using the assignment illustrated in Figure 10 and new site volumes are illustrated in Figure 11.

Figure 10: Traffic Assignment (%)

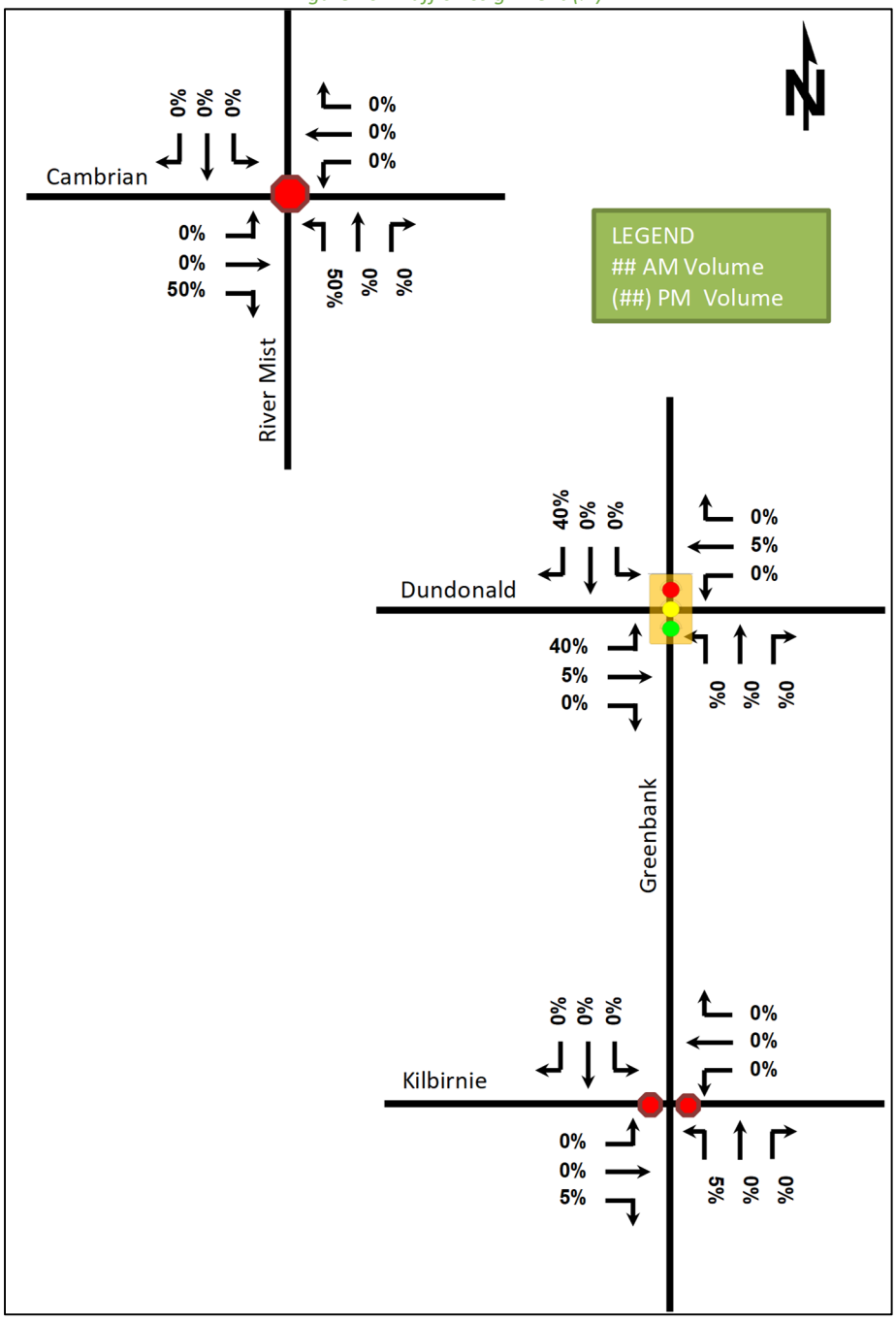
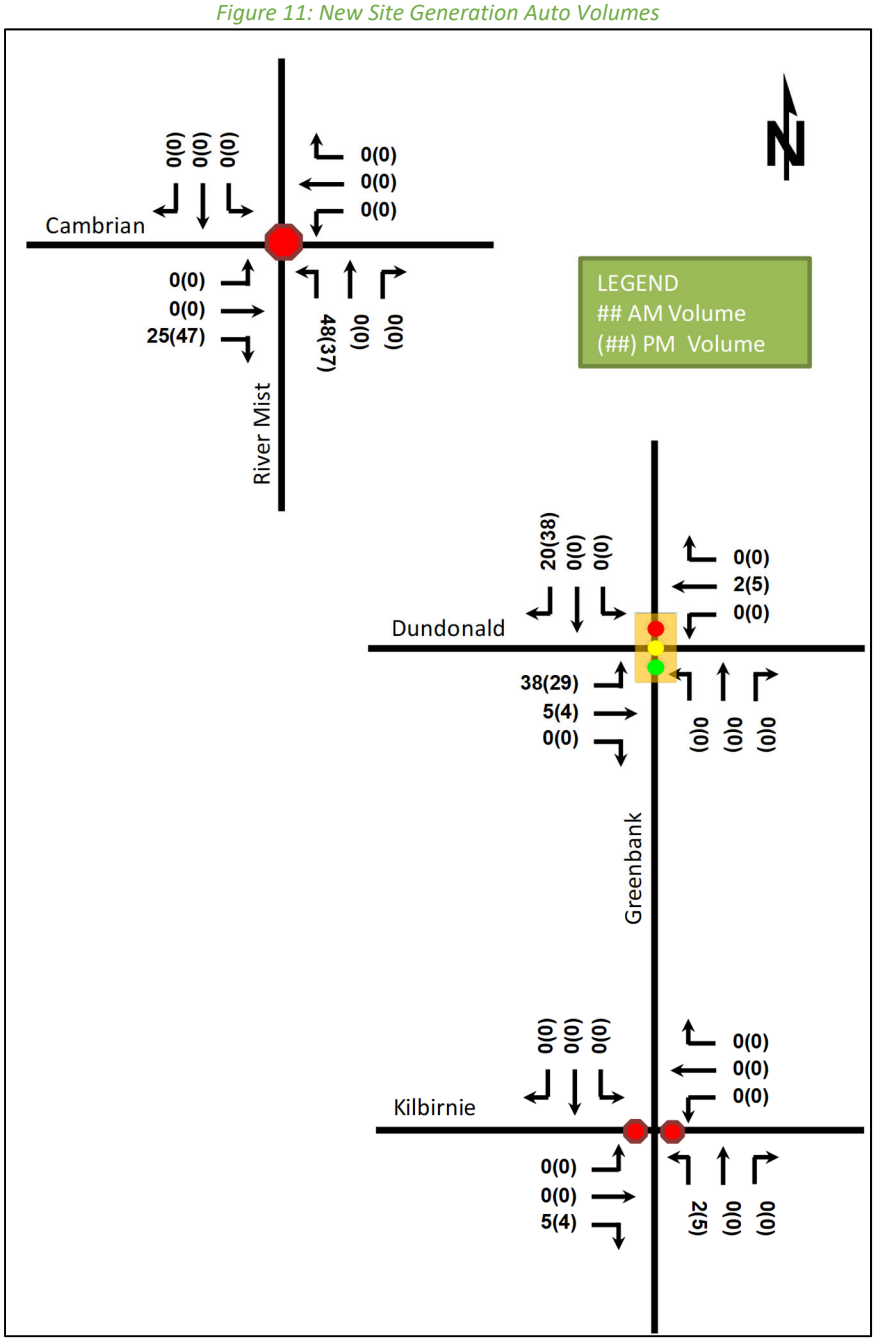


Figure 11: New Site Generation Auto Volumes



6 Background Network Travel Demand

6.1 Transportation Network Plans

The transportation network plans were discussed in Section 2.3.

6.2 Background Growth

A large amount of background traffic has been accounted for through the other developments that have been documented in Sections 2.3.2 and 6.3. To be consistent with the approved transportation impact assessments in the area, a 2% growth rate was applied to the existing volumes along the mainline volumes (e.g. north-south on

Greenbank Road and east-west on Cambrian Road). Figure 12 illustrates the background 2020 study area auto volumes and the Figure 13 illustrates the background 2025 auto volumes. The background development volumes have been included from Section 6.3 below.

Figure 12: Background 2020 Volumes

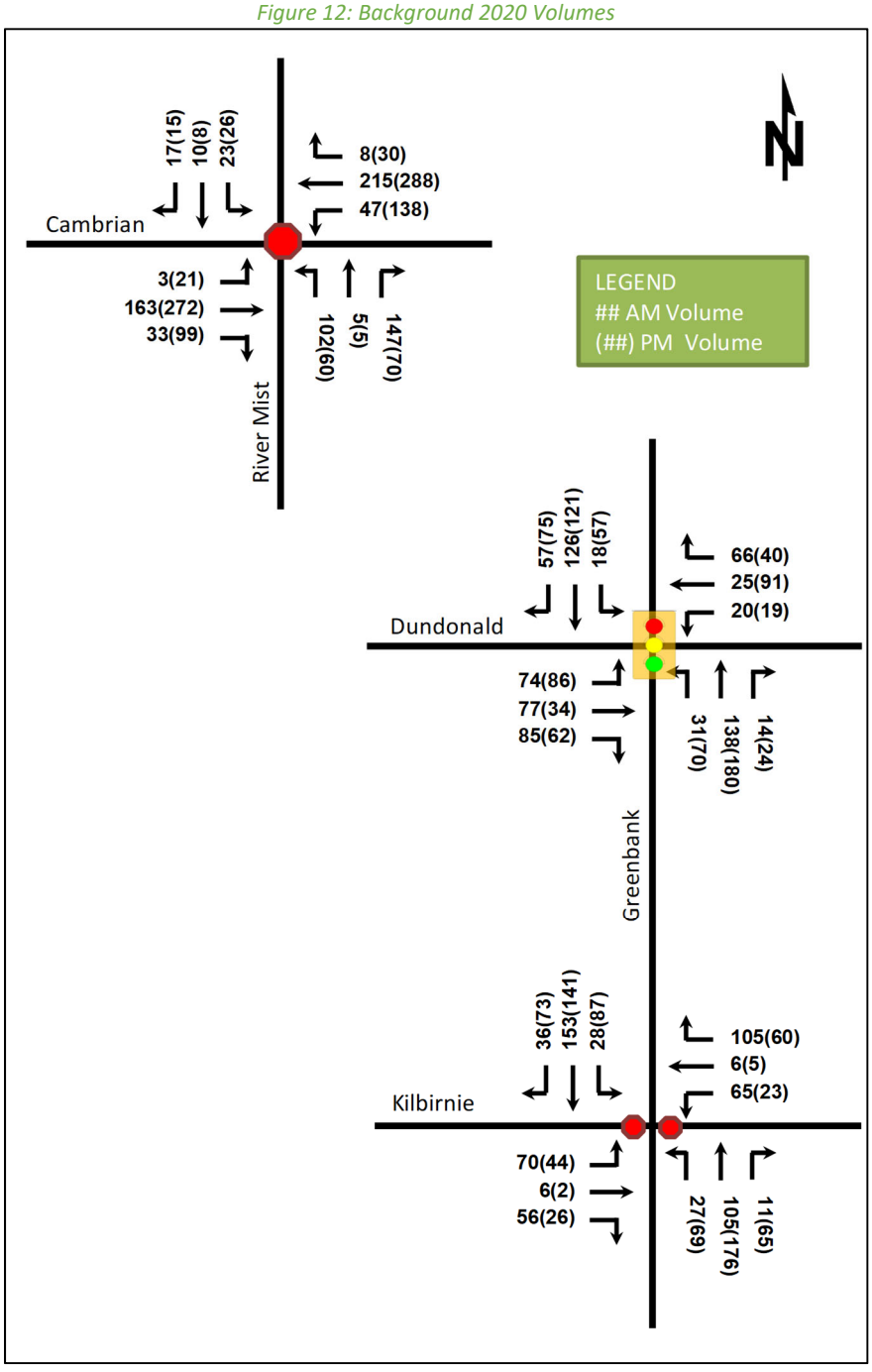
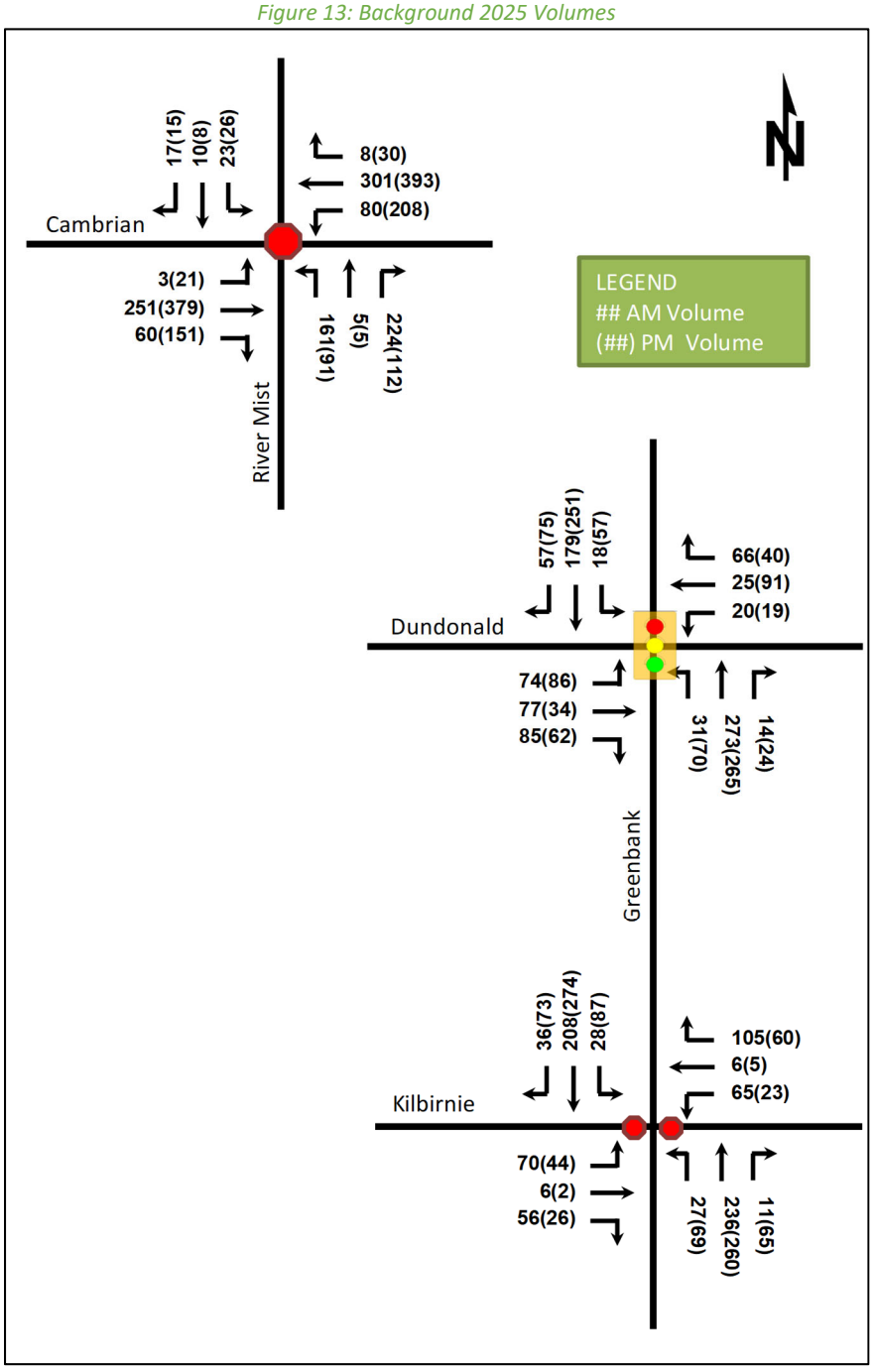


Figure 13: Background 2025 Volumes



6.3 Other Developments

The background development volumes have been summarized for the 2020 and 2025 horizons. Mattamy Half Moon Bay West and Tamarack Meadows Phase 4 have been included in the 2020 horizon, and Tamarack Meadows Phase 5 and the Barrhaven South Expansion Area development has been added on for the 2025 horizon.

Figure 14: Background 2020 Development Volumes

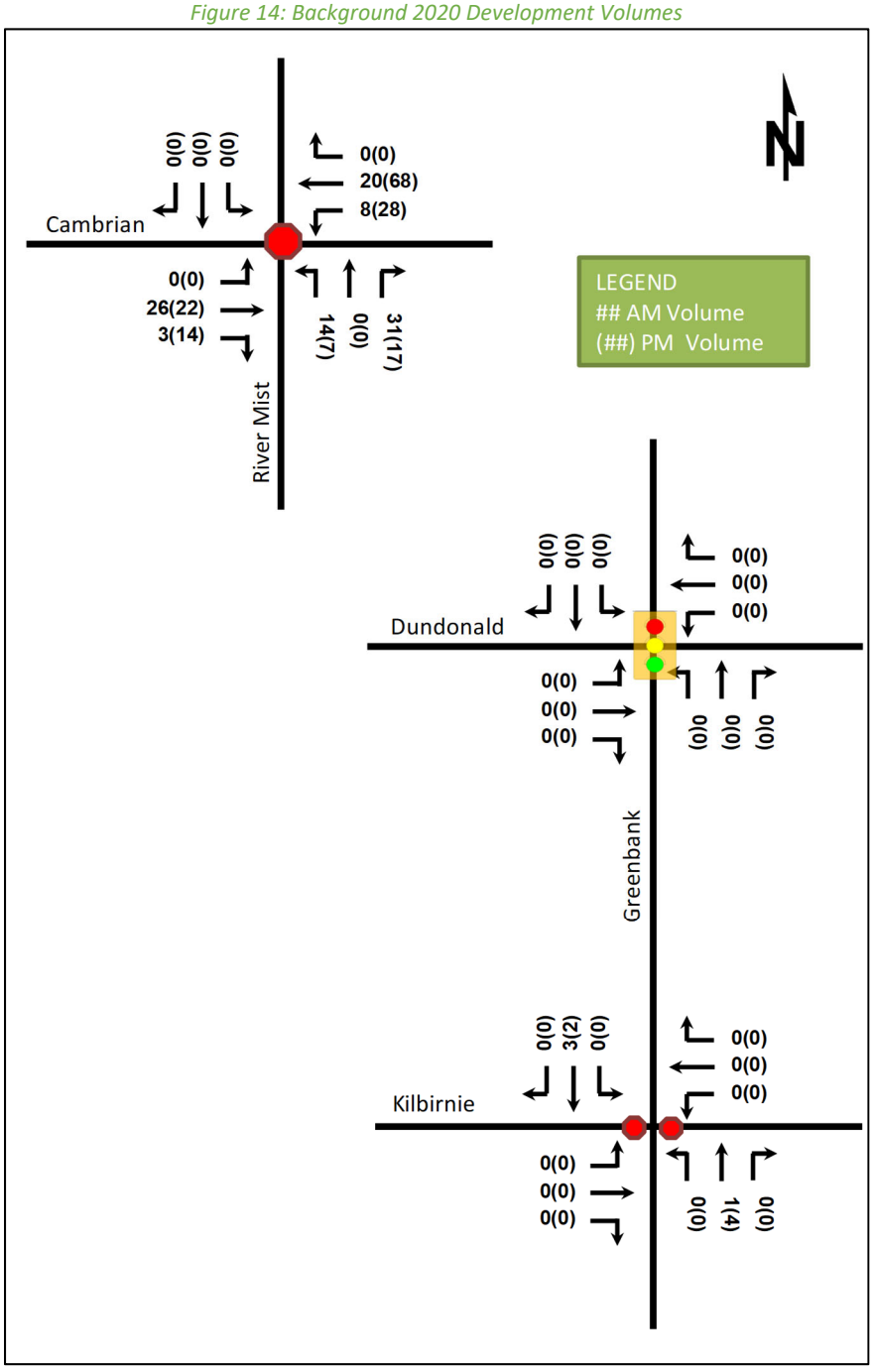
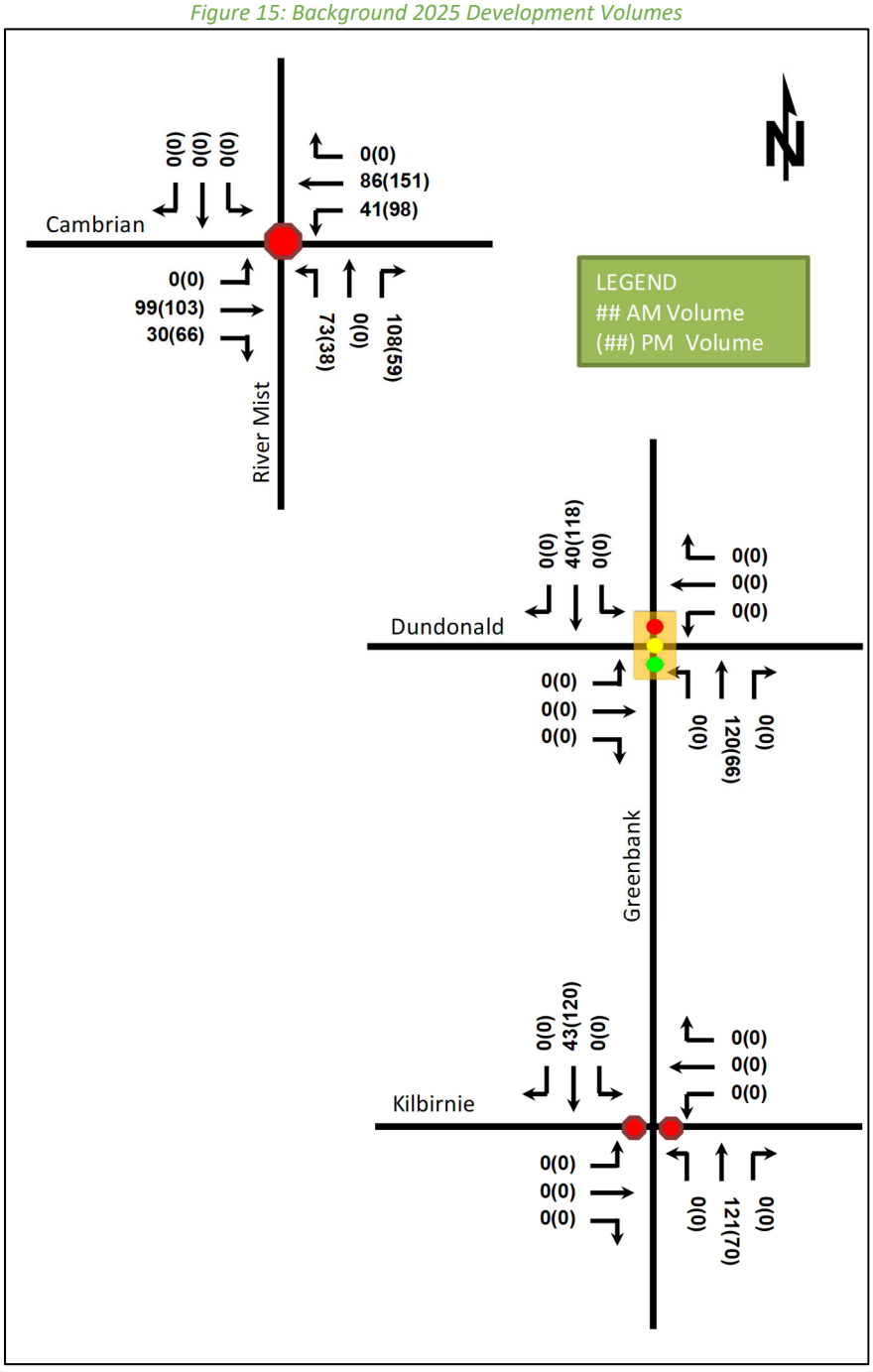


Figure 15: Background 2025 Development Volumes



7 Demand Rationalization

7.1 Background 2020 Operations

The intersection operations for the background 2020 conditions are summarized in Table 9.

The synchro worksheets for the background 2020 conditions are provided in Appendix E.

Table 9: Background 2020 Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Greenbank Road & Dundonald Drive ***Signalized***	EB	C	25.5	0.65	44.2	C	24.6	0.54	32.1
	WB	B	10.8	0.28	14.9	C	21.3	0.39	26.5
	NBL	C	30.5	0.17	11.8	C	32.0	0.32	19.9
	NBT	B	12.6	0.18	28.4	B	16.4	0.23	34.6
	NBR	A	0.1	0.02	0.0	A	0.1	0.03	0.0
	SBL	C	30.8	0.11	8.3	C	32.0	0.27	17.2
	SBT	B	15.2	0.18	26.7	B	16.6	0.16	24.7
	SBR	A	0.4	0.08	0.7	A	1.9	0.10	3.3
	Overall	**B**	**16.9**	**-**	**-**	**B**	**19.6**	**-**	**-**
Greenbank Road & Kilbirnie Drive ***Unsignalized***	EB	B	14.5	0.28	1.1	C	16.9	0.19	0.7
	WB	B	12.8	0.30	1.2	B	12.6	0.16	0.6
	NBL	A	7.7	0.02	0.1	A	7.8	0.05	0.2
	NBT	-	-	-	-	-	-	-	-
	NBR	-	-	-	-	-	-	-	-
	SBL	A	7.5	0.02	0.1	A	7.9	0.07	0.2
	SBT	-	-	-	-	-	-	-	-
	SBR	-	-	-	-	-	-	-	-
	Overall	**A**	**6.9**	**-**	**-**	**A**	**4.6**	**-**	**-**
Cambrian Road & River Mist Road ***Unsignalized***	EB	B	10.7	0.32	1.4	B	13.8	0.54	3.3
	WB	B	12.2	0.43	2.2	C	16.6	0.64	4.6
	NB	B	11.6	0.40	1.9	B	10.6	0.22	0.8
	SB	A	9.3	0.09	0.3	A	9.9	0.09	0.3
	Overall	**B**	**11.4**	**-**	**-**	**B**	**14.4**	**-**	**-**

The background 2020 intersection operations are forecasted to operate at acceptable levels of service. No rationalization of the proposed development trip generation or background volumes are required for the 2020 horizon.

7.2 Background 2025 Operations

The intersection operations for the background 2025 conditions are summarized below in Table 10.

The intersection of Cambrian Road and River Mist Road requires a westbound left-turn lane during the PM peak for potential operational issues by 2025, and using the TAC left-turn warrants, a minimum storage length of 25m is required. This left-turn lane has been included in the following analysis. The left-turn warrant is provided in Appendix F.

The synchro worksheets for the background 2025 conditions are provided in Appendix G.

Table 10: Background 2025 Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Greenbank Road & Dundonald Drive ***Signalized***	EB	C	25.5	0.65	44.2	C	24.6	0.54	32.1
	WB	B	10.8	0.28	14.9	C	21.3	0.39	26.5
	NBL	C	30.5	0.17	11.8	C	32.0	0.32	19.9
	NBT	B	13.9	0.35	55.3	B	17.3	0.34	50.7
	NBR	A	0.1	0.02	0.0	A	0.1	0.03	0.0
	SBL	C	30.8	0.11	8.3	C	32.0	0.27	17.2
	SBT	B	15.5	0.25	36.9	B	17.6	0.33	48.8
	SBR	A	0.4	0.08	0.7	A	1.9	0.10	3.3
	Overall	**B**	**16.7**	**-**	**-**	**B**	**19.5**	**-**	**-**
Greenbank Road & Kilbirnie Drive ***Unsignalized***	EB	C	19.3	0.37	1.7	C	23.1	0.27	1.0
	WB	C	16.7	0.39	1.8	C	15.2	0.20	0.7
	NBL	A	7.9	0.02	0.1	A	8.2	0.056	0.2
	NBT	-	-	-	-	-	-	-	-
	NBR	-	-	-	-	-	-	-	-
	SBL	A	7.9	0.02	0.1	A	8.1	0.07	0.2
	SBT	-	-	-	-	-	-	-	-
	SBR	-	-	-	-	-	-	-	-
	Overall	**A**	**6.9**	**-**	**-**	**A**	**4.3**	**-**	**-**
Cambrian Road & River Mist Road ***Unsignalized***	EB	C	19.5	0.62	4.2	D	33.7	0.86	9.8
	WBL	B	11.7	0.18	0.7	B	13.6	0.39	1.8
	WBT/R	C	21.4	0.65	4.6	C	23.0	0.72	5.9
	NB	C	24.6	0.74	6.3	B	13.8	0.39	1.8
	SB	B	11.4	0.12	0.4	B	11.4	0.10	0.3
	Overall	**C**	**20.9**	**-**	**-**	**C**	**24.0**	**-**	**-**

The background 2020 intersection operations are forecasted to operate at acceptable levels of service. As noted previously, the Cambrian Road and River Mist Road intersection will begin to experience capacity issues related to driver delay during the PM peak and the westbound left-turn movement. A westbound left-turn auxiliary lane has been assumed to be in place to support the background developments and traffic growth in the area. The eastbound and westbound approaches will also see increased delay with the background growth. During the AM peak, the northbound approach will also be experienced increased delay for vehicles turning onto Cambrian Road.

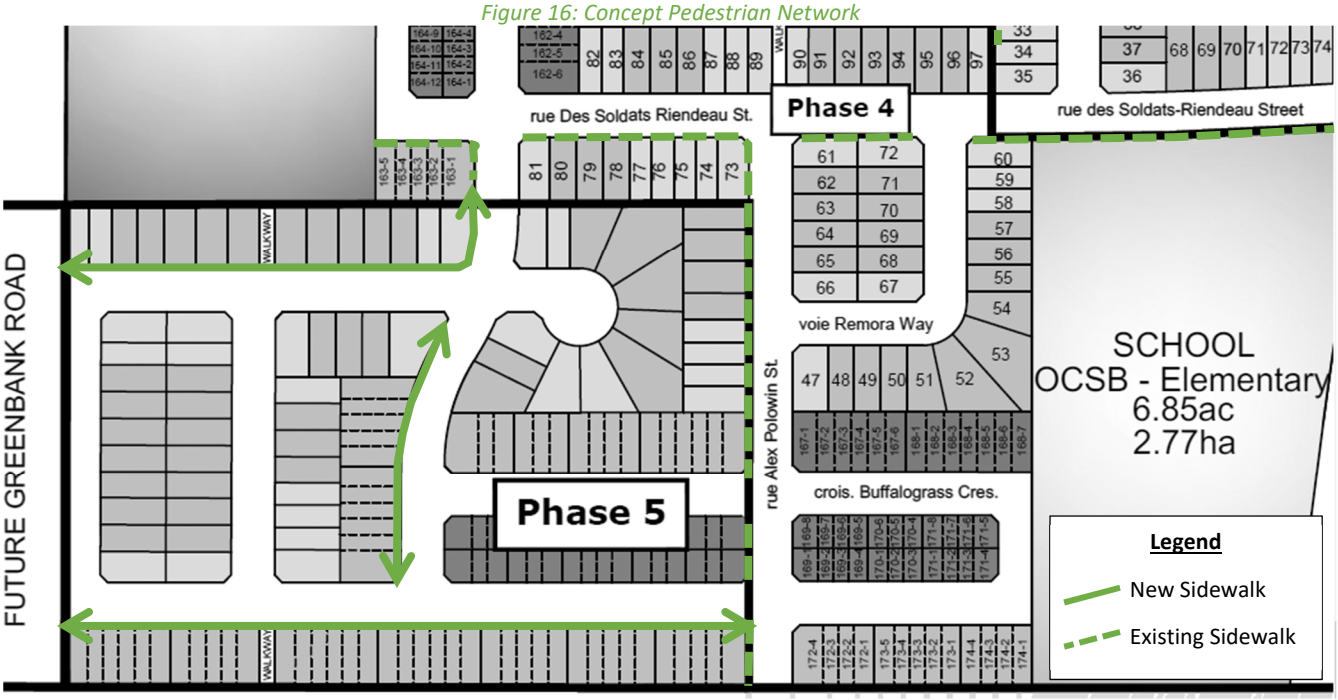
Overall, no rationalization of the proposed development trip generation or background volumes are required for the 2025 horizon.

8 Development Design

8.1 Design for Sustainable Modes

The proposed development is a residential subdivision and therefore auto and bicycle parking areas will be within each resident's home. Figure 16 illustrates the concept active mode network. The plan incorporates the adjacent developments, planned routes on geoOttawa, and the extension of the Barrhaven South Urban Expansion Study Area CDP networks.

Figure 16: Concept Pedestrian Network



8.2 New Street Networks

The planned street network will include 18.0 metre local roadways and a 14.5 metre window street on the western edge of the site. The local roads may include a sidewalk on one side, and the window street will need to tie into the eventual sidewalks along the future Re-Aligned Greenbank Road.

No traffic calming measures are recommended for the site.

The internal road intersections are recommended to be stop-controlled on the minor approaches.

9 Boundary Street Design

Table 11 summarizes the MMLOS analysis for the boundary road of Alex Polowin Avenue, using the developing community land-use designation. Alex Polowin Avenue meets the MMLOS targets for the area. The MMLOS worksheet has been provided in Appendix H.

Table 11: Boundary Street MMLOS Analysis

Segment	Pedestrian LOS		Bicycle LOS		Transit LOS		Truck LOS	
	PLOS	Target	BLOS	Target	TLOS	Target	TrLOS	Target
Alex Polowin Avenue	B	C	B	C	-	N/A	-	N/A

10 Access Intersection Design

10.1 Location and Design of Access

The proposed access to the subdivision is through the adjacent development local roads. The subdivision is Phase 5 of the Half Moon Bay South Community and was planned to connect through Phase 4 along Fameflower Street, Soldats-Riendeau Street, and Alex Polowin Street.

10.2 Access Intersection Control

Based on the projected volumes, minor stop-controlled intersections are recommended at the future intersections. No further traffic control or turn lanes are warranted to address operational issues.

10.3 Access Intersection Design

The local road intersections will be shared lanes and formalize the planned intersections within the context of Half Moon Bay South.

11 Transportation Demand Management

11.1 Context for TDM

The mode shares are heavily focused on auto travel and are anticipated to be achieved and will not impact any adjacent residential, recreational or natural land uses beyond the planned conditions and results of this study.

The subject site is within the Barrhaven South Expansion Area.

Total bedrooms within the development is subject to owner purchasing preferences. No age restrictions are noted.

11.2 Need and Opportunity

The subject site has been assumed to rely predominantly on auto travel and those assumptions have been carried through the analysis. Little opportunity is available to shift these modes until major infrastructure projects are completed to increase the transit and active mode network connectivity from South Barrhaven to the rest of the City.

11.3 TDM Program

As discussed above, any “suite of post-occupancy TDM measures” are limited in their applicability. It is anticipated that this development will rely predominantly on auto travel and those assumptions have been carried through the analysis.

12 Neighbourhood Traffic Management

Overall the site is anticipated to generate approximately 145 to 166 vehicle trips during the peak hours and will access the adjacent roads of Soldats-Riendeau Street, Fameflower Street, and Alex Polowin Street. The 120-vehicle threshold for local roads during a peak hour is a low threshold and will typically be exceeded if a local road is longer than a few blocks or have been designed to collect other minor streets.

The adjacent local roads are designed with an 18.0 metre right-of-way, 8.5 metre pavement width, and on-street parking. Due to the residential driveways and on-street parking, no traffic management features are recommended along Soldats-Riendeau Street, Fameflower Street, and Alex Polowin Street.

13 Transit

13.1 Route Capacity

Overall, the forecasted new transit trips would result in approximately an 20 passengers during the peak hours, split between inbound and outbound travel.

The existing transit routes are beyond 400 metres and not anticipated to be closer in proximity to the site until Re-Aligned Greenbank Road is constructed.

13.2 Transit Priority

No transit priority is required/considered for the study area.

14 Network Intersection Design

14.1 Network Intersection Control

No changes are proposed to the existing area intersection control.

14.2 Network Intersection Design

14.2.1 2020 Future Total Intersection Operations

The 2020 future total intersection volumes are illustrated in Figure 17 and the operations are summarized below in Table 12. The synchro worksheets have been provided in Appendix I.

Figure 17: 2020 Future Total Traffic Volumes

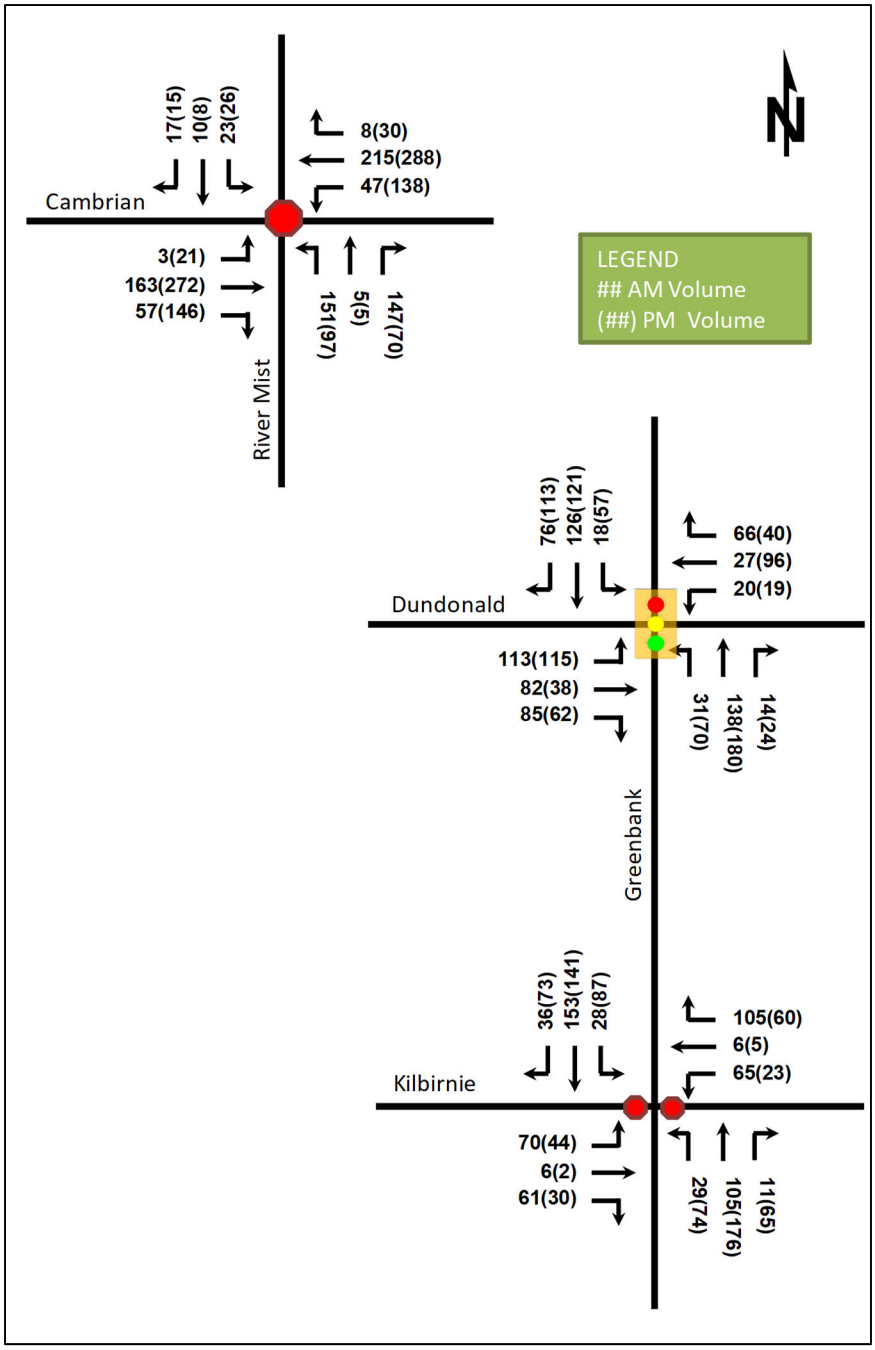

Cambrian
17(15)
10(8)
23(26)
8(30)
215(288)
47(138)
3(21)
163(272)
57(146)
151(97)
5(5)
147(70)
River Mist
LEGEND
AM Volume
(##) PM Volume
Dundonald
76(113)
126(121)
18(57)
66(40)
27(96)
20(19)
113(115)
82(38)
85(62)
31(70)
138(180)
14(24)
Greenbank
Kilbirnie
36(73)
153(141)
28(87)
105(60)
6(5)
65(23)
70(44)
6(2)
61(30)
29(74)
105(176)
11(65)

Table 12: Total 2020 Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Greenbank Road & Dundonald Drive ***Signalized***	EB	C	30.0	0.74	56.3	C	27.7	0.61	40.0
	WB	B	11.1	0.29	16.2	C	20.7	0.37	27.4
	NBL	C	31.5	0.18	11.8	C	32.9	0.32	19.9
	NBT	B	13.5	0.19	28.4	B	17.4	0.24	34.6
	NBR	A	0.1	0.02	0.0	A	0.1	0.03	0.0
	SBL	C	31.8	0.11	8.3	C	32.8	0.28	17.2
	SBT	B	16.3	0.19	26.7	B	17.6	0.16	24.7
	SBR	A	1.9	0.12	3.7	A	4.8	0.16	9.0
	Overall	**B**	**19.1**	**-**	**-**	**C**	**20.5**	**-**	**-**
Greenbank Road & Kilbirnie Drive ***Unsignalized***	EB	B	14.5	0.29	1.2	C	16.8	0.20	0.7
	WB	B	12.9	0.30	1.3	B	12.7	0.16	0.6
	NBL	A	7.7	0.02	0.1	A	7.8	0.06	0.2
	NBT	-	-	-	-	-	-	-	-
	NBR	-	-	-	-	-	-	-	-
	SBL	A	7.5	0.02	0.1	A	7.9	0.07	0.2
	SBT	-	-	-	-	-	-	-	-
	SBR	-	-	-	-	-	-	-	-
	Overall	**A**	**7.0**	**-**	**-**	**A**	**4.7**	**-**	**-**
Cambrian Road & River Mist Road ***Unsignalized***	EB	B	11.6	0.37	1.7	C	16.3	0.63	4.4
	WB	B	13.0	0.46	2.4	C	18.4	0.67	5.1
	NB	B	13.5	0.50	2.8	B	11.8	0.30	1.2
	SB	A	9.6	0.09	0.3	B	10.3	0.09	0.3
	Overall	**B**	**12.6**	**-**	**-**	**C**	**16.2**	**-**	**-**

The future total 2020 intersection operate similarly to the background 2020 conditions. No intersection improvements are recommended for the site build-out horizon.

14.2.2 2025 Future Total Intersection Operations

The 2025 future total intersection volumes are illustrated in Figure 18 and the operations are summarized below in Table 13. The synchro worksheets have been provided in Appendix J.

Figure 18: 2025 Future Total Traffic Volumes

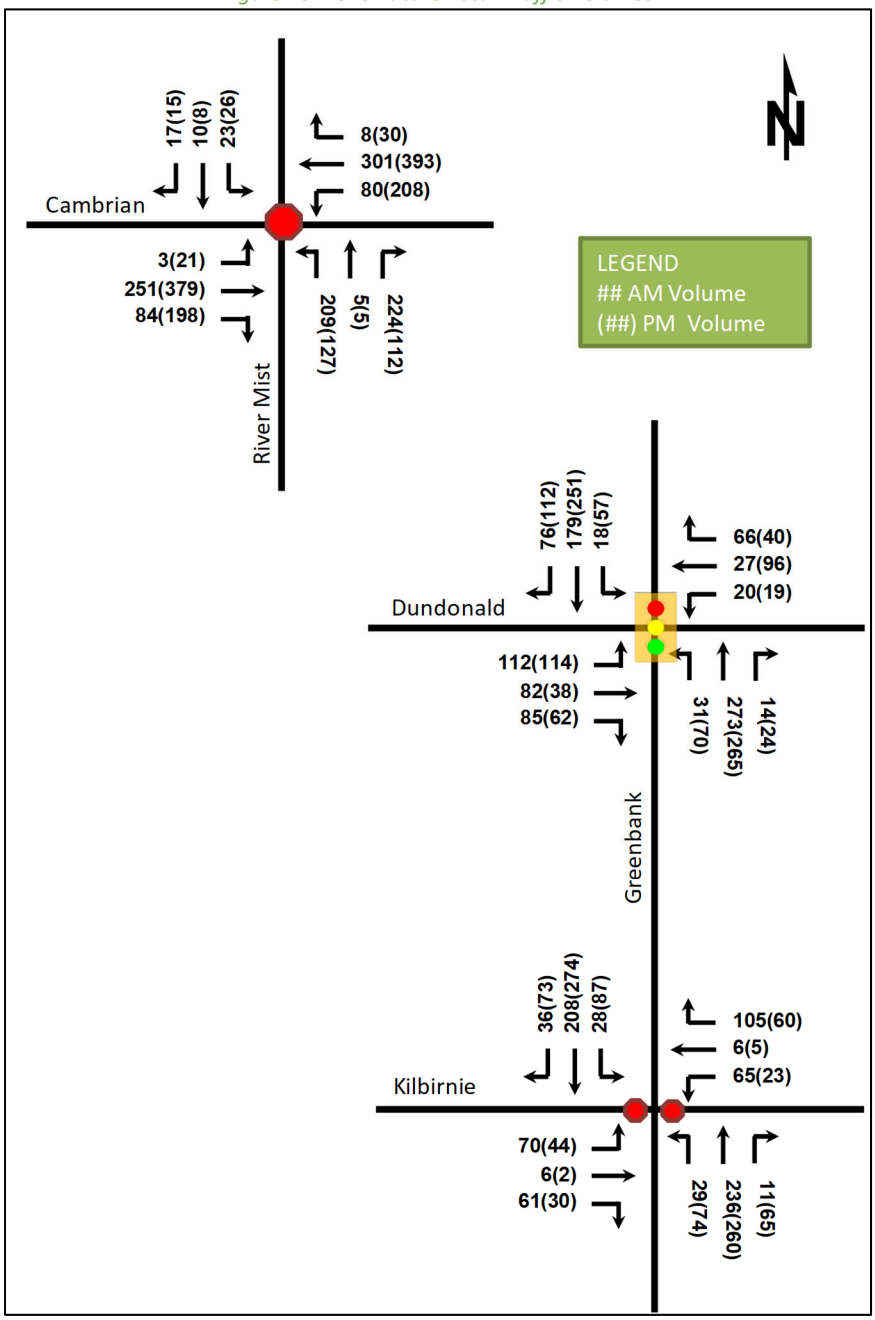


Table 13: Total 2025 Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Greenbank Road & Dundonald Drive ***Signalized***	EB	C	30.2	0.74	56.4	B	29.3	0.64	41.2
	WB	B	10.5	0.26	15.2	B	29.5	0.63	44.1
	NBL	C	31.5	0.18	11.8	C	33.1	0.32	19.9
	NBT	B	15.0	0.37	55.3	B	18.9	0.36	50.7
	NBR	A	0.1	0.02	0.0	A	0.1	0.03	0.0
	SBL	C	31.8	0.11	8.3	C	33.1	0.28	17.2
	SBT	B	16.7	0.26	36.9	B	19.2	0.35	48.8
	SBR	A	1.9	0.12	3.7	A	4.8	0.17	9.0
	Overall	**B**	**18.7**	**-**	**-**	**C**	**22.5**	**-**	**-**
Greenbank Road & Kilbirnie Drive ***Unsignalized***	EB	C	19.4	0.38	1.7	D	23.1	0.28	1.1
	WB	C	16.9	0.40	1.9	C	15.4	0.20	0.8
	NBL	A	7.9	0.03	0.1	A	8.2	0.06	0.2
	NBT	-	-	-	-	-	-	-	-
	NBR	-	-	-	-	-	-	-	-
	SBL	A	7.9	0.02	0.1	A	8.1	0.07	0.2
	SBT	-	-	-	-	-	-	-	-
	SBR	-	-	-	-	-	-	-	-
	Overall	**A**	**7.1**	**-**	**-**	**A**	**4.4**	**-**	**-**
Cambrian Road & River Mist Road ***Unsignalized***	EB	C	24.0	0.70	5.5	F	57.2	0.97	14.5
	WBL	B	12.3	0.19	0.7	B	14.7	0.41	2.0
	WBT/R	C	24.4	0.69	5.2	D	27.6	0.76	6.9
	NB	E	37.2	0.86	9.5	C	16.3	0.48	2.5
	SB	B	12.1	0.12	0.4	B	12.0	0.11	0.4
	Overall	**D**	**27.6**	**-**	**-**	**D**	**35.1**	**-**	**-**

The study area intersection operations see an increased delay with the additional background development traffic and growth. The intersection of Cambrian Road and River Mist Road eastbound approach will experience a delay of over 50 seconds during the PM peak. The separation of the right-turn volume to an auxiliary lane is a potential improvement for this intersection. Table 14 summarizes the PM peak operations for the Cambrian Road and River Mist Road intersection with an eastbound auxiliary right-turn lane.

Table 14: Total 2025 Intersection Operations

Intersection	Lane	PM Peak Hour			
		LOS	Delay	V/C	Q (95th)
Cambrian Road & River Mist Road ***Unsignalized***	EBL/T	D	25.1	0.73	6.0
	EBR	B	11.4	0.32	1.4
	WBL	B	14.4	0.41	1.9
	WBT/R	D	26.3	0.75	6.6
	NB	C	15.3	0.46	2.3
	SB	B	11.5	0.10	0.3
	Overall	**C**	**20.2**	**-**	**-**

The addition of the eastbound-right turn lane would improve the intersection operations at the Cambrian Road and River Mist Road intersection. Once Cambrian Road is widened, the additional eastbound lane would provide a similar benefit for the intersection.

14.2.3 Intersection MMLOS

Table 15 summarizes the MMLOS analysis for the Greenbank Road and Dundonald Drive intersection. No existing MMLOS analysis has been provided as the intersection is currently a minor stop-controlled intersection. The MMLOS worksheet has been provided in Appendix F.

Table 15: 2025 Future Signalized MMLOS Analysis

Intersection	Pedestrian LOS		Bicycle LOS		Transit LOS		Truck LOS		Auto LOS	
	PLOS	Target	BLOS	Target	TLOS	Target	TrLOS	Target	ALOS	Target
Greenbank Road & Dundonald Drive	D	C	F	C	E	D	-	N/A	B	D

The Greenbank Road and Dundonald Drive intersection does not meet the pedestrian, bicycle, or transit MMLOS targets for a developing community. The crossing distance across Greenbank Road limits the ability of this intersection to meet the target and would require a road narrowing to improve the PLOS. For the BLOS, the mixed traffic operation on the east/west approaches result in a BLOS D, and the on-street bike lane for the northbound approach is a BLOS F. If the northbound traffic uses the multi-use pathway along the west side of Greenbank Road, the facility provides a PLOS A. The TLOS is limited by the delays to transit vehicles on the eastbound approach.

No modifications are recommended for this intersection as a Greenbank Road would need to be narrowed for the pedestrian LOS, a multi-use pathway is already provided for cycling, and the intersection timing is currently free. The Traffic Services Department may revise the signal timing to reduce the delay on transit vehicles.

14.2.4 Recommended Design Elements

The study area intersection of Cambrian Road and River Mist Road operations in the 2025 future total conditions indicate the need to provide a right-turn lane in the eastbound direction. This is in addition to the westbound left-turn lane identified during the background conditions for 2025.

The Cambrian Road is currently 11.0 metres wide along the mainline segments and the curb radii at the stop bar locations provide an effective width of 14.0 metres. A revision of the pavement markings at this intersection would allow for the inclusion of the eastbound shared left-turn/through lane and right-turn lane. To accommodate both the eastbound right-turn and westbound left-turn, the intersection would need to be widened.

15 Summary of Improvements Indicated and Modifications Options

The following summarizes the analysis and results presented in this TIA report:

Proposed Site and Screening

- The proposed site includes 165 units, split approximately between 67 single detached homes and 98 townhomes
- Access will be provided from the development through the previous phases of the Half Moon Bay South development, accessing Greenbank Road at Dundonald Drive and Kilbirnie Drive, and Cambrian Road at River Mist Road
- The development is proposed to be completed as a single phase by 2020
- The Trip Generation and Location triggers were met for the TIA Screening

Existing Conditions

- The adjacent local road network consists of 18.0 metre right-of-way roads, with a sidewalk, and on-street parking with (un)posted 50 km/h speed limits

- Pedestrian and cycling facilities are provided along the local roads, and transit facilities are provided beyond a 400-metre linear distance from the proposed development
- No collision issues were noted in the study area

Development Generated Travel Demand

- The proposed development is forecasted to generate 181 people two-way trips during the AM peak and 208 people two-way trips during the PM peak
- Based on the study area travel patterns, a total of 145 two-way vehicle trips will be generated during the AM peak and 166 two-way vehicles trips during the PM peak
- 95% of the traffic is estimated to travel north of the site (ultimately 80% north, 10% east, and 5% west) and 5% to the south of the site

Background Conditions

- The background developments of Half Moon Bay West and Tamarack Meadows Phase 4 were included within the 2020 horizon, and Tamarack Meadows Phase 5 and the Barrhaven South Expansion Area were included in the 2025 horizon
- A westbound left-turn lane was noted to be required due to background traffic at the Cambrian Road and River Mist Road intersection by the 2025 horizon

Development Design

- The development roads are 18.0 metre local roads and a 14.5 metre window street is located on the west side of the development
- The internal road intersections are recommended to be minor stop-controlled
- No traffic calming measures are recommended within the development

Boundary Street Design

- The existing and future Alex Polowin Road meets the targets for MMLOS
- No improvements are recommended

Access Intersections Design

- The access intersections are local road to local road intersections, as planned through the draft plan of the Half Moon Bay South development
- Minor stop-controlled intersections are recommended for the connections to Soldats-Riendeau Street and Alex Polowin Street

TDM

- The lack of supporting infrastructure limits the potential for TDM measures to reduce the auto reliance anticipated for the proposed development
- Beyond the study horizons, the transit network along Re-Aligned Greenbank Road and the associated cycling and pedestrian networks will begin to produce the connectivity required to see a mode shift from the proposed development

Neighbourhood Traffic Management

- No traffic management features are recommended for Soldats-Riendeau Street, Fameflower Street, or Alex Polowin Street

Transit

- No transit service is provided on the boundary road network, nor future route plans include the proposed development at this time
- To meet minimum area transit use, half of a single bus, or equivalent capacity, would be required to support the proposed development during the AM and PM peak hours

Network Intersection Design

- An eastbound approach was noted to have delays above 50 seconds due to background and development traffic at the Cambrian Road and River Mist Road intersection by the 2025 horizon
- An auxiliary right-turn lane would reduce the delay at the intersection and improve the eastbound approach level of service

16 Next Steps

Following the circulation and review of this Step 4 Strategy Report, any comments received from City Staff will be incorporated into the Step 5 TIA Report. Once sign-off has been received from City Transportation Project Manager for all Steps of the TIA process, a signed and stamped final report will be provided to City staff.

Appendix A

TIA Screening Form and PM Certification Form

CGH TRANSPORTATION INC.

13 Markham Avenue
Nepean ON K2G 3Z1

City of Ottawa 2017 TIA Guidelines
Step 1 - Screening Form

Date: Sept. 25, 2018
Project Number: 2018-32
Project Reference: Mattamy HMBS Phase 5

1.1 Description of Proposed Development	
Municipal Address	3718 Greenbank Road
Description of Location	Ward 21 - PIN 045922110
Land Use Classification	Residential
Development Size	163 units (69 singles, 94 townhomes)
Accesses	Existing HMBS, Ultimately Realigned Greenbank
Phase of Development	Single Phase
Buildout Year	2020
TIA Requirement	Full TIA Required

1.2 Trip Generation Trigger		
Land Use Type	Townhomes or apartments	
Development Size	94	Units
Trip Generation Trigger	Yes	

1.3 Location Triggers	
Does the development propose a new driveway to a boundary street that is designated as part of the City's Transit Priority, Rapid Transit or Spine Bicycle Networks?	Yes
Is the development in a Design Priority Area (DPA) or Transit-oriented Development (TOD) zone?	No
Location Trigger	Yes

1.4. Safety Triggers		
Are posted speed limits on a boundary street are 80 km/hr or greater?	No	
Are there any horizontal/vertical curvatures on a boundary street limits sight lines at a proposed driveway?	No	
Is the proposed driveway within the area of influence of an adjacent traffic signal or roundabout (i.e. within 300 m of intersection in rural conditions, or within 150 m of intersection in urban/ suburban conditions)?	No	Ultimately. Not during build-out or +5 year horizon.
Is the proposed driveway within auxiliary lanes of an intersection?	No	
Does the proposed driveway make use of an existing median break that serves an existing site?	No	
Is there is a documented history of traffic operations or safety concerns on the boundary streets within 500 m of the development?	No	
Does the development include a drive-thru facility?	No	
Safety Trigger	No	

TIA Plan Reports

On 14 June 2017, the Council of the City of Ottawa adopted new Transportation Impact Assessment (TIA) Guidelines. In adopting the guidelines, Council established a requirement for those preparing and delivering transportation impact assessments and reports to sign a letter of certification.

Individuals submitting TIA reports will be responsible for all aspects of development-related transportation assessment and reporting, and undertaking such work, in accordance and compliance with the City of Ottawa's Official Plan, the Transportation Master Plan and the Transportation Impact Assessment (2017) Guidelines.

By submitting the attached TIA report (and any associated documents) and signing this document, the individual acknowledges that s/he meets the four criteria listed below.

CERTIFICATION

1. I have reviewed and have a sound understanding of the objectives, needs and requirements of the City of Ottawa's Official Plan, Transportation Master Plan and the Transportation Impact Assessment (2017) Guidelines;
2. I have a sound knowledge of industry standard practice with respect to the preparation of transportation impact assessment reports, including multi modal level of service review;
3. I have substantial experience (more than 5 years) in undertaking and delivering transportation impact studies (analysis, reporting and geometric design) with strong background knowledge in transportation planning, engineering or traffic operations; and
4. I am either a licensed[1] or registered[2] professional in good standing, whose field of expertise [check √ appropriate field(s)] is either transportation engineering √ or transportation planning □.

[1,2] License of registration body that oversees the profession is required to have a code of conduct and ethics guidelines that will ensure appropriate conduct and representation for transportation planning and/or transportation engineering works.

City Of Ottawa
Infrastructure Services and Community Sustainability
Planning and Growth Management
110 Laurier Avenue West, 4th fl.
Ottawa, ON K1P 1J1
Tel. : 613-580-2424
Fax: 613-560-6006

Ville d'Ottawa
Services d 'infrastructure et Viabilité des collectivités
Urbanisme et Gestion de la croissance
110, avenue Laurier Ouest
Ottawa (Ontario) K1P 1J1
Tél. : 613-580-2424
Télécopieur: 613-560-6006

Dated at ___Ottawa_____ this __20__ day of _____September_____, 2018.
(City)

Name: _____Andrew Harte_____
(Please Print)

Professional Title: _____Professional Engineer_____

_____
Signature of Individual certifier that s/he meets the above four criteria

Office Contact Information (Please Print)
Address: 13 Markham Avenue
City / Postal Code: Ottawa / K2G 3Z1
Telephone / Extension: (613) 697-3797
E-Mail Address: Andrew.Harte@CGHTransportation.com

Half Moon Bay South

Phase 5

Coloured Plan

September 16th, 2014

Unit Type

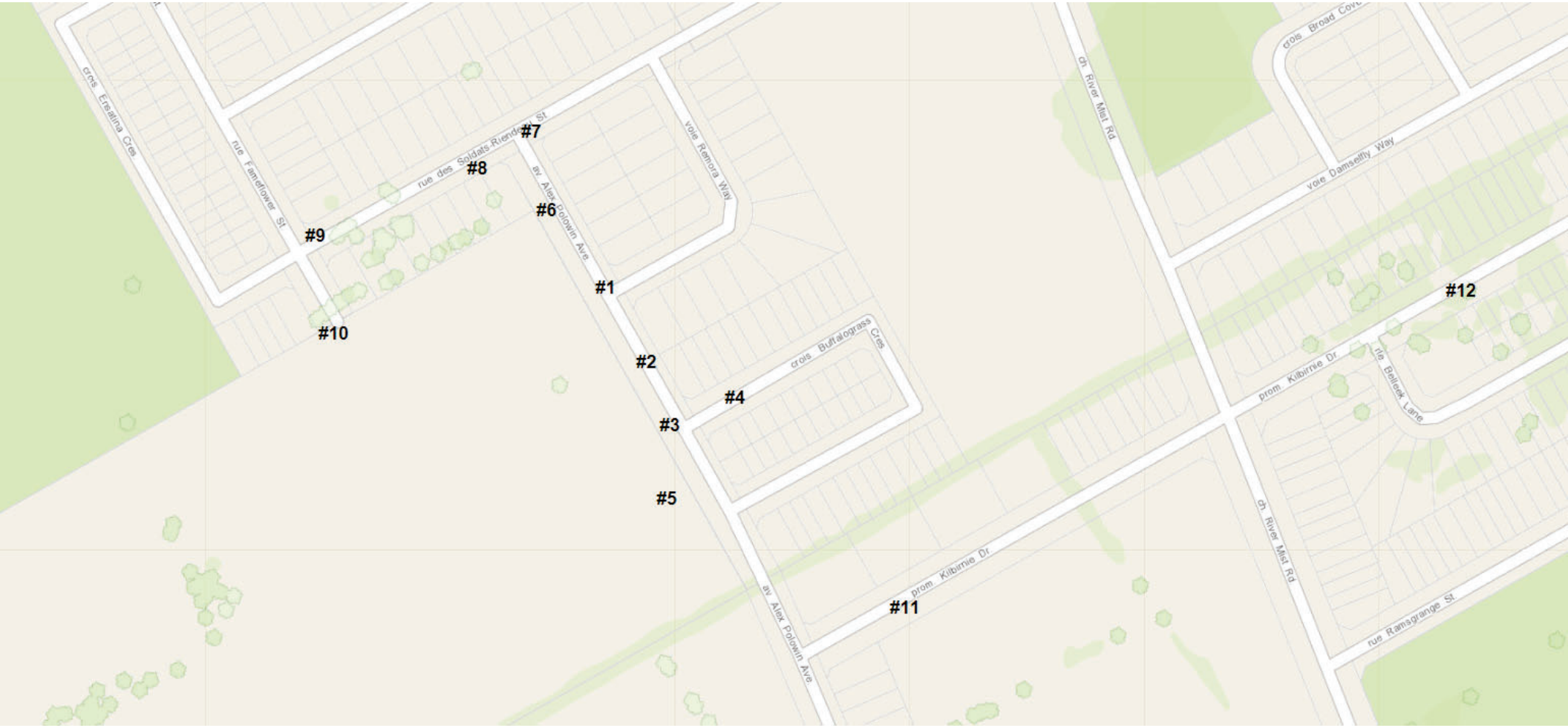
- 30' Single
- 36' Single
- 43' Single
- 21' Townhomes
- 23' Townhomes
- 21' Villagehomes

HMBS Phase 5 Lot Count

34	BTB Townhomes	(21%)
38	21' Townhomes	(23%)
22	23' Townhomes	(14%)
17	30' Singles	(10%)
11	30' Singles Corner	(7%)
25	36 Singles	(15%)
16	43' Singles	(10%)
163	TOTAL	94 Townhomes (58%)
		69 Singles (42%)

Appendix B

Adjacent Driveway and Local Road Intersections


cres Ensalina Cres
rue Fameflower St
rue des Soulats-Riendeau St
av Alex Polowin Ave
voie Remora Way
ch River Mist Rd
croi Broad Cove
voie Damselfly Way
croi Buffalograss Cres
prom Kilbirnie Dr
rte Belleek Lane
rue Ramsgrange St
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
#11
#12

#1

Alex Polowin South at Remora

#2

Alex Polowin Mailbox between Remora and Buffalo Grass

#3

Alex Polowin South at Buffalograss

#4

Buffalograss East

#5

Alex Polowin North

#6

Alex Polowin North to Soldats Riendeau

#7

Soldats Riendeau East at Alex Polowin

#8

Soldasts Riendeau West of Alex Polowin

#9

Soldats Riendeau at Fameflower Northeast

#10

Fameflower South

#11

Kilbirnie East of Alex Polowin

#12

Kilbirnie East of River Mist

Appendix C

Turning Movement Counts

Transportation Services - Traffic Services

W.O. 37049

Turning Movement Count - 15 Minute Summary Report

DUNDONALD DR @ GREENBANK RD

Survey Date: Wednesday, May 24, 2017

Total Observed U-Turns

Northbound: 0 Southbound: 0

Eastbound: 1 Westbound: 0

		GREENBANK RD								DUNDONALD DR									
		Northbound				Southbound				Eastbound				Westbound					
Time Period		LT	ST	RT	N TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT	E TOT	LT	ST	RT	W TOT	STR TOT	Grand Total
07:00	07:15	7	26	3	**36**	1	32	12	**45**	**81**	25	20	21	**66**	3	4	11	**18**	**84**	**165**
07:15	07:30	8	25	2	**35**	6	32	13	**51**	**86**	25	33	26	**84**	4	5	9	**18**	**102**	**188**
07:30	07:45	9	30	5	**44**	4	30	8	**42**	**86**	17	15	25	**57**	4	8	11	**23**	**80**	**166**
07:45	08:00	4	35	2	**41**	5	26	15	**46**	**87**	8	17	18	**44**	6	6	17	**29**	**73**	**160**
08:00	08:15	10	43	5	**58**	3	33	21	**57**	**115**	24	12	16	**52**	6	6	29	**41**	**93**	**208**
08:15	08:30	5	39	3	**47**	7	27	12	**46**	**93**	23	17	18	**58**	3	6	17	**26**	**84**	**177**
08:30	08:45	8	32	4	**44**	3	29	9	**41**	**85**	16	10	24	**50**	4	5	16	**25**	**75**	**160**
08:45	09:00	2	40	1	**43**	4	27	7	**38**	**81**	19	11	12	**42**	3	10	12	**25**	**67**	**148**
09:00	09:15	13	45	4	**62**	9	34	14	**57**	**119**	22	20	10	**52**	3	15	20	**38**	**90**	**209**
09:15	09:30	4	23	2	**29**	6	24	17	**47**	**76**	19	3	12	**34**	1	3	11	**15**	**49**	**125**
09:30	09:45	3	37	3	**43**	1	21	16	**38**	**81**	8	5	10	**23**	2	1	8	**11**	**34**	**115**
09:45	10:00	2	26	2	**30**	2	10	16	**28**	**58**	7	4	6	**17**	3	4	6	**13**	**30**	**88**
11:30	11:45	3	23	0	**26**	2	32	8	**42**	**68**	18	3	8	**29**	2	4	2	**8**	**37**	**105**
11:45	12:00	5	31	1	**37**	5	19	13	**37**	**74**	13	3	5	**21**	0	5	2	**7**	**28**	**102**
12:00	12:15	7	22	3	**32**	9	24	16	**49**	**81**	21	2	3	**26**	1	4	5	**10**	**36**	**117**
12:15	12:30	9	23	2	**34**	1	26	5	**32**	**66**	9	3	6	**18**	3	2	6	**11**	**29**	**95**
12:30	12:45	5	21	2	**28**	4	24	21	**49**	**77**	19	3	8	**30**	1	5	1	**7**	**37**	**114**
12:45	13:00	3	22	2	**27**	2	24	12	**38**	**65**	12	9	6	**27**	2	8	4	**14**	**41**	**106**
13:00	13:15	4	38	3	**45**	4	21	14	**39**	**84**	16	6	7	**29**	1	8	4	**13**	**42**	**126**
13:15	13:30	7	21	4	**32**	1	22	9	**32**	**64**	13	3	7	**23**	3	2	2	**7**	**30**	**94**
15:00	15:15	10	32	4	**46**	6	23	15	**44**	**90**	9	2	5	**16**	3	4	7	**14**	**30**	**120**
15:15	15:30	17	29	4	**50**	2	21	23	**46**	**96**	19	8	5	**32**	3	8	8	**19**	**51**	**147**
15:30	15:45	17	36	2	**55**	7	18	16	**41**	**96**	16	10	7	**33**	4	12	10	**26**	**59**	**155**
15:45	16:00	14	31	3	**48**	16	36	20	**72**	**120**	31	12	21	**64**	4	17	9	**30**	**94**	**214**
16:00	16:15	13	36	5	**54**	9	40	14	**63**	**117**	7	5	12	**24**	1	10	9	**20**	**44**	**161**
16:15	16:30	20	30	5	**55**	9	38	14	**61**	**116**	13	3	14	**30**	5	14	5	**24**	**54**	**170**
16:30	16:45	15	49	4	**68**	12	27	25	**64**	**132**	21	8	10	**39**	1	21	6	**28**	**67**	**199**
16:45	17:00	21	45	3	**69**	12	25	24	**61**	**130**	14	5	3	**22**	5	23	14	**42**	**64**	**194**
17:00	17:15	29	48	2	**79**	15	32	17	**64**	**143**	25	9	15	**49**	5	17	5	**27**	**76**	**219**
17:15	17:30	16	39	6	**61**	6	32	15	**53**	**114**	21	8	10	**39**	4	22	14	**40**	**79**	**193**
17:30	17:45	9	33	9	**51**	11	29	21	**61**	**112**	25	9	18	**52**	5	22	10	**37**	**89**	**201**
17:45	18:00	16	53	7	**76**	25	23	22	**70**	**146**	15	8	19	**42**	5	30	11	**46**	**88**	**234**
TOTAL:		315	1063	107	**1485**	209	861	484	**1554**	**3039**	550	286	387	**1224**	100	311	301	**712**	**1936**	**4975**

Note: U-Turns are included in Totals.

Comment:

Transportation Services - Traffic Services

Turning Movement Count - Cyclist Volume Report

Work Order 37049

DUNDONALD DR @ GREENBANK RD

Count Date: Wednesday, May 24, 2017 **Start Time:** 07:00

	GREENBANK RD			DUNDONALD DR			
Time Period	Northbound	Southbound	Street Total	Eastbound	Westbound	Street Total	Grand Total
07:00 08:00	0	0	**0**	0	0	**0**	**0**
08:00 09:00	0	0	**0**	0	0	**0**	**0**
09:00 10:00	1	1	**2**	1	0	**1**	**3**
11:30 12:30	0	0	**0**	0	1	**1**	**1**
12:30 13:30	1	1	**2**	0	0	**0**	**2**
15:00 16:00	0	1	**1**	0	0	**0**	**1**
16:00 17:00	2	5	**7**	0	0	**0**	**7**
17:00 18:00	0	2	**2**	0	0	**0**	**2**
Total	4	10	**14**	1	1	**2**	**16**

Comment:

Note: These volumes consists of bicycles only (no mopeds or motorcycles) and ARE NOT included in the Turning Movement Count Summary.

Transportation Services - Traffic Services

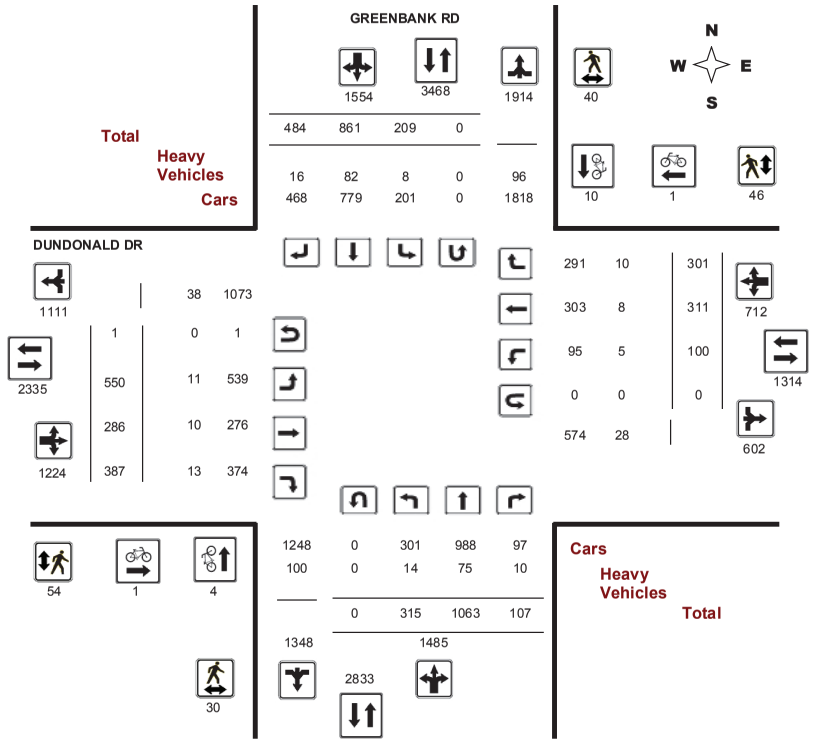
Turning Movement Count - Full Study Diagram

DUNDONALD DR @ GREENBANK RD

Survey Date: Wednesday, May 24, 2017

WO#: 37049

Device: Miovision



Comments

Transportation Services - Traffic Services

W.O. 37049

Turning Movement Count - Heavy Vehicle Report

DUNDONALD DR @ GREENBANK RD

Survey Date: Wednesday, May 24, 2017

		GREENBANK RD								DUNDONALD DR									
		Northbound				Southbound				Eastbound				Westbound					
Time Period		LT	ST	RT	N TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT	E TOT	LT	ST	RT	W TOT	STR TOT	Grand Total
07:00	08:00	0	6	3	**9**	4	18	1	**23**	**32**	1	0	3	**4**	0	2	0	**2**	**6**	**38**
08:00	09:00	5	13	1	**19**	1	7	2	**10**	**29**	0	1	1	**2**	1	1	3	**5**	**7**	**36**
09:00	10:00	3	9	1	**13**	0	8	4	**12**	**25**	1	1	4	**6**	0	3	1	**4**	**10**	**35**
11:30	12:30	0	7	1	**8**	0	10	5	**15**	**23**	2	0	0	**2**	0	0	1	**1**	**3**	**26**
12:30	13:30	0	10	3	**13**	1	11	1	**13**	**26**	4	4	2	**10**	0	2	1	**3**	**13**	**39**
15:00	16:00	6	14	1	**21**	2	12	3	**17**	**38**	3	3	1	**7**	1	0	2	**3**	**10**	**48**
16:00	17:00	0	8	0	**8**	0	13	0	**13**	**21**	0	1	2	**3**	3	0	2	**5**	**8**	**29**
17:00	18:00	0	8	0	**8**	0	3	0	**3**	**11**	0	0	0	**0**	0	0	0	**0**	**0**	**11**
Sub Total		14	75	10	**99**	8	82	16	**106**	**205**	11	10	13	**34**	5	8	10	**23**	**57**	**262**
U-Turns (Heavy Vehicles)					**0**				**0**	**0**				**0**				**0**	**0**	**0**
Total		14	75	10	**0**	8	82	16	**106**	**205**	11	10	13	**34**	5	8	10	**23**	**57**	**262**

Heavy Vehicles include Buses, Single-Unit Trucks and Articulated Trucks. Further, they ARE included in the Turning Movement Count Summary.

Transportation Services - Traffic Services

Work Order 37049

Turning Movement Count - Pedestrian Volume Report

DUNDONALD DR @ GREENBANK RD

Count Date: Wednesday, May 24, 2017 **Start Time:** 07:00

Time Period	NB Approach (E or W Crossing)	SB Approach (E or W Crossing)	Total	EB Approach (N or S Crossing)	WB Approach (N or S Crossing)	Total	Grand Total
07:00 07:15	0	1	1	2	0	2	3
07:15 07:30	0	1	1	1	3	4	5
07:30 07:45	1	2	3	1	0	1	4
07:45 08:00	1	0	1	2	1	3	4
07:00 08:00	2	4	6	6	4	10	16
08:00 08:15	0	0	0	1	1	2	2
08:15 08:30	1	2	3	1	0	1	4
08:30 08:45	0	3	3	1	1	2	5
08:45 09:00	1	0	1	6	0	6	7
08:00 09:00	2	5	7	9	2	11	18
09:00 09:15	0	2	2	1	0	1	3
09:15 09:30	0	0	0	3	0	3	3
09:30 09:45	1	2	3	0	1	1	4
09:45 10:00	1	1	2	0	0	0	2
09:00 10:00	2	5	7	4	1	5	12
11:30 11:45	0	0	0	1	0	1	1
11:45 12:00	0	0	0	0	0	0	0
12:00 12:15	0	0	0	0	0	0	0
12:15 12:30	1	0	1	0	3	3	4
11:30 12:30	1	0	1	1	3	4	5
12:30 12:45	1	1	2	0	2	2	4
12:45 13:00	0	0	0	1	0	1	1
13:00 13:15	0	0	0	4	1	5	5
13:15 13:30	0	0	0	1	0	1	1
12:30 13:30	1	1	2	6	3	9	11
15:00 15:15	0	0	0	0	1	1	1
15:15 15:30	1	2	3	4	1	5	8
15:30 15:45	1	2	3	1	2	3	6
15:45 16:00	5	4	9	6	7	13	22
15:00 16:00	7	8	15	11	11	22	37
16:00 16:15	1	0	1	0	0	0	1
16:15 16:30	3	3	6	6	6	12	18
16:30 16:45	6	1	7	3	4	7	14
16:45 17:00	0	2	2	1	0	1	3
16:00 17:00	10	6	16	10	10	20	36
17:00 17:15	1	4	5	1	2	3	8
17:15 17:30	3	2	5	2	4	6	11
17:30 17:45	0	3	3	3	5	8	11
17:45 18:00	1	2	3	1	1	2	5
17:00 18:00	5	11	16	7	12	19	35
Total	30	40	70	54	46	100	170

Comment:

Transportation Services - Traffic Services

Work Order 37049

Turning Movement Count - Full Study Summary Report

DUNDONALD DR @ GREENBANK RD

Survey Date: Wednesday, May 24, 2017

Total Observed U-Turns

Northbound: 0 Southbound: 0

Eastbound: 1 Westbound: 0

AADT Factor .90

Full Study

	GREENBANK RD									DUNDONALD DR									
	Northbound				Southbound					Eastbound				Westbound					
Period	LT	ST	RT	NB TOT	LT	ST	RT	SB TOT	STR TOT	LT	ST	RT	EB TOT	LT	ST	RT	WB TOT	STR TOT	Grand Total
07:00 08:00	28	116	12	156	16	120	48	184	340	75	85	90	250	17	23	48	88	338	678
08:00 09:00	25	154	13	192	17	116	49	182	374	82	50	70	202	16	27	74	117	319	693
09:00 10:00	22	131	11	164	18	89	63	170	334	56	32	38	126	9	23	45	77	203	537
11:30 12:30	24	99	6	129	17	101	42	160	289	61	11	22	94	6	15	15	36	130	419
12:30 13:30	19	102	11	132	11	91	56	158	290	60	21	28	109	7	23	11	41	150	440
15:00 16:00	58	128	13	199	31	98	74	203	402	75	32	38	145	14	41	34	89	234	636
16:00 17:00	69	160	17	246	42	130	77	249	495	55	21	39	115	12	68	34	114	229	724
17:00 18:00	70	173	24	267	57	116	75	248	515	86	34	62	182	19	91	40	150	332	847
Sub Total	315	1063	107	1485	209	861	484	1554	3039	550	286	387	1223	100	311	301	712	1935	4974
U Turns				0				0	0				1				0	1	1
Total	315	1063	107	1485	209	861	484	1554	3039	550	286	387	1224	100	311	301	712	1936	4975
EQ 12Hr	438	1478	149	2064	291	1197	673	2160	4224	764	398	538	1701	139	432	418	990	2691	6915
Note: These values are calculated by multiplying the totals by the appropriate expansion factor.													1.39						
AVG 12Hr	394	1330	134	1858	261	1077	605	1944	3802	688	358	484	1531	125	389	377	891	2422	6224
Note: These volumes are calculated by multiplying the Equivalent 12 hr. totals by the AADT factor.													.90						
AVG 24Hr	516	1742	175	2434	343	1411	793	2547	4981	901	469	634	2006	164	510	493	1167	3173	8154
Note: These volumes are calculated by multiplying the Average Daily 12 hr. totals by 12 to 24 expansion factor.													1.31						

Comments:

Note: U-Turns provided for approach totals. Refer to 'U-Turn' Report for specific breakdown.

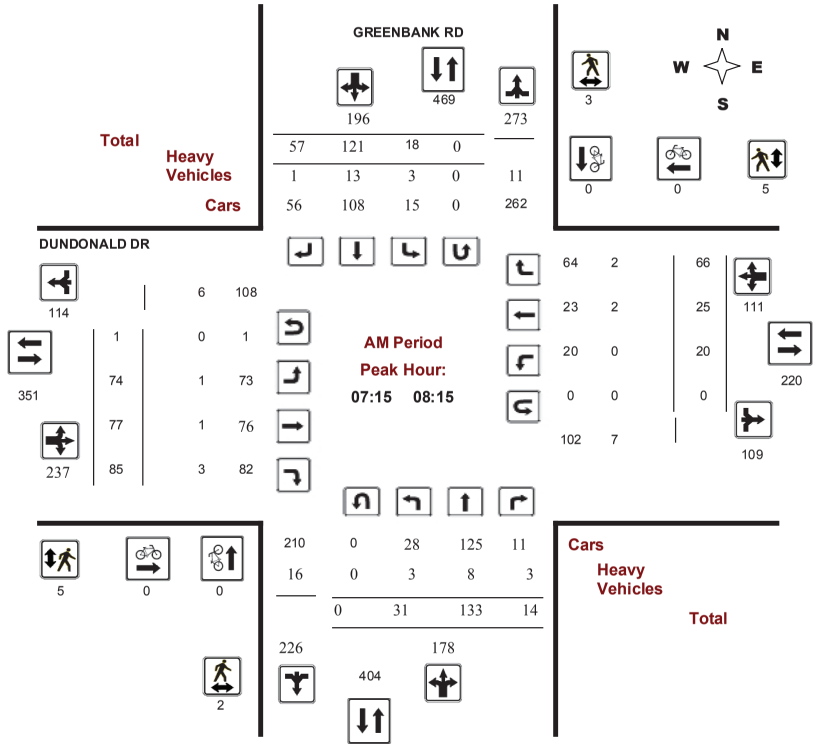
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

DUNDONALD DR @ GREENBANK RD

Survey Date: Wednesday, May 24, 2017 **WO No:** 37049

Start Time: 07:00 **Device:** Miovision



Comments

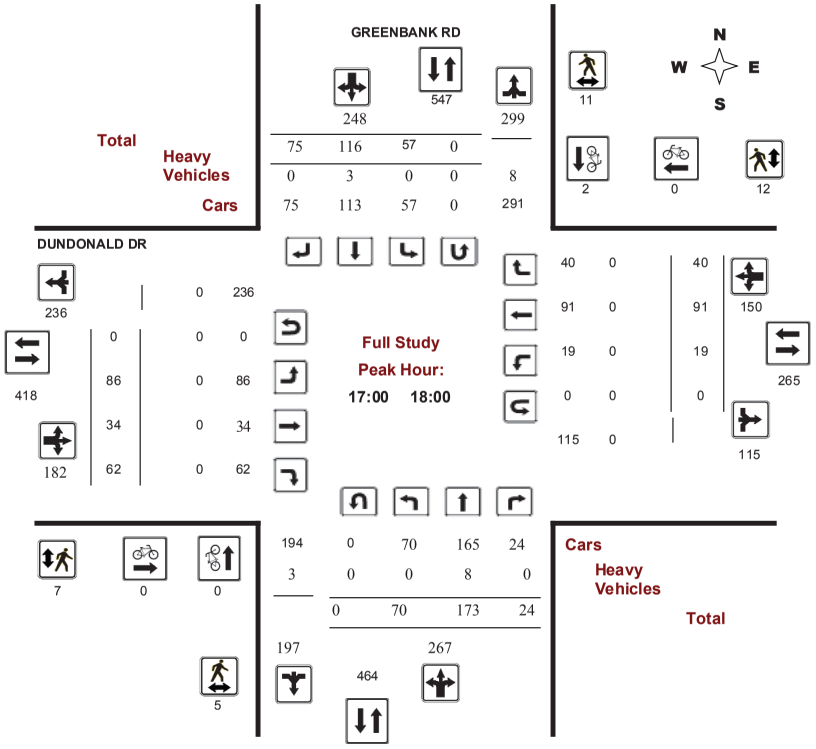
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

DUNDONALD DR @ GREENBANK RD

Survey Date: Wednesday, May 24, 2017 **WO No:** 37049

Start Time: 07:00 **Device:** Miovision



Comments

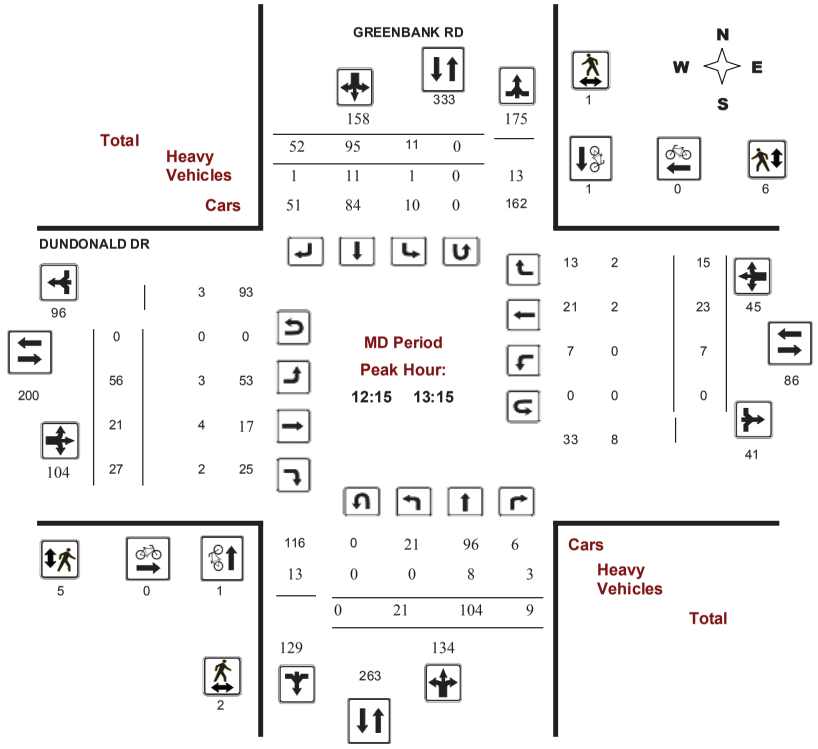
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

DUNDONALD DR @ GREENBANK RD

Survey Date: Wednesday, May 24, 2017 **WO No:** 37049

Start Time: 07:00 **Device:** Miovision



Comments

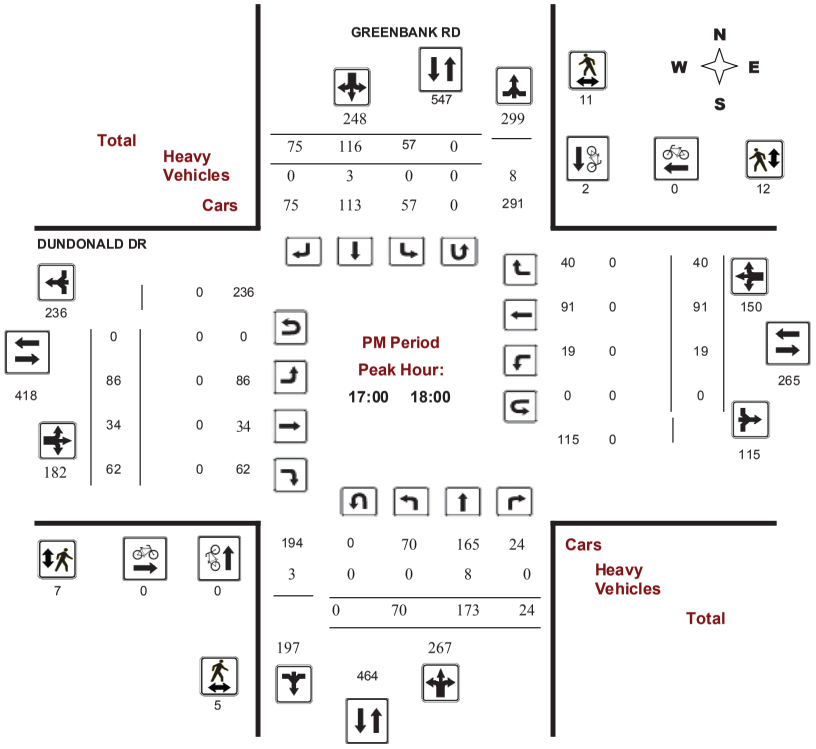
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

DUNDONALD DR @ GREENBANK RD

Survey Date: Wednesday, May 24, 2017 **WO No:** 37049

Start Time: 07:00 **Device:** Miovision



Comments

Transportation Services - Traffic Services

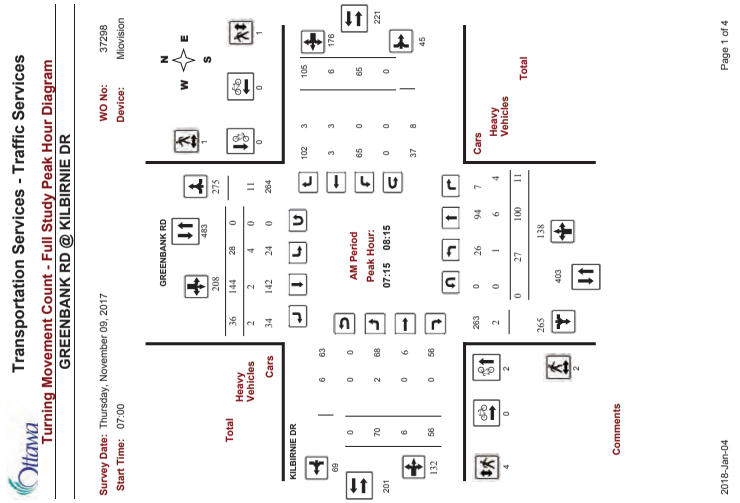
Work Order
37049

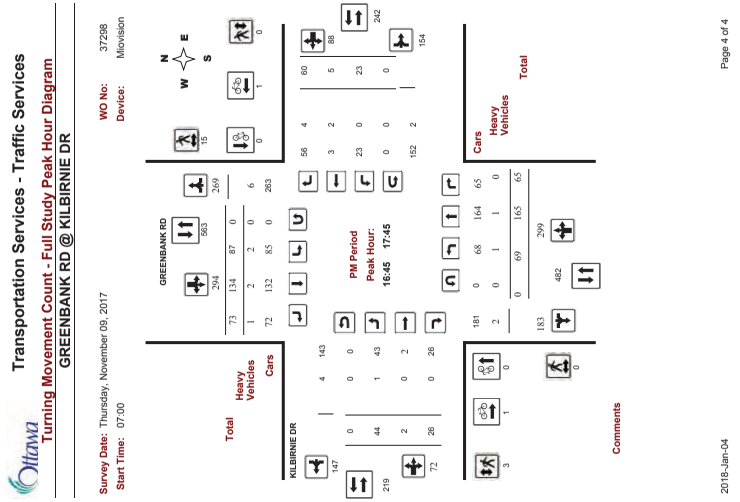
Turning Movement Count - 15 Min U-Turn Total Report

DUNDONALD DR @ GREENBANK RD

Survey Date: Wednesday, May 24, 2017

Time Period		Northbound U-Turn Total	Southbound U-Turn Total	Eastbound U-Turn Total	Westbound U-Turn Total	Total
07:00	07:15	0	0	0	0	0
07:15	07:30	0	0	0	0	0
07:30	07:45	0	0	0	0	0
07:45	08:00	0	0	1	0	1
08:00	08:15	0	0	0	0	0
08:15	08:30	0	0	0	0	0
08:30	08:45	0	0	0	0	0
08:45	09:00	0	0	0	0	0
09:00	09:15	0	0	0	0	0
09:15	09:30	0	0	0	0	0
09:30	09:45	0	0	0	0	0
09:45	10:00	0	0	0	0	0
11:30	11:45	0	0	0	0	0
11:45	12:00	0	0	0	0	0
12:00	12:15	0	0	0	0	0
12:15	12:30	0	0	0	0	0
12:30	12:45	0	0	0	0	0
12:45	13:00	0	0	0	0	0
13:00	13:15	0	0	0	0	0
13:15	13:30	0	0	0	0	0
15:00	15:15	0	0	0	0	0
15:15	15:30	0	0	0	0	0
15:30	15:45	0	0	0	0	0
15:45	16:00	0	0	0	0	0
16:00	16:15	0	0	0	0	0
16:15	16:30	0	0	0	0	0
16:30	16:45	0	0	0	0	0
16:45	17:00	0	0	0	0	0
17:00	17:15	0	0	0	0	0
17:15	17:30	0	0	0	0	0
17:30	17:45	0	0	0	0	0
17:45	18:00	0	0	0	0	0
Total		0	0	1	0	1





Survey Date: Wednesday August 23 2017
Weather: Wet

TURNING MOVEMENT COUNT SUMMARY - ALL MODES

AM Peak Hour: 7:30 AM to 8:30 AM
MD Peak Hour: 11:30 AM to 12:30 PM
PM Peak Hour: 5:00 PM to 6:00 PM

AADT FACTOR: 0.9

Turning Movement Count - Full Study Summary Report (Vehicles)

Time Period		River Mist Road Northbound					River Mist Road Southbound					N/S STREET TOTAL	Cambrian Road Eastbound					Cambrian Road Westbound					E/W STREET TOTAL	Grand TOTAL
		LT	ST	RT	U-Turns	NB TOTAL	LT	ST	RT	U-Turns	SB TOTAL		LT	ST	RT	U-Turns	EB TOTAL	LT	ST	RT	U-Turns	WB TOTAL		
7:00	8:00	78	10	123	0	**211**	37	7	13	0	**57**	**268**	4	141	21	0	**166**	28	168	13	0	**209**	**375**	**643**
8:00	9:00	88	5	116	0	**209**	23	10	17	0	**50**	**259**	3	132	30	0	**165**	39	187	8	0	**234**	**399**	**658**
9:00	10:00	44	3	54	0	**101**	14	6	8	0	**28**	**129**	6	83	18	0	**105**	32	140	10	0	**182**	**287**	**416**
AVG AM Pk HR		70	6	98	0	**174**	25	8	13	0	**45**	**219**	4	118	23	0	**145**	33	165	10	0	**208**	**354**	**572**
11:30	12:30	36	6	104	0	**146**	21	6	9	0	**36**	**182**	8	105	30	0	**143**	57	152	21	0	**230**	**373**	**555**
12:30	13:30	60	5	91	0	**156**	16	9	8	0	**33**	**189**	16	115	36	0	**167**	31	125	14	0	**170**	**337**	**526**
AVG MD Pk HR		48	6	98	0	**151**	19	8	9	0	**35**	**186**	12	110	33	0	**155**	44	139	18	0	**200**	**355**	**541**
15:00	16:00	43	6	74	0	**123**	6	5	5	0	**16**	**139**	20	144	54	0	**218**	70	148	29	0	**247**	**465**	**604**
16:00	17:00	39	5	66	0	**110**	23	8	9	0	**40**	**150**	18	217	68	0	**303**	100	190	33	0	**323**	**626**	**776**
17:00	18:00	53	5	53	0	**111**	26	8	15	0	**49**	**160**	21	240	85	0	**346**	110	211	30	0	**351**	**697**	**857**
AVG PM Pk HR		45	5	64	0	**114**	18	7	10	0	**35**	**150**	22	300	69	0	**391**	93	183	31	0	**307**	**574**	**746**
TOTAL		599	57	876	0	**1,492**	209	74	105	0	**389**	**1,880**	112	1,403	398	0	**1,913**	544	1,625	186	0	**2,354**	**4,268**	**6,148**
AM Peak Hour		88	8	110	0	**206**	35	8	15	0	**58**	**264**	2	152	21	0	**175**	34	196	12	0	**242**	**417**	**681**
MD Peak Hour		36	6	65	0	**107**	21	6	9	0	**36**	**143**	8	105	30	0	**143**	57	152	21	0	**230**	**373**	**516**
PM Peak Hour		53	7	67	0	**127**	26	8	15	0	**49**	**176**	21	240	85	0	**346**	110	211	30	0	**351**	**697**	**873**
EQ 12Hr		777	79	1218	0	2073	291	103	146	0	540	2613	156	1950	553	0	2660	756	2258	258	0	3273	5932	8545
											1.39													
Note: These volumes are calculated by multiplying the totals by the appropriate expansion factor.																								
AVG 12Hr		699	71	1096	0	1866	262	93	132	0	486	2352	141	1755	498	0	2394	681	2032	232	0	2945	5339	7691
											0.9													
Note: These volumes are calculated by multiplying the Equivalent 12 hr. totals by the AADT factor.																								
AVG 24Hr		916	93	1436	0	2445	343	122	172	0	637	3081	184	2299	652	0	3136	892	2662	305	0	3858	6994	10075
													1.31											
Note: These volumes are calculated by multiplying the Average Daily 12hr. totals by the 12 to 24 expansion factor.																								

Turning Movement Count - Full Study Summary Report (Pedestrians)

Time Period		River Mist Road NB Approach (East or West Crossing)	River Mist Road SB Approach (East or West Crossing)	N/S STREET TOTAL	Cambrian Road EB Approach (North or South Crossing)	Cambrian Road WB Approach (North or South Crossing)	E/W STREET TOTAL	Grand TOTAL
7:00	8:00	4	4	**8**	5	3	**8**	**16**
8:00	9:00	1	0	**1**	0	7	**7**	**8**
9:00	10:00	3	5	**8**	3	32	**35**	**43**
11:30	12:30	3	11	**14**	6	12	**18**	**32**
12:30	13:30	2	12	**14**	11	5	**16**	**30**
15:00	16:00	0	2	**2**	0	5	**5**	**7**
16:00	17:00	1	13	**14**	6	1	**7**	**21**
17:00	18:00	3	14	**17**	5	6	**11**	**28**
TOTAL:		17	61	**78**	36	71	**107**	**185**

Turning Movement Count - Full Study Summary Report (Cyclists)

Time Period		River Mist Road Northbound	River Mist Road Southbound	N/S STREET TOTAL	Cambrian Road Eastbound	Cambrian Road Westbound	E/W STREET TOTAL	Grand TOTAL
7:00	8:00	1	0	**1**	0	0	**0**	**1**
8:00	9:00	0	0	**0**	0	0	**0**	**0**
9:00	10:00	0	1	**1**	0	1	**1**	**2**
11:30	12:30	0	0	**0**	0	3	**3**	**3**
12:30	13:30	1	0	**1**	1	2	**3**	**4**
15:00	16:00	3	0	**3**	3	0	**3**	**6**
16:00	17:00	0	1	**1**	0	1	**1**	**2**
17:00	18:00	0	2	**2**	0	0	**0**	**2**
TOTAL:		5	4	**9**	4	7	**11**	**20**

Turning Movement Count - Full Study Summary Report (Heavy Vehicles)

Time Period		River Mist Road Northbound					River Mist Road Southbound					N/S STREET TOTAL	Cambrian Road Eastbound					Cambrian Road Westbound					E/W STREET TOTAL	Grand TOTAL
		LT	ST	RT	U-Turns	NB TOTAL	LT	ST	RT	U-Turns	SB TOTAL		LT	ST	RT	U-Turns	EB TOTAL	LT	ST	RT	U-Turns	WB TOTAL		
7:00	8:00	3	1	2	0	**6**	4	1	1	0	**6**	**12**	2	9	2	0	**13**	0	11	2	0	**13**	**26**	**38**
8:00	9:00	2	1	1	0	**4**	0	1	0	0	**1**	**5**	1	6	2	0	**9**	2	2	0	0	**4**	**13**	**18**
9:00	10:00	2	1	1	0	**4**	0	2	0	0	**2**	**6**	0	8	2	0	**10**	1	6	0	0	**7**	**17**	**23**
11:30	12:30	4	1	2	0	**7**	1	2	0	0	**3**	**10**	1	8	1	0	**10**	0	11	0	0	**11**	**21**	**31**
12:30	13:30	4	0	0	0	**4**	0	1	0	0	**1**	**5**	0	7	3	0	**10**	0	9	0	0	**9**	**19**	**24**
15:00	16:00	1	0	0	0	**1**	2	0	0	0	**2**	**3**	1	5	5	0	**11**	0	9	1	0	**10**	**21**	**24**
16:00	17:00	2	1	1	0	**4**	2	0	0	0	**2**	**6**	0	8	0	0	**8**	3	7	0	0	**10**	**18**	**24**
17:00	18:00	5	0	2	0	**7**	1	0	1	0	**2**	**9**	1	6	3	0	**10**	0	6	0	0	**6**	**16**	**25**
TOTAL:		23	5	9	0	**37**	10	7	2	0	**19**	**56**	6	57	18	0	**81**	6	61	3	0	**70**	**151**	**207**

Appendix D

Collision Data

Record	Location	X	Y	Date	Time	Environment	Road_Surface	Traffic_Control	Collision_Location	Light	Collision_Classification	Impact_type
1903	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2014-09-25	16:02	01 - Clear	01 - Dry	02 - Stop sign	02 - Intersection related	01 - Daylight	02 - Non-fatal injury	07 - SMV other
2240	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2014-07-24	16:07	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	02 - Non-fatal injury	05 - Turning movement
8226	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2014-06-24	13:00	02 - Rain	02 - Wet	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	05 - Turning movement
9398	KILBIRNIE DR btwn Continuation of KILBIRNIE DR & SANDGATE RDG	365915.4773	5011900.139	2014-08-03	15:46	01 - Clear	01 - Dry	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
10143	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2014-11-05	18:20	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	07 - Dark	03 - P.D. only	02 - Angle
13592	RIVER MIST RD btwn DUNDONALD DR & WHITE ARCTIC	364714.9791	5011998.489	2014-01-14	6:00	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	07 - Dark	03 - P.D. only	06 - SMV unattended vehicle
13908	CAMBRIAN RD @ RIVER MIST RD	364357.1859	5012611.708	2014-06-07	7:48	01 - Clear	01 - Dry		03 - At intersection	01 - Daylight	03 - P.D. only	05 - Turning movement
13913	RIVER MIST RD btwn DUNDONALD DR & WHITE ARCTIC	364714.9791	5011998.489	2014-02-07	21:43	01 - Clear	05 - Packed snow	10 - No control	04 - At/near private drive	07 - Dark	03 - P.D. only	06 - SMV unattended vehicle
13920	RIVER MIST RD btwn DUNDONALD DR & WHITE ARCTIC	364714.9791	5011998.489	2014-07-17	11:30	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
13963	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2014-05-19	15:42	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
14349	RIVER MIST RD btwn BRAMBLING WAY & RIVER ROCK AVE	364415.0397	5012518.186	2014-11-19	9:53	01 - Clear	06 - Ice	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	03 - Rear end
3960	DES SOLDATS-RIENDEAU ST btwn ANDRE AUDET AVE & RIVER MIST RD	364947.678	5011788.769	2015-01-05	15:15	01 - Clear	06 - Ice	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
3962	DES SOLDATS-RIENDEAU ST btwn ANDRE AUDET AVE & RIVER MIST RD	364947.678	5011788.769	2015-03-03	16:47	03 - Snow	05 - Packed snow	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
4038	DUNDONALD DR btwn ANDRE AUDET AVE & RIVER MIST RD	364845.4792	5011979.537	2015-02-17	9:36	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
10123	RIVER MIST RD btwn BRAMBLING WAY & RIVER ROCK AVE	364434.9645	5012485.54	2015-06-24	11:06	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
10445	CAMBRIAN RD @ RIVER MIST RD	364357.1859	5012611.708	2015-09-04	7:15	01 - Clear	01 - Dry	02 - Stop sign	02 - Intersection related	01 - Daylight	03 - P.D. only	02 - Angle
12243	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2015-10-09	14:10	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
456	ANDRE AUDET AVE @ DUNDONALD DR	364934.617	5012032.691	2016-06-22	17:23	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
1864	BLACKLEAF DR btwn CHEYENNE WAY/KENNACRAIG PRIV S & DUNDONALD DR	365215.3079	5012239.134	2016-01-14	12:45	03 - Snow	04 - Slush	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
4220	DES SOLDATS-RIENDEAU ST btwn ANDRE AUDET AVE & RIVER MIST RD	364947.678	5011788.769	2016-03-10	8:39	01 - Clear	01 - Dry	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
4381	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2016-02-20	14:55	02 - Rain	02 - Wet	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
4382	DUNDONALD DR @ RIVER MIST RD	364756.3412	5011926.383	2016-04-22	8:50	01 - Clear	01 - Dry	11 - Roundabout	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
5516	GREENBANK RD @ KILBIRNIE DR	365285.2559	5011656.861	2016-12-01	6:47	01 - Clear	02 - Wet	02 - Stop sign	03 - At intersection	07 - Dark	02 - Non-fatal injury	02 - Angle
11771	RIVER MIST RD btwn DUNDONALD DR & WHITE ARCTIC	364714.9791	5011998.489	2016-03-22	0:00	01 - Clear	01 - Dry	10 - No control	01 - Non intersection	00 - Unknown	03 - P.D. only	06 - SMV unattended vehicle
482	ANDRE AUDET AVE @ DUNDONALD DR	364934.61700	5012032.69100	2017-12-01	13:51	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
3457	CENTERRA CRT btwn END & KILBIRNIE DR	365312.41530	5011768.38240	2017-03-26	15:32	01 - Clear	02 - Wet	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
4383	DES SOLDATS-RIENDEAU ST btwn ANDRE AUDET AVE & RIVER MIST RD	364883.16400	5011750.42900	2017-03-04	5:45	01 - Clear	01 - Dry	10 - No control	01 - Non intersection	07 - Dark	03 - P.D. only	06 - SMV unattended vehicle
4542	DUNDONALD DR @ GREENBANK RD	365090.64410	5012122.31100	2017-05-17	15:19	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	03 - Rear end
4543	DUNDONALD DR @ GREENBANK RD	365090.64410	5012122.31100	2017-04-19	16:43	02 - Rain	02 - Wet	02 - Stop sign	02 - Intersection related	01 - Daylight	03 - P.D. only	07 - SMV other
4544	DUNDONALD DR btwn LAMPREY ST & RIVER MIST RD	364650.97510	5011867.22940	2017-01-05	9:53	01 - Clear	06 - Ice	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
5698	GREENBANK RD @ KILBIRNIE DR	365285.25590	5011656.86110	2017-08-19	11:36	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	02 - Non-fatal injury	02 - Angle
8964	KILBIRNIE DR btwn BREAKSTONE RD & GREENBANK RD	365228.44560	5011629.42890	2017-12-25	11:57	03 - Snow	03 - Loose snow	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
8965	KILBIRNIE DR btwn GREENBANK RD & KILMARNOCK WAY	365492.82248	5011699.59063	2017-09-17	0:41	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	07 - Dark	03 - P.D. only	06 - SMV unattended vehicle
11120	OSNABROOK PRIV btwn DUNDONALD DR & KILBIRNIE DR	365547.34637	5012190.19654	2017-08-28	7:00	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
12194	RIVER MIST RD btwn BRAMBLING WAY & RIVER ROCK AVE	364432.21400	5012488.31611	2017-07-14	19:51	01 - Clear	02 - Wet	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
12195	RIVER MIST RD btwn DAMSELFLY WAY & DES SOLDATS-RIENDEAU ST	364911.71000	5011575.09500	2017-12-20	20:41	03 - Snow	04 - Slush	10 - No control	04 - At/near private drive	07 - Dark	03 - P.D. only	02 - Angle

Appendix E

2020 Future Background Synchro Worksheets

Intersection	
Intersection Delay, s/veh	11.4
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	3	163	33	47	215	8	102	5	147	23	10	17
Future Vol, veh/h	3	163	33	47	215	8	102	5	147	23	10	17
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	181	37	52	239	9	113	6	163	26	11	19
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	10.7	12.2	11.6	9.3
HCM LOS	B	B	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	40%	2%	17%	46%
Vol Thru, %	2%	82%	80%	20%
Vol Right, %	58%	17%	3%	34%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	254	199	270	50
LT Vol	102	3	47	23
Through Vol	5	163	215	10
RT Vol	147	33	8	17
Lane Flow Rate	282	221	300	56
Geometry Grp	1	1	1	1
Degree of Util (X)	0.402	0.32	0.433	0.088
Departure Headway (Hd)	5.126	5.206	5.201	5.677
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	703	690	693	630
Service Time	3.158	3.241	3.233	3.721
HCM Lane V/C Ratio	0.401	0.32	0.433	0.089
HCM Control Delay	11.6	10.7	12.2	9.3
HCM Lane LOS	B	B	B	A
HCM 95th-tile Q	1.9	1.4	2.2	0.3

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↕						
Traffic Volume (vph)	74	77	20	25	31	138	14	18	126	57
Future Volume (vph)	74	77	20	25	31	138	14	18	126	57
Lane Group Flow (vph)	0	262	0	123	34	153	16	20	140	63
Turn Type	Perm	NA	Perm	NA	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4		8	5	2		1	6	
Permitted Phases	4		8				2			6
Detector Phase	4	4	8	8	5	2	2	1	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	33.3	33.3	33.3	33.3	11.1	31.1	31.1	11.1	31.1	31.1
Total Split (s)	33.3	33.3	33.3	33.3	15.1	31.1	31.1	15.1	31.1	31.1
Total Split (%)	41.9%	41.9%	41.9%	41.9%	19.0%	39.1%	39.1%	19.0%	39.1%	39.1%
Maximum Green (s)	27.0	27.0	27.0	27.0	9.0	25.0	25.0	9.0	25.0	25.0
Yellow Time (s)	3.3	3.3	3.3	3.3	3.7	3.7	3.7	3.7	3.7	3.7
All-Red Time (s)	3.0	3.0	3.0	3.0	2.4	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		6.3		6.3	6.1	6.1	6.1	6.1	6.1	6.1
Lead/Lag					Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	Max	Max	None	Max	Max
Walk Time (s)	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0
Flash Dont Walk (s)	20.0	20.0	20.0	20.0		15.0	15.0		15.0	15.0
Pedestrian Calls (#/hr)	2	2	3	3		5	5		5	5
Act Effct Green (s)		15.4		15.4	7.0	29.2	29.2	6.5	26.7	26.7
Actuated g/C Ratio		0.26		0.26	0.12	0.49	0.49	0.11	0.45	0.45
v/c Ratio		0.65		0.28	0.17	0.18	0.02	0.11	0.18	0.08
Control Delay		25.5		10.8	30.5	12.6	0.1	30.8	15.2	0.4
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		25.5		10.8	30.5	12.6	0.1	30.8	15.2	0.4
LOS		C		B	C	B	A	C	B	A
Approach Delay		25.5		10.8		14.6			12.4	
Approach LOS		C		B		B			B	
Queue Length 50th (m)		16.2		3.2	2.6	6.3	0.0	1.5	5.7	0.0
Queue Length 95th (m)		44.2		14.9	11.8	28.4	0.0	8.3	26.7	0.7
Internal Link Dist (m)		369.8		119.4		475.6			719.1	
Turn Bay Length (m)					90.0		50.0	145.0		100.0
Base Capacity (vph)		703		739	263	863	799	263	789	742
Starvation Cap Reductn		0		0	0	0	0	0	0	0
Spillback Cap Reductn		0		0	0	0	0	0	0	0
Storage Cap Reductn		0		0	0	0	0	0	0	0
Reduced v/c Ratio		0.37		0.17	0.13	0.18	0.02	0.08	0.18	0.08

Intersection Summary
Cycle Length: 79.5
Actuated Cycle Length: 59.7
Natural Cycle: 80
Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.65

Intersection Signal Delay: 16.9	Intersection LOS: B
Intersection Capacity Utilization 48.7%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 2: Greenbank & Dundonald

Intersection	
Int Delay, s/veh	6.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	70	6	56	65	6	105	27	105	11	28	153	36
Future Vol, veh/h	70	6	56	65	6	105	27	105	11	28	153	36
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	400	-	250	800	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	78	7	62	72	7	117	30	117	12	31	170	40

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	497	441	190	464	449	117	210	0	0	129	0	0
Stage 1	252	252	-	177	177	-	-	-	-	-	-	-
Stage 2	245	189	-	287	272	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	483	510	852	508	505	935	1361	-	-	1457	-	-
Stage 1	752	698	-	825	753	-	-	-	-	-	-	-
Stage 2	759	744	-	720	685	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	405	488	852	451	483	935	1361	-	-	1457	-	-
Mov Cap-2 Maneuver	405	488	-	451	483	-	-	-	-	-	-	-
Stage 1	735	683	-	807	736	-	-	-	-	-	-	-
Stage 2	644	728	-	647	671	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	14.5	12.8	1.5	1
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1361	-	-	526	655	1457	-	-
HCM Lane V/C Ratio	0.022	-	-	0.279	0.299	0.021	-	-
HCM Control Delay (s)	7.7	-	-	14.5	12.8	7.5	-	-
HCM Lane LOS	A	-	-	B	B	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.1	1.2	0.1	-	-

Intersection	
Intersection Delay, s/veh	14.4
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	21	272	99	138	288	30	60	5	70	26	8	15
Future Vol, veh/h	21	272	99	138	288	30	60	5	70	26	8	15
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	21	272	99	138	288	30	60	5	70	26	8	15
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	13.8	16.6	10.6	9.9
HCM LOS	B	C	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	44%	5%	30%	53%
Vol Thru, %	4%	69%	63%	16%
Vol Right, %	52%	25%	7%	31%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	135	392	456	49
LT Vol	60	21	138	26
Through Vol	5	272	288	8
RT Vol	70	99	30	15
Lane Flow Rate	135	392	456	49
Geometry Grp	1	1	1	1
Degree of Util (X)	0.22	0.542	0.639	0.085
Departure Headway (Hd)	5.879	4.974	5.045	6.246
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	609	725	716	572
Service Time	3.926	3.005	3.074	4.301
HCM Lane V/C Ratio	0.222	0.541	0.637	0.086
HCM Control Delay	10.6	13.8	16.6	9.9
HCM Lane LOS	B	B	C	A
HCM 95th-tile Q	0.8	3.3	4.6	0.3

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕							
Traffic Volume (vph)	86	34	62	19	91	40	70	180	24	57	121	75
Future Volume (vph)	86	34	62	19	91	40	70	180	24	57	121	75
Satd. Flow (prot)	0	1645	0	0	1691	0	1676	1765	1500	1676	1765	1500
Flt Permitted		0.808			0.940		0.950			0.950		
Satd. Flow (perm)	0	1360	0	0	1599	0	1676	1765	1500	1676	1765	1500
Satd. Flow (RTOR)		32			22				120			120
Lane Group Flow (vph)	0	182	0	0	150	0	70	180	24	57	121	75
Turn Type	Perm	NA		Perm	NA		Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8					2			6
Detector Phase	4	4		8	8		5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	33.3	33.3		33.3	33.3		11.1	31.1	31.1	11.1	31.1	31.1
Total Split (s)	33.3	33.3		33.3	33.3		21.1	31.1	31.1	21.1	31.1	31.1
Total Split (%)	38.9%	38.9%		38.9%	38.9%		24.7%	36.4%	36.4%	24.7%	36.4%	36.4%
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7	3.7	3.7	3.7	3.7
All-Red Time (s)	3.0	3.0		3.0	3.0		2.4	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		6.3			6.3		6.1	6.1	6.1	6.1	6.1	6.1
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None		None	None		None	Max	Max	None	Max	Max
Act Effct Green (s)		14.5			14.5		8.3	27.9	27.9	7.9	27.5	27.5
Actuated g/C Ratio		0.23			0.23		0.13	0.44	0.44	0.12	0.43	0.43
v/c Ratio		0.54			0.39		0.32	0.23	0.03	0.27	0.16	0.10
Control Delay		24.6			21.3		32.0	16.4	0.1	32.0	16.6	1.9
Queue Delay		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		24.6			21.3		32.0	16.4	0.1	32.0	16.6	1.9
LOS		C			C		C	B	A	C	B	A
Approach Delay		24.6			21.3			19.0			15.7	
Approach LOS		C			C			B			B	
Queue Length 50th (m)		14.9			12.3		7.1	12.7	0.0	5.8	8.4	0.0
Queue Length 95th (m)		32.1			26.5		19.9	34.6	0.0	17.2	24.7	3.3
Internal Link Dist (m)		369.8			119.4			475.6			719.1	
Turn Bay Length (m)							90.0		50.0	145.0		100.0
Base Capacity (vph)		619			719		411	777	727	411	768	720
Starvation Cap Reductn		0			0		0	0	0	0	0	0
Spillback Cap Reductn		0			0		0	0	0	0	0	0
Storage Cap Reductn		0			0		0	0	0	0	0	0
Reduced v/c Ratio		0.29			0.21		0.17	0.23	0.03	0.14	0.16	0.10

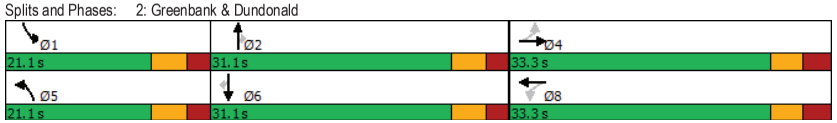
Intersection Summary
Cycle Length: 85.5
Actuated Cycle Length: 63.3
Natural Cycle: 80
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.54

Lanes, Volumes, Timings
2: Greenbank & Dundonald

01-10-2019

Intersection Signal Delay: 19.6 — Intersection LOS: B
Intersection Capacity Utilization 54.5% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 2: Greenbank & Dundonald



HCM 2010 TWSC
3: Greenbank & Kilbirnie

01-10-2019

Intersection	
Int Delay, s/veh	4.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	44	2	26	23	5	60	69	176	65	87	141	73
Future Vol, veh/h	44	2	26	23	5	60	69	176	65	87	141	73
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	400	-	250	800	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	44	2	26	23	5	60	69	176	65	87	141	73

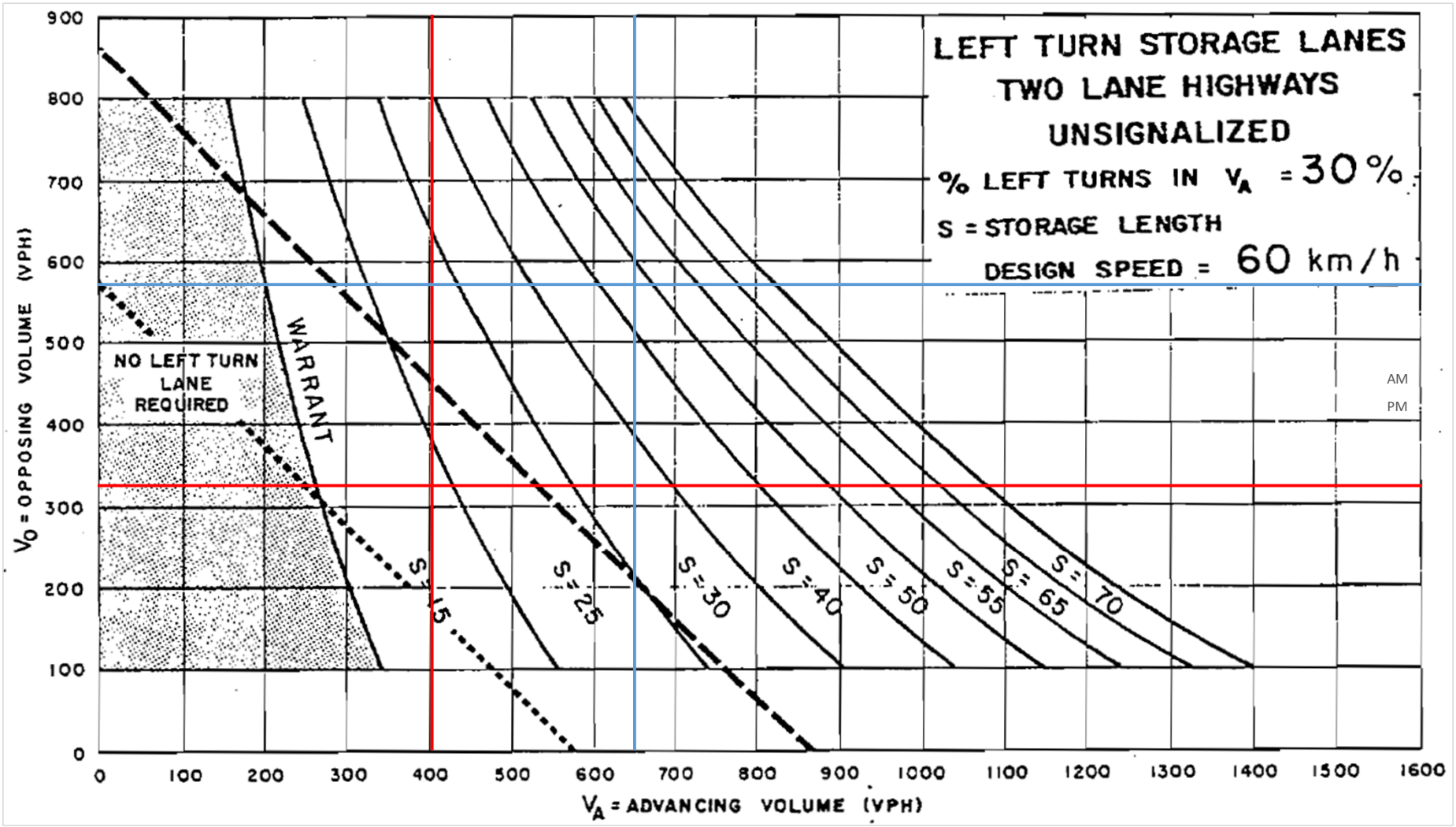
Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	731	731	178	680	702	176	214	0	0	241	0	0
Stage 1	352	352	-	314	314	-	-	-	-	-	-	-
Stage 2	379	379	-	366	388	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	337	349	865	365	362	867	1356	-	-	1326	-	-
Stage 1	665	632	-	697	656	-	-	-	-	-	-	-
Stage 2	643	615	-	653	609	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	283	309	865	322	321	867	1356	-	-	1326	-	-
Mov Cap-2 Maneuver	283	309	-	322	321	-	-	-	-	-	-	-
Stage 1	631	590	-	661	623	-	-	-	-	-	-	-
Stage 2	563	584	-	590	569	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	16.9	12.6	1.7	2.3
HCM LOS	C	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1356	-	-	375	563	1326	-	-
HCM Lane V/C Ratio	0.051	-	-	0.192	0.156	0.066	-	-
HCM Control Delay (s)	7.8	-	-	16.9	12.6	7.9	-	-
HCM Lane LOS	A	-	-	C	B	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0.7	0.6	0.2	-	-

Appendix F

Cambrian Road and River Mist Road Westbound Left-Turn Lane Warrant


LEFT TURN STORAGE LANES
TWO LANE HIGHWAYS
UNSIGNALIZED
% LEFT TURNS IN V_A = 30 %
S = STORAGE LENGTH
DESIGN SPEED = 60 km/h
NO LEFT TURN LANE REQUIRED
WARRANT
S=15
S=25
S=30
S=40
S=50
S=55
S=65
S=70
V_O = OPPOSING VOLUME (VPH)
V_A = ADVANCING VOLUME (VPH)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600

Appendix G

2025 Future Background Synchro Worksheets

Intersection	
Intersection Delay, s/veh	20.9
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	3	251	60	80	301	8	161	5	224	23	10	17
Future Vol, veh/h	3	251	60	80	301	8	161	5	224	23	10	17
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	279	67	89	334	9	179	6	249	26	11	19
Number of Lanes	0	1	0	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	1
HCM Control Delay	19.5	19.4	24.6	11.4
HCM LOS	C	C	C	B

Lane	NBLn1	EBLn1	WBLn1	WBLn2	SBLn1
Vol Left, %	41%	1%	100%	0%	46%
Vol Thru, %	1%	80%	0%	97%	20%
Vol Right, %	57%	19%	0%	3%	34%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	390	314	80	309	50
LT Vol	161	3	80	0	23
Through Vol	5	251	0	301	10
RT Vol	224	60	0	8	17
Lane Flow Rate	433	349	89	343	56
Geometry Grp	2	5	7	7	2
Degree of Util (X)	0.738	0.621	0.181	0.65	0.114
Departure Headway (Hd)	6.133	6.408	7.347	6.817	7.408
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	589	562	488	529	482
Service Time	4.176	4.461	5.101	4.57	5.486
HCM Lane V/C Ratio	0.735	0.621	0.182	0.648	0.116
HCM Control Delay	24.6	19.5	11.7	21.4	11.4
HCM Lane LOS	C	C	B	C	B
HCM 95th-tile Q	6.3	4.2	0.7	4.6	0.4

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations										
Traffic Volume (vph)	74	77	20	25	31	273	14	18	179	57
Future Volume (vph)	74	77	20	25	31	273	14	18	179	57
Lane Group Flow (vph)	0	262	0	123	34	303	16	20	199	63
Turn Type	Perm	NA	Perm	NA	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4		8	5	2		1	6	
Permitted Phases	4		8				2			6
Detector Phase	4	4	8	8	5	2	2	1	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	33.3	33.3	33.3	33.3	11.1	31.1	31.1	11.1	31.1	31.1
Total Split (s)	33.3	33.3	33.3	33.3	15.1	31.1	31.1	15.1	31.1	31.1
Total Split (%)	41.9%	41.9%	41.9%	41.9%	19.0%	39.1%	39.1%	19.0%	39.1%	39.1%
Maximum Green (s)	27.0	27.0	27.0	27.0	9.0	25.0	25.0	9.0	25.0	25.0
Yellow Time (s)	3.3	3.3	3.3	3.3	3.7	3.7	3.7	3.7	3.7	3.7
All-Red Time (s)	3.0	3.0	3.0	3.0	2.4	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		6.3		6.3	6.1	6.1	6.1	6.1	6.1	6.1
Lead/Lag					Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	Max	Max	None	Max	Max
Walk Time (s)	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0
Flash Dont Walk (s)	20.0	20.0	20.0	20.0		15.0	15.0		15.0	15.0
Pedestrian Calls (#/hr)	2	2	3	3		5	5		5	5
Act Effct Green (s)		15.4		15.4	7.0	29.2	29.2	6.5	26.7	26.7
Actuated g/C Ratio		0.26		0.26	0.12	0.49	0.49	0.11	0.45	0.45
v/c Ratio		0.65		0.28	0.17	0.35	0.02	0.11	0.25	0.08
Control Delay		25.5		10.8	30.5	13.9	0.1	30.8	15.5	0.4
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		25.5		10.8	30.5	13.9	0.1	30.8	15.5	0.4
LOS		C		B	C	B	A	C	B	A
Approach Delay		25.5		10.8		14.8			13.2	
Approach LOS		C		B		B			B	
Queue Length 50th (m)		16.2		3.2	2.6	13.8	0.0	1.5	8.5	0.0
Queue Length 95th (m)		44.2		14.9	11.8	55.3	0.0	8.3	36.9	0.7
Internal Link Dist (m)		369.8		119.4		475.6			719.1	
Turn Bay Length (m)					90.0		50.0	145.0		100.0
Base Capacity (vph)		703		739	263	863	799	263	789	742
Starvation Cap Reductn		0		0	0	0	0	0	0	0
Spillback Cap Reductn		0		0	0	0	0	0	0	0
Storage Cap Reductn		0		0	0	0	0	0	0	0
Reduced v/c Ratio		0.37		0.17	0.13	0.35	0.02	0.08	0.25	0.08

Intersection Summary
Cycle Length: 79.5
Actuated Cycle Length: 59.7
Natural Cycle: 80
Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.65

Intersection Signal Delay: 16.7	Intersection LOS: B
Intersection Capacity Utilization 55.5%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 2: Greenbank & Dundonald

Intersection	
Int Delay, s/veh	6.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	70	6	56	65	6	105	27	236	11	28	208	36
Future Vol, veh/h	70	6	56	65	6	105	27	236	11	28	208	36
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	400	-	250	800	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	78	7	62	72	7	117	30	262	12	31	231	40

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	703	647	251	670	655	262	271	0	0	274	0	0
Stage 1	313	313	-	322	322	-	-	-	-	-	-	-
Stage 2	390	334	-	348	333	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	352	390	788	371	386	777	1292	-	-	1289	-	-
Stage 1	698	657	-	690	651	-	-	-	-	-	-	-
Stage 2	634	643	-	668	644	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	284	372	788	325	368	777	1292	-	-	1289	-	-
Mov Cap-2 Maneuver	284	372	-	325	368	-	-	-	-	-	-	-
Stage 1	682	641	-	674	636	-	-	-	-	-	-	-
Stage 2	521	628	-	594	629	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	19.3	16.7	0.8	0.8
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1292	-	-	396	501	1289	-	-
HCM Lane V/C Ratio	0.023	-	-	0.37	0.39	0.024	-	-
HCM Control Delay (s)	7.9	-	-	19.3	16.7	7.9	-	-
HCM Lane LOS	A	-	-	C	C	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.7	1.8	0.1	-	-

Intersection	
Intersection Delay, s/veh	24
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	21	379	151	208	393	30	91	5	112	26	8	15
Future Vol, veh/h	21	379	151	208	393	30	91	5	112	26	8	15
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	21	379	151	208	393	30	91	5	112	26	8	15
Number of Lanes	0	1	0	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	1
HCM Control Delay	33.7	19.9	13.8	11.4
HCM LOS	D	C	B	B

Lane	NBLn1	EBLn1	WBLn1	WBLn2	SBLn1
Vol Left, %	44%	4%	100%	0%	53%
Vol Thru, %	2%	69%	0%	93%	16%
Vol Right, %	54%	27%	0%	7%	31%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	208	551	208	423	49
LT Vol	91	21	208	0	26
Through Vol	5	379	0	393	8
RT Vol	112	151	0	30	15
Lane Flow Rate	208	551	208	423	49
Geometry Grp	2	5	7	7	2
Degree of Util (X)	0.383	0.86	0.385	0.717	0.102
Departure Headway (Hd)	6.632	5.62	6.665	6.106	7.528
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	539	639	537	588	479
Service Time	4.729	3.695	4.449	3.889	5.528
HCM Lane V/C Ratio	0.386	0.862	0.387	0.719	0.102
HCM Control Delay	13.8	33.7	13.6	23	11.4
HCM Lane LOS	B	D	B	C	B
HCM 95th-tile Q	1.8	9.8	1.8	5.9	0.3

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	86	34	62	19	91	40	70	265	24	57	251	75
Future Volume (vph)	86	34	62	19	91	40	70	265	24	57	251	75
Satd. Flow (prot)	0	1645	0	0	1691	0	1676	1765	1500	1676	1765	1500
Flt Permitted		0.808			0.940		0.950			0.950		
Satd. Flow (perm)	0	1360	0	0	1599	0	1676	1765	1500	1676	1765	1500
Satd. Flow (RTOR)		32			22				120			120
Lane Group Flow (vph)	0	182	0	0	150	0	70	265	24	57	251	75
Turn Type	Perm	NA		Perm	NA		Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8					2			6
Detector Phase	4	4		8	8		5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	33.3	33.3		33.3	33.3		11.1	31.1	31.1	11.1	31.1	31.1
Total Split (s)	33.3	33.3		33.3	33.3		21.1	31.1	31.1	21.1	31.1	31.1
Total Split (%)	38.9%	38.9%		38.9%	38.9%		24.7%	36.4%	36.4%	24.7%	36.4%	36.4%
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7	3.7	3.7	3.7	3.7
All-Red Time (s)	3.0	3.0		3.0	3.0		2.4	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		6.3			6.3		6.1	6.1	6.1	6.1	6.1	6.1
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None		None	None		None	Max	Max	None	Max	Max
Act Effct Green (s)		14.5			14.5		8.3	27.9	27.9	7.9	27.5	27.5
Actuated g/C Ratio		0.23			0.23		0.13	0.44	0.44	0.12	0.43	0.43
v/c Ratio		0.54			0.39		0.32	0.34	0.03	0.27	0.33	0.10
Control Delay		24.6			21.3		32.0	17.3	0.1	32.0	17.6	1.9
Queue Delay		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		24.6			21.3		32.0	17.3	0.1	32.0	17.6	1.9
LOS		C			C		C	B	A	C	B	A
Approach Delay		24.6			21.3			19.1			16.7	
Approach LOS		C			C			B			B	
Queue Length 50th (m)		14.9			12.3		7.1	19.8	0.0	5.8	18.8	0.0
Queue Length 95th (m)		32.1			26.5		19.9	50.7	0.0	17.2	48.8	3.3
Internal Link Dist (m)		369.8			119.4			475.6			719.1	
Turn Bay Length (m)							90.0		50.0	145.0		100.0
Base Capacity (vph)		619			719		411	777	727	411	768	720
Starvation Cap Reductn		0			0		0	0	0	0	0	0
Spillback Cap Reductn		0			0		0	0	0	0	0	0
Storage Cap Reductn		0			0		0	0	0	0	0	0
Reduced v/c Ratio		0.29			0.21		0.17	0.34	0.03	0.14	0.33	0.10

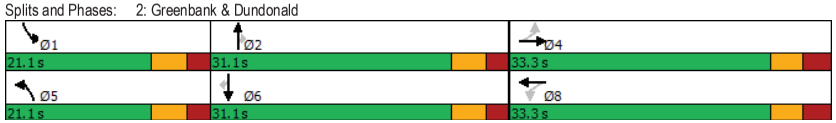
Intersection Summary
Cycle Length: 85.5
Actuated Cycle Length: 63.3
Natural Cycle: 80
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.54

Lanes, Volumes, Timings
2: Greenbank & Dundonald

01-10-2019

Intersection Signal Delay: 19.5 | Intersection LOS: B
Intersection Capacity Utilization 59.2% | ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 2: Greenbank & Dundonald



HCM 2010 TWSC
3: Greenbank & Kilbirnie

01-10-2019

Intersection	
Int Delay, s/veh	4.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	44	2	26	23	5	60	69	260	65	87	274	73
Future Vol, veh/h	44	2	26	23	5	60	69	260	65	87	274	73
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	400	-	250	800	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	44	2	26	23	5	60	69	260	65	87	274	73

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	948	948	311	897	919	260	347	0	0	325	0	0
Stage 1	485	485	-	398	398	-	-	-	-	-	-	-
Stage 2	463	463	-	499	521	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	241	261	729	261	271	779	1212	-	-	1235	-	-
Stage 1	563	552	-	628	603	-	-	-	-	-	-	-
Stage 2	579	564	-	554	532	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	198	229	729	226	238	779	1212	-	-	1235	-	-
Mov Cap-2 Maneuver	198	229	-	226	238	-	-	-	-	-	-	-
Stage 1	531	513	-	592	569	-	-	-	-	-	-	-
Stage 2	500	532	-	495	495	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	23.1	15.2	1.4	1.6
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1212	-	-	270	440	1235	-	-
HCM Lane V/C Ratio	0.057	-	-	0.267	0.2	0.07	-	-
HCM Control Delay (s)	8.2	-	-	23.1	15.2	8.1	-	-
HCM Lane LOS	A	-	-	C	C	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	1	0.7	0.2	-	-

Appendix H

MMLOS Analysis

Multi-Modal Level of Service - Intersections Form

Consultant	**CGH Transportation**	**Project**	**2018-32**
Scenario	**Existing and Future 2025**	**Date**	**10-Jan-19**
Comments			

INTERSECTIONS		**Greenbank and Dundonald**			
	Crossing Side	**NORTH**	**SOUTH**	**EAST**	**WEST**
Pedestrian	Lanes	4	4	0 - 2	0 - 2
	Median	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m
	Conflicting Left Turns	Permissive	Permissive	Protected	Protected
	Conflicting Right Turns	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control
	Right Turns on Red (RToR) ?	RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed
	Ped Signal Leading Interval?	No	No	No	No
	Right Turn Channel	No Channel	No Channel	No Channel	No Channel
	Corner Radius	10-15m	10-15m	10-15m	10-15m
	Crosswalk Type	Std transverse markings	Std transverse markings	Std transverse markings	Std transverse markings
	PETSI Score	**53**	**53**	**93**	**93**
	Ped. Exposure to Traffic LoS	**D**	**D**	**A**	**A**
	Cycle Length				
	Effective Walk Time				
	Average Pedestrian Delay				
	Pedestrian Delay LoS	-	-	-	-
	Level of Service	**D**	**D**	**A**	**A**
		D			
	Approach From	**NORTH**	**SOUTH**	**EAST**	**WEST**
Bicycle	Bicycle Lane Arrangement on Approach	Curb Bike Lane, Cycletrack or MUP	Pocket Bike Lane	Mixed Traffic	Mixed Traffic
	Right Turn Lane Configuration	Not Applicable	> 50 m Introduced right turn lane	≤ 50 m	≤ 50 m
	Right Turning Speed	Not Applicable	>25 to 30 km/h	≤ 25 km/h	≤ 25 km/h
	Cyclist relative to RT motorists	**Not Applicable**	**D**	**D**	**D**
	Separated or Mixed Traffic	**Separated**	**Separated**	**Mixed Traffic**	**Mixed Traffic**
	Left Turn Approach	2-stage, LT box	≥ 2 lanes crossed	No lane crossed	No lane crossed
	Operating Speed	≥ 60 km/h	≥ 60 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h
	Left Turning Cyclist	**A**	**F**	**B**	**B**
	Level of Service	**A**	**F**	**D**	**D**
		F			
Transit	Average Signal Delay	≤ 20 sec	≤ 20 sec	≤ 40 sec	≤ 20 sec
	Level of Service	**C**	**C**	**E**	**C**
		E			
Truck	Effective Corner Radius	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m
	Number of Receiving Lanes on Departure from Intersection	≥ 2	≥ 2	1	1
	Level of Service	**B**	**B**	**E**	**E**
		E			
Auto	Volume to Capacity Ratio	0.61 - 0.70			
	Level of Service	**B**			

Multi-Modal Level of Service - Segments Form

Consultant	**CGH Transportation**	**Project**	**2018-32**
Scenario	**Existing and Future 2025**	**Date**	**10-Jan-19**
Comments			

SEGMENTS		**Street A**	Re-Algined Greenbank	Alex Polowin	Section
			1	2	3
Pedestrian	Sidewalk Width Boulevard Width	-	≥ 2 m 0.5 - 2 m	1.8 m < 0.5 m	
	Avg Daily Curb Lane Traffic Volume		> 3000	≤ 3000	
	Operating Speed On-Street Parking		> 60 km/h no	> 30 to 50 km/h yes	
	Exposure to Traffic PLoS		**E**	**B**	**-**
	Effective Sidewalk Width				
	Pedestrian Volume				
	Crowding PLoS		**-**	**-**	**-**
	Level of Service		**-**	**-**	**-**
Bicycle	Type of Cycling Facility	C	Curbside Bike Lane	Mixed Traffic	
	Number of Travel Lanes		2 ea. dir. (w median)	≤ 2 (no centreline)	
	Operating Speed		>50 to 70 km/h	>40 to <50 km/h	
	# of Lanes & Operating Speed LoS		**C**	**B**	**-**
	Bike Lane (+ Parking Lane) Width		≥ 1.8 m		
	Bike Lane Width LoS		**A**	**-**	**-**
	Bike Lane Blockages		Rare		
	Blockage LoS		**A**	**-**	**-**
	Median Refuge Width (no median = < 1.8 m)		≥ 1.8 m refuge	< 1.8 m refuge	
	No. of Lanes at Unsignalized Crossing		4-5 lanes	≤ 3 lanes	
	Sidestreet Operating Speed		>50 to 60 km/h	>40 to 50 km/h	
	Unsignalized Crossing - Lowest LoS		**C**	**A**	**-**
	Level of Service		**C**	**B**	**-**
Transit	Facility Type	A	Segregated ROW		
	Friction or Ratio Transit:Posted Speed				
	Level of Service		**A**	**-**	**-**
Truck	Truck Lane Width	A	≤ 3.5 m		
	Travel Lanes per Direction		> 1		
	Level of Service		**A**	**-**	**-**

Appendix I

2020 Future Total Synchro Worksheets

Intersection	
Intersection Delay, s/veh	12.6
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	3	163	57	47	215	8	151	5	147	23	10	17
Future Vol, veh/h	3	163	57	47	215	8	151	5	147	23	10	17
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	181	63	52	239	9	168	6	163	26	11	19
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	11.6	13	13.5	9.6
HCM LOS	B	B	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	50%	1%	17%	46%
Vol Thru, %	2%	73%	80%	20%
Vol Right, %	49%	26%	3%	34%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	303	223	270	50
LT Vol	151	3	47	23
Through Vol	5	163	215	10
RT Vol	147	57	8	17
Lane Flow Rate	337	248	300	56
Geometry Grp	1	1	1	1
Degree of Util (X)	0.497	0.37	0.454	0.091
Departure Headway (Hd)	5.318	5.37	5.447	5.927
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	677	669	660	602
Service Time	3.362	3.417	3.492	3.992
HCM Lane V/C Ratio	0.498	0.371	0.455	0.093
HCM Control Delay	13.5	11.6	13	9.6
HCM Lane LOS	B	B	B	A
HCM 95th-tile Q	2.8	1.7	2.4	0.3

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣		✣						
Traffic Volume (vph)	113	82	27	25	31	138	14	18	126	76
Future Volume (vph)	113	82	27	25	31	138	14	18	126	76
Lane Group Flow (vph)	0	311	0	131	34	153	16	20	140	84
Turn Type	Perm	NA	Perm	NA	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4		8	5	2		1	6	
Permitted Phases	4		8				2			6
Detector Phase	4	4	8	8	5	2	2	1	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	33.3	33.3	33.3	33.3	11.1	31.1	31.1	11.1	31.1	31.1
Total Split (s)	33.3	33.3	33.3	33.3	15.1	31.1	31.1	15.1	31.1	31.1
Total Split (%)	41.9%	41.9%	41.9%	41.9%	19.0%	39.1%	39.1%	19.0%	39.1%	39.1%
Maximum Green (s)	27.0	27.0	27.0	27.0	9.0	25.0	25.0	9.0	25.0	25.0
Yellow Time (s)	3.3	3.3	3.3	3.3	3.7	3.7	3.7	3.7	3.7	3.7
All-Red Time (s)	3.0	3.0	3.0	3.0	2.4	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		6.3		6.3	6.1	6.1	6.1	6.1	6.1	6.1
Lead/Lag					Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	Max	Max	None	Max	Max
Walk Time (s)	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0
Flash Dont Walk (s)	20.0	20.0	20.0	20.0		15.0	15.0		15.0	15.0
Pedestrian Calls (#/hr)	2	2	3	3		5	5		5	5
Act Effct Green (s)		17.4		17.4	7.0	28.6	28.6	6.6	26.2	26.2
Actuated g/C Ratio		0.28		0.28	0.11	0.47	0.47	0.11	0.43	0.43
v/c Ratio		0.74		0.29	0.18	0.19	0.02	0.11	0.19	0.12
Control Delay		30.0		11.1	31.5	13.5	0.1	31.8	16.3	1.9
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		30.0		11.1	31.5	13.5	0.1	31.8	16.3	1.9
LOS		C		B	C	B	A	C	B	A
Approach Delay		30.0		11.1		15.5			12.6	
Approach LOS		C		B		B			B	
Queue Length 50th (m)		21.6		3.7	2.8	7.2	0.0	1.6	6.6	0.0
Queue Length 95th (m)		56.3		16.2	11.8	28.4	0.0	8.3	26.7	3.7
Internal Link Dist (m)		369.8		119.4		475.6			719.1	
Turn Bay Length (m)					90.0		50.0	145.0		100.0
Base Capacity (vph)		665		699	258	825	770	258	755	716
Starvation Cap Reductn		0		0	0	0	0	0	0	0
Spillback Cap Reductn		0		0	0	0	0	0	0	0
Storage Cap Reductn		0		0	0	0	0	0	0	0
Reduced v/c Ratio		0.47		0.19	0.13	0.19	0.02	0.08	0.19	0.12

Intersection Summary
Cycle Length: 79.5
Actuated Cycle Length: 61.1
Natural Cycle: 80
Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.74

Intersection Signal Delay: 19.1	Intersection LOS: B
Intersection Capacity Utilization 51.2%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 2: Greenbank & Dundonald

Intersection	
Int Delay, s/veh	7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	70	6	61	65	6	105	29	105	11	28	153	36
Future Vol, veh/h	70	6	61	65	6	105	29	105	11	28	153	36
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	400	-	250	800	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	78	7	68	72	7	117	32	117	12	31	170	40

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	501	445	190	471	453	117	210	0	0	129	0	0
Stage 1	252	252	-	181	181	-	-	-	-	-	-	-
Stage 2	249	193	-	290	272	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	480	508	852	503	503	935	1361	-	-	1457	-	-
Stage 1	752	698	-	821	750	-	-	-	-	-	-	-
Stage 2	755	741	-	718	685	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	402	486	852	443	481	935	1361	-	-	1457	-	-
Mov Cap-2 Maneuver	402	486	-	443	481	-	-	-	-	-	-	-
Stage 1	734	683	-	801	732	-	-	-	-	-	-	-
Stage 2	639	723	-	641	671	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	14.5	12.9	1.5	1
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1361	-	-	531	648	1457	-	-
HCM Lane V/C Ratio	0.024	-	-	0.287	0.302	0.021	-	-
HCM Control Delay (s)	7.7	-	-	14.5	12.9	7.5	-	-
HCM Lane LOS	A	-	-	B	B	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.2	1.3	0.1	-	-

Intersection	
Intersection Delay, s/veh	16.2
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	21	272	146	138	288	30	97	5	70	26	8	15
Future Vol, veh/h	21	272	146	138	288	30	97	5	70	26	8	15
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	21	272	146	138	288	30	97	5	70	26	8	15
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	16.3	18.4	11.8	10.3
HCM LOS	C	C	B	B

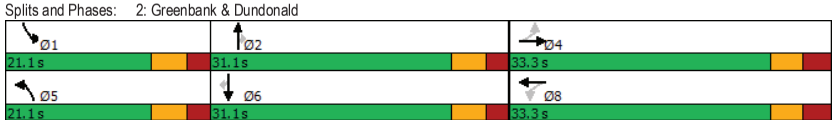
Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	56%	5%	30%	53%
Vol Thru, %	3%	62%	63%	16%
Vol Right, %	41%	33%	7%	31%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	172	439	456	49
LT Vol	97	21	138	26
Through Vol	5	272	288	8
RT Vol	70	146	30	15
Lane Flow Rate	172	439	456	49
Geometry Grp	1	1	1	1
Degree of Util (X)	0.293	0.623	0.669	0.089
Departure Headway (Hd)	6.142	5.112	5.281	6.545
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	583	702	684	544
Service Time	4.205	3.158	3.325	4.626
HCM Lane V/C Ratio	0.295	0.625	0.667	0.09
HCM Control Delay	11.8	16.3	18.4	10.3
HCM Lane LOS	B	C	C	B
HCM 95th-tile Q	1.2	4.4	5.1	0.3

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕							
Traffic Volume (vph)	115	38	62	19	96	40	70	180	24	57	121	113
Future Volume (vph)	115	38	62	19	96	40	70	180	24	57	121	113
Satd. Flow (prot)	0	1652	0	0	1693	0	1676	1765	1500	1676	1765	1500
Flt Permitted		0.783			0.942		0.950			0.950		
Satd. Flow (perm)	0	1328	0	0	1604	0	1676	1765	1500	1676	1765	1500
Satd. Flow (RTOR)		25			21				120			120
Lane Group Flow (vph)	0	215	0	0	155	0	70	180	24	57	121	113
Turn Type	Perm	NA		Perm	NA		Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8					2			6
Detector Phase	4	4		8	8		5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	33.3	33.3		33.3	33.3		11.1	31.1	31.1	11.1	31.1	31.1
Total Split (s)	33.3	33.3		33.3	33.3		21.1	31.1	31.1	21.1	31.1	31.1
Total Split (%)	38.9%	38.9%		38.9%	38.9%		24.7%	36.4%	36.4%	24.7%	36.4%	36.4%
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7	3.7	3.7	3.7	3.7
All-Red Time (s)	3.0	3.0		3.0	3.0		2.4	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		6.3			6.3		6.1	6.1	6.1	6.1	6.1	6.1
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None		None	None		None	Max	Max	None	Max	Max
Act Effct Green (s)		16.1			16.1		8.4	27.2	27.2	7.9	26.8	26.8
Actuated g/C Ratio		0.25			0.25		0.13	0.42	0.42	0.12	0.42	0.42
v/c Ratio		0.61			0.37		0.32	0.24	0.03	0.28	0.16	0.16
Control Delay		27.7			20.7		32.9	17.4	0.1	32.8	17.6	4.8
Queue Delay		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		27.7			20.7		32.9	17.4	0.1	32.8	17.6	4.8
LOS		C			C		C	B	A	C	B	A
Approach Delay		27.7			20.7			19.8			15.6	
Approach LOS		C			C			B			B	
Queue Length 50th (m)		19.8			13.0		7.5	13.8	0.0	6.1	9.1	0.0
Queue Length 95th (m)		40.0			27.4		19.9	34.6	0.0	17.2	24.7	9.0
Internal Link Dist (m)		369.8			119.4			475.6			719.1	
Turn Bay Length (m)							90.0		50.0	145.0		100.0
Base Capacity (vph)		594			713		407	747	704	407	737	696
Starvation Cap Reductn		0			0		0	0	0	0	0	0
Spillback Cap Reductn		0			0		0	0	0	0	0	0
Storage Cap Reductn		0			0		0	0	0	0	0	0
Reduced v/c Ratio		0.36			0.22		0.17	0.24	0.03	0.14	0.16	0.16

Intersection Summary
Cycle Length: 85.5
Actuated Cycle Length: 64.2
Natural Cycle: 80
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.61

Intersection Signal Delay: 20.5	Intersection LOS: C
Intersection Capacity Utilization 56.7%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 2: Greenbank & Dundonald



Intersection	
Int Delay, s/veh	4.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	44	2	30	23	5	60	74	176	65	87	141	73
Future Vol, veh/h	44	2	30	23	5	60	74	176	65	87	141	73
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	400	-	250	800	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	44	2	30	23	5	60	74	176	65	87	141	73

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	741	741	178	692	712	176	214	0	0	241	0	0
Stage 1	352	352	-	324	324	-	-	-	-	-	-	-
Stage 2	389	389	-	368	388	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	332	344	865	358	358	867	1356	-	-	1326	-	-
Stage 1	665	632	-	688	650	-	-	-	-	-	-	-
Stage 2	635	608	-	652	609	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	278	304	865	313	316	867	1356	-	-	1326	-	-
Mov Cap-2 Maneuver	278	304	-	313	316	-	-	-	-	-	-	-
Stage 1	628	590	-	650	614	-	-	-	-	-	-	-
Stage 2	554	575	-	586	569	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	16.8	12.7	1.8	2.3
HCM LOS	C	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1356	-	-	381	555	1326	-	-
HCM Lane V/C Ratio	0.055	-	-	0.199	0.159	0.066	-	-
HCM Control Delay (s)	7.8	-	-	16.8	12.7	7.9	-	-
HCM Lane LOS	A	-	-	C	B	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0.7	0.6	0.2	-	-

Appendix J

2025 Future Total Synchro Worksheets

Intersection	
Intersection Delay, s/veh	27.6
Intersection LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	3	251	84	80	301	8	210	5	224	23	10	17
Future Vol, veh/h	3	251	84	80	301	8	210	5	224	23	10	17
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	279	93	89	334	9	233	6	249	26	11	19
Number of Lanes	0	1	0	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	1
HCM Control Delay	24	21.9	37.2	12.1
HCM LOS	C	C	E	B

Lane	NBLn1	EBLn1	WBLn1	WBLn2	SBLn1
Vol Left, %	48%	1%	100%	0%	46%
Vol Thru, %	1%	74%	0%	97%	20%
Vol Right, %	51%	25%	0%	3%	34%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	439	338	80	309	50
LT Vol	210	3	80	0	23
Through Vol	5	251	0	301	10
RT Vol	224	84	0	8	17
Lane Flow Rate	488	376	89	343	56
Geometry Grp	2	5	7	7	2
Degree of Util (X)	0.862	0.699	0.191	0.686	0.123
Departure Headway (Hd)	6.36	6.696	7.73	7.198	7.986
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	566	537	462	501	452
Service Time	4.423	4.775	5.513	4.981	5.986
HCM Lane V/C Ratio	0.862	0.7	0.193	0.685	0.124
HCM Control Delay	37.2	24	12.3	24.4	12.1
HCM Lane LOS	E	C	B	C	B
HCM 95th-tile Q	9.5	5.5	0.7	5.2	0.4

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations										
Traffic Volume (vph)	113	82	20	27	31	273	14	18	179	76
Future Volume (vph)	113	82	20	27	31	273	14	18	179	76
Lane Group Flow (vph)	0	311	0	125	34	303	16	20	199	84
Turn Type	Perm	NA	Perm	NA	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4		8	5	2		1	6	
Permitted Phases	4		8				2			6
Detector Phase	4	4	8	8	5	2	2	1	6	6
Switch Phase										
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	33.3	33.3	33.3	33.3	11.1	31.1	31.1	11.1	31.1	31.1
Total Split (s)	33.3	33.3	33.3	33.3	15.1	31.1	31.1	15.1	31.1	31.1
Total Split (%)	41.9%	41.9%	41.9%	41.9%	19.0%	39.1%	39.1%	19.0%	39.1%	39.1%
Maximum Green (s)	27.0	27.0	27.0	27.0	9.0	25.0	25.0	9.0	25.0	25.0
Yellow Time (s)	3.3	3.3	3.3	3.3	3.7	3.7	3.7	3.7	3.7	3.7
All-Red Time (s)	3.0	3.0	3.0	3.0	2.4	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		6.3		6.3	6.1	6.1	6.1	6.1	6.1	6.1
Lead/Lag					Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	Max	Max	None	Max	Max
Walk Time (s)	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0
Flash Dont Walk (s)	20.0	20.0	20.0	20.0		15.0	15.0		15.0	15.0
Pedestrian Calls (#/hr)	2	2	3	3		5	5		5	5
Act Effct Green (s)		17.4		17.4	7.0	28.6	28.6	6.6	26.2	26.2
Actuated g/C Ratio		0.28		0.28	0.11	0.47	0.47	0.11	0.43	0.43
v/c Ratio		0.74		0.26	0.18	0.37	0.02	0.11	0.26	0.12
Control Delay		30.2		10.5	31.5	15.0	0.1	31.8	16.7	1.9
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		30.2		10.5	31.5	15.0	0.1	31.8	16.7	1.9
LOS		C		B	C	B	A	C	B	A
Approach Delay		30.2		10.5		15.9			13.6	
Approach LOS		C		B		B			B	
Queue Length 50th (m)		21.6		3.3	2.8	15.8	0.0	1.6	9.7	0.0
Queue Length 95th (m)		56.4		15.2	11.8	55.3	0.0	8.3	36.9	3.7
Internal Link Dist (m)		369.8		119.4		475.6			719.1	
Turn Bay Length (m)					90.0		50.0	145.0		100.0
Base Capacity (vph)		663		725	258	825	770	258	755	716
Starvation Cap Reductn		0		0	0	0	0	0	0	0
Spillback Cap Reductn		0		0	0	0	0	0	0	0
Storage Cap Reductn		0		0	0	0	0	0	0	0
Reduced v/c Ratio		0.47		0.17	0.13	0.37	0.02	0.08	0.26	0.12

Intersection Summary
Cycle Length: 79.5
Actuated Cycle Length: 61.1
Natural Cycle: 80
Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.74

Intersection Signal Delay: 18.7	Intersection LOS: B
Intersection Capacity Utilization 58.0%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 2: Greenbank & Dundonald

Intersection	
Int Delay, s/veh	7.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	70	6	61	65	6	105	29	236	11	28	208	36
Future Vol, veh/h	70	6	61	65	6	105	29	236	11	28	208	36
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	400	-	250	800	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	78	7	68	72	7	117	32	262	12	31	231	40

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	707	651	251	677	659	262	271	0	0	274	0	0
Stage 1	313	313	-	326	326	-	-	-	-	-	-	-
Stage 2	394	338	-	351	333	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	350	388	788	367	384	777	1292	-	-	1289	-	-
Stage 1	698	657	-	687	648	-	-	-	-	-	-	-
Stage 2	631	641	-	666	644	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	282	369	788	319	366	777	1292	-	-	1289	-	-
Mov Cap-2 Maneuver	282	369	-	319	366	-	-	-	-	-	-	-
Stage 1	681	641	-	670	632	-	-	-	-	-	-	-
Stage 2	517	625	-	588	629	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	19.4	16.9	0.8	0.8
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1292	-	-	401	495	1289	-	-
HCM Lane V/C Ratio	0.025	-	-	0.38	0.395	0.024	-	-
HCM Control Delay (s)	7.9	-	-	19.4	16.9	7.9	-	-
HCM Lane LOS	A	-	-	C	C	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.7	1.9	0.1	-	-

Intersection	
Intersection Delay, s/veh	35.1
Intersection LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	21	379	198	208	393	30	128	5	112	26	8	15
Future Vol, veh/h	21	379	198	208	393	30	128	5	112	26	8	15
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	21	379	198	208	393	30	128	5	112	26	8	15
Number of Lanes	0	1	0	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	1
HCM Control Delay	57.2	23.3	16.3	12
HCM LOS	F	C	C	B

Lane	NBLn1	EBLn1	WBLn1	WBLn2	SBLn1
Vol Left, %	52%	4%	100%	0%	53%
Vol Thru, %	2%	63%	0%	93%	16%
Vol Right, %	46%	33%	0%	7%	31%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	245	598	208	423	49
LT Vol	128	21	208	0	26
Through Vol	5	379	0	393	8
RT Vol	112	198	0	30	15
Lane Flow Rate	245	598	208	423	49
Geometry Grp	2	5	7	7	2
Degree of Util (X)	0.476	0.986	0.409	0.766	0.109
Departure Headway (Hd)	7.001	5.936	7.077	6.515	7.974
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	514	616	508	554	447
Service Time	5.058	3.936	4.828	4.266	6.059
HCM Lane V/C Ratio	0.477	0.971	0.409	0.764	0.11
HCM Control Delay	16.3	57.2	14.7	27.6	12
HCM Lane LOS	C	F	B	D	B
HCM 95th-tile Q	2.5	14.5	2	6.9	0.4

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	38	62	96	91	40	70	265	24	57	251	113
Future Volume (vph)	115	38	62	96	91	40	70	265	24	57	251	113
Satd. Flow (prot)	0	1652	0	0	1686	0	1676	1765	1500	1676	1765	1500
Flt Permitted		0.719			0.782		0.950			0.950		
Satd. Flow (perm)	0	1219	0	0	1347	0	1676	1765	1500	1676	1765	1500
Satd. Flow (RTOR)		25			13				120			120
Lane Group Flow (vph)	0	215	0	0	227	0	70	265	24	57	251	113
Turn Type	Perm	NA		Perm	NA		Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8					2			6
Detector Phase	4	4		8	8		5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	33.3	33.3		33.3	33.3		11.1	31.1	31.1	11.1	31.1	31.1
Total Split (s)	33.3	33.3		33.3	33.3		21.1	31.1	31.1	21.1	31.1	31.1
Total Split (%)	38.9%	38.9%		38.9%	38.9%		24.7%	36.4%	36.4%	24.7%	36.4%	36.4%
Yellow Time (s)	3.3	3.3		3.3	3.3		3.7	3.7	3.7	3.7	3.7	3.7
All-Red Time (s)	3.0	3.0		3.0	3.0		2.4	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		6.3			6.3		6.1	6.1	6.1	6.1	6.1	6.1
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None		None	None		None	Max	Max	None	Max	Max
Act Effct Green (s)		16.7			16.7		8.4	26.5	26.5	8.0	26.2	26.2
Actuated g/C Ratio		0.26			0.26		0.13	0.41	0.41	0.12	0.41	0.41
v/c Ratio		0.64			0.63		0.32	0.36	0.03	0.28	0.35	0.17
Control Delay		29.3			29.5		33.1	18.9	0.1	33.1	19.2	4.8
Queue Delay		0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		29.3			29.5		33.1	18.9	0.1	33.1	19.2	4.8
LOS		C			C		C	B	A	C	B	A
Approach Delay		29.3			29.5			20.4			17.2	
Approach LOS		C			C			C			B	
Queue Length 50th (m)		20.1			22.7		7.6	22.0	0.0	6.2	20.9	0.0
Queue Length 95th (m)		41.2			44.1		19.9	50.7	0.0	17.2	48.8	9.0
Internal Link Dist (m)		369.8			119.4			475.6			719.1	
Turn Bay Length (m)							90.0		50.0	145.0		100.0
Base Capacity (vph)		550			600		409	729	689	409	719	682
Starvation Cap Reductn		0			0		0	0	0	0	0	0
Spillback Cap Reductn		0			0		0	0	0	0	0	0
Storage Cap Reductn		0			0		0	0	0	0	0	0
Reduced v/c Ratio		0.39			0.38		0.17	0.36	0.03	0.14	0.35	0.17

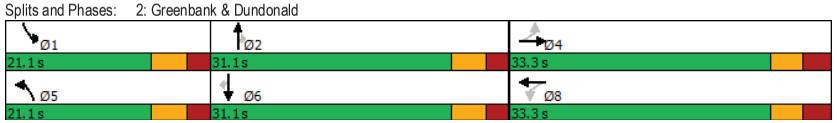
Intersection Summary
Cycle Length: 85.5
Actuated Cycle Length: 64.2
Natural Cycle: 80
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.64

Lanes, Volumes, Timings
2: Greenbank & Dundonald

01-16-2019

Intersection Signal Delay: 22.5	Intersection LOS: C
Intersection Capacity Utilization 52.5%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 2: Greenbank & Dundonald



HCM 2010 TWSC
3: Greenbank & Kilbirnie

01-16-2019

Intersection	
Int Delay, s/veh	4.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	44	2	30	23	5	60	74	260	65	87	274	73
Future Vol, veh/h	44	2	30	23	5	60	74	260	65	87	274	73
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	400	-	250	800	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	44	2	30	23	5	60	74	260	65	87	274	73

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	958	958	311	909	929	260	347	0	0	325	0	0
Stage 1	485	485	-	408	408	-	-	-	-	-	-	-
Stage 2	473	473	-	501	521	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	237	257	729	256	268	779	1212	-	-	1235	-	-
Stage 1	563	552	-	620	597	-	-	-	-	-	-	-
Stage 2	572	558	-	552	532	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	194	224	729	220	234	779	1212	-	-	1235	-	-
Mov Cap-2 Maneuver	194	224	-	220	234	-	-	-	-	-	-	-
Stage 1	529	513	-	582	561	-	-	-	-	-	-	-
Stage 2	491	524	-	490	495	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	23.1	15.4	1.5	1.6
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1212	-	-	274	434	1235	-	-
HCM Lane V/C Ratio	0.061	-	-	0.277	0.203	0.07	-	-
HCM Control Delay (s)	8.2	-	-	23.1	15.4	8.1	-	-
HCM Lane LOS	A	-	-	C	C	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	1.1	0.8	0.2	-	-

Intersection	
Intersection Delay, s/veh	20.2
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	21	379	198	208	393	30	128	5	112	26	8	15
Future Vol, veh/h	21	379	198	208	393	30	128	5	112	26	8	15
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	21	379	198	208	393	30	128	5	112	26	8	15
Number of Lanes	0	1	1	1	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	2	2
HCM Control Delay	20.6	22.4	15.3	11.5
HCM LOS	C	C	C	B

Lane	NBLn1	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	52%	5%	0%	100%	0%	53%
Vol Thru, %	2%	95%	0%	0%	93%	16%
Vol Right, %	46%	0%	100%	0%	7%	31%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	245	400	198	208	423	49
LT Vol	128	21	0	208	0	26
Through Vol	5	379	0	0	393	8
RT Vol	112	0	198	0	30	15
Lane Flow Rate	245	400	198	208	423	49
Geometry Grp	2	7	7	7	7	2
Degree of Util (X)	0.454	0.728	0.32	0.402	0.752	0.104
Departure Headway (Hd)	6.664	6.556	5.816	6.959	6.399	7.641
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	537	548	612	514	563	472
Service Time	4.757	4.354	3.613	4.755	4.194	5.641
HCM Lane V/C Ratio	0.456	0.73	0.324	0.405	0.751	0.104
HCM Control Delay	15.3	25.1	11.4	14.4	26.3	11.5
HCM Lane LOS	C	D	B	B	D	B
HCM 95th-tile Q	2.3	6	1.4	1.9	6.6	0.3