January 26th, 2015

AECOM
4th Floor, 30 Leek Crescent
Richmond Hill, ON L4B 4N4

Re: TTC McNicoll Bus Garage – DRAFT REPORT
Redlea / McNicoll Roadway Assessment
Novus File No. 13-0054

AECOM retained Novus Environmental Inc. (Novus) as part of an environmental assessment for the proposed TTC McNicoll Bus Garage to be located at the corner of McNicoll Avenue and a future extension of Redlea Avenue. This assessment evaluates the increased bus traffic and employee vehicle traffic on the roadways surrounding the facility. A detailed air quality assessment of all on-site emission sources was previously conducted ("TTC McNicoll Bus Garage TPAP – Air Quality Assessment", dated December 3, 2014). The results of this assessment take into account the combined effect of background concentrations, facility on-site emissions and offsite vehicle emissions from buses and employee vehicles.

1.0 Introduction

The project includes the construction of a new bus storage and maintenance facility for the Toronto Transit Commission (TTC). The proposed facility is located on McNicoll Avenue, just east of Kennedy Road in the City of Toronto. The new facility will be used to house buses when they are not in use, and for general maintenance and repair on the buses. **Figure 1** shows the facility's location as well as the proposed extension of Redlea Avenue and the Employee Parking Lot at the facility.

This assessment specifically considers the impact of the additional bus traffic on Redlea Avenue as well as the additional employee vehicle traffic. Contaminant concentrations have been predicted at sensitive receptors surrounding the facility consistent with the previous air quality assessment. Five years of meteorological conditions and ambient contaminant concentrations have been considered in this assessment.

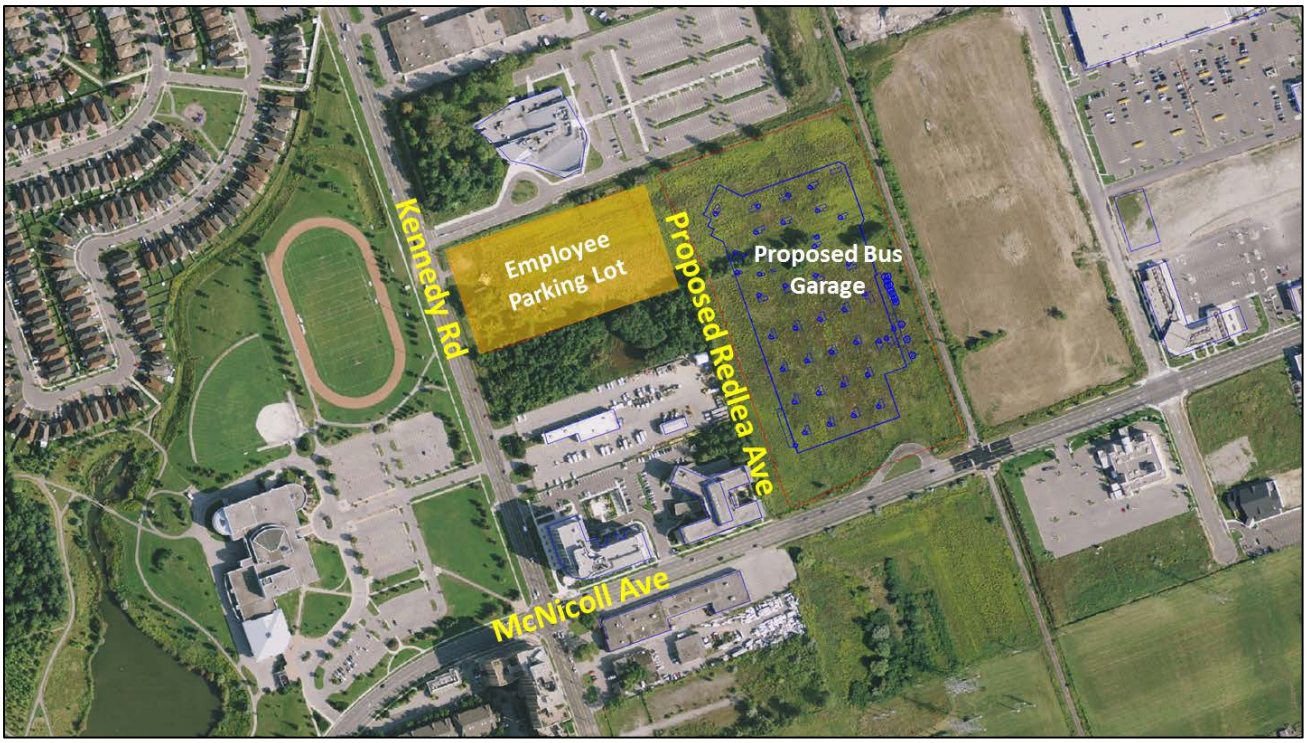


Figure 1: Project Site and Study Area

2.0 Assessment Approach

The roadway assessment has been conducted following typical methodologies for roadway projects in Ontario. The methodology followed is summarized below:

- Roadway alignment, volume, and signal parameters were identified for the project modelling year (2011).
- Motor vehicle emission rates were developed using the US EPA's MOVES software, which is based on "an analysis of millions of emission test results and considerable advances in the Agency's understanding of vehicle emissions and… accounts for changes in emissions due to proposed standards and regulations".
- Nearby receptors were identified, including any:
  - Residence;
  - Place of worship;
  - School or Daycare; and
  - Health Care Facility.
- The roadway traffic due to the project (i.e. buses and employee vehicles) was modelled using the US EPA's CAL3QHCR model which predicts contaminant air dispersion from a roadway. The model was run using 5-year of local meteorology (2006-2010) to ensure various meteorological conditions are considered.
- Worst-case predicted concentrations of the Contaminants of Concern (CAC's) at the nearest sensitive receptor were added to the worst-case predicted values from the

facility assessment (completed by Novus dated December 3, 2014) as well as the worst-case background contaminant concentrations.

- The worst-case predicted concentrations of each contaminant were compared against the relevant provincial standards to determine compliance.

It should be noted that this approach is extremely conservative as it combines the worst-case concentration from three different independent sources (i.e. the facility, the roadway, and ambient contaminant concentrations) over a 5-year period. It is very unlikely that these three maximum values would occur simultaneously.

3.0 Local Meteorology

Local meteorological conditions are used in the CAL3QHCR model to predict the dispersion of contaminants from the roadway. Surface measurements were taken from Pearson International Airport while upper air data was taken from the closest measurement site, the Buffalo International Airport. **Figure 2** presents a wind rose illustrating the meteorological conditions modelled for the 5-year period.

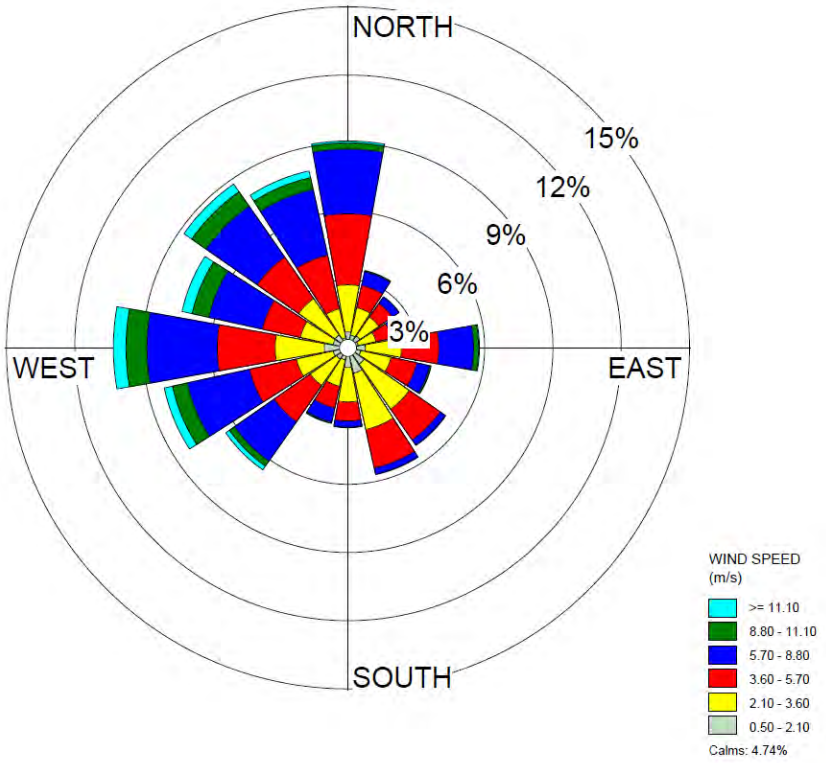


Figure 2: Wind Frequency Diagram for Pearson International Airport

4.0 Ambient Pollutant Concentrations

The predicted contaminant concentrations from the project were added to ambient concentrations in order to evaluate a 'worst-case' scenario. The CAC's which were evaluated are shown in **Table 1** along with their respective standards.

Table 1: Applicable Contaminant Guidelines

Pollutant	Averaging Period	Guideline (µg/m^3)	Source
NO_2	1 hr	400	AAQC
	24 hr	200	AAQC
CO	1 hr	36,200	AAQC
	8 hr	15,700	AAQC
$PM_{2.5}$	24 hr	27*	AAQC (CWS)
PM_{10}	24 hr	50	Interim AAQC
Acetaldehyde	24 hr	500	AAQC
Acrolein	1 hr	4.5	Environmental Registry
	24 hr	0.4	
Benzene	24 hr	2.3	Environmental Registry
1,3-Butadiene	24 hr	10	Environmental Registry
Formaldehyde	24 hr	65	AAQC

* The CWS is based on the annual 98th percentile concentration, averaged over three consecutive years. The standard becomes 27 in year 2020.

Each of the CAC's concentrations from the nearest four MOECC and six NAPS monitoring stations were compared to determine the worst-case ambient background concentrations. Determination of the worst-case monitoring station for each contaminant and averaging period was performed in the detailed Air Quality Assessment. Worst-case background concentrations used in this assessment are consistent with those considered in the Air Quality Assessment. **Figure 3** shows the ambient concentrations of each contaminant from the worst-case monitoring stations as a percentage of the respective guideline.

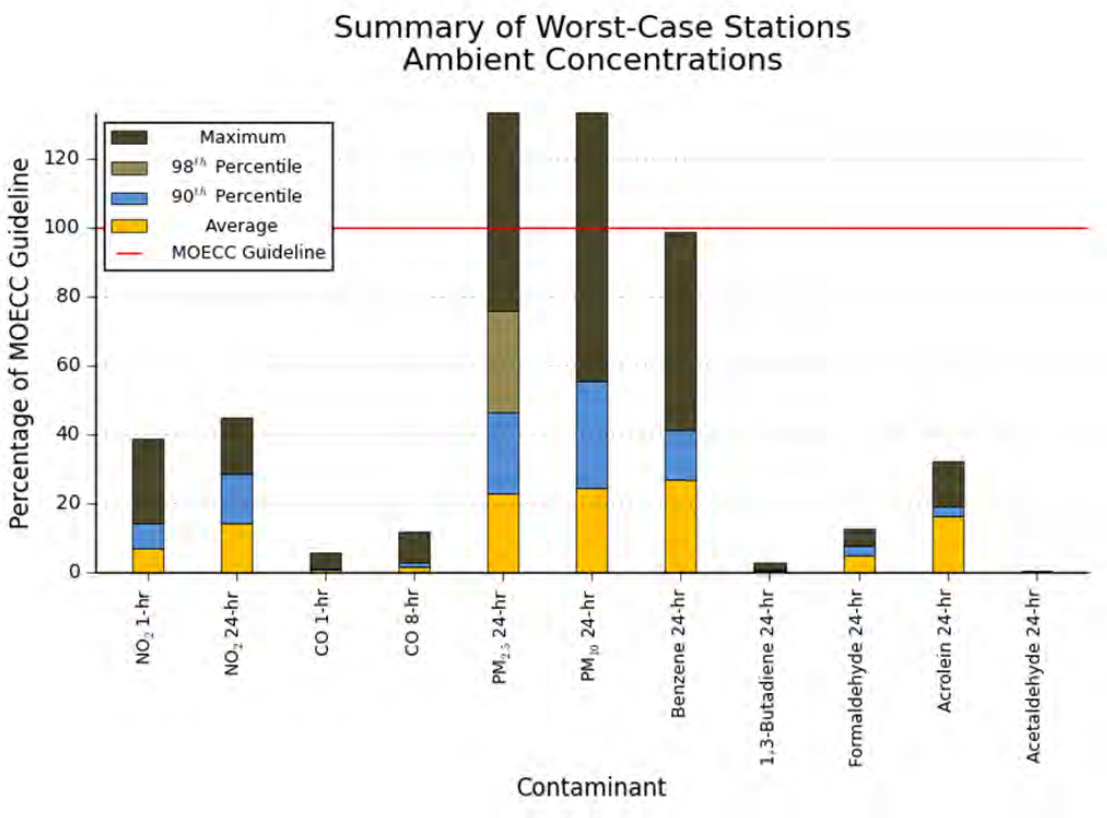


Figure 3: Summary of Background Conditions

For the contaminants which exceed their respective guidelines (i.e. $PM_{2.5}$ and PM_{10}), the frequency of exceedance was considered. Both $PM_{2.5}$ and PM_{10} exceeded their respective standards 12 times over the 5-year period. It should be noted that PM_{10} is not measured in Ontario and is calculated form measured $PM_{2.5}$ concentrations. Additionally it should be noted that $PM_{2.5}$ is regulated based on the 3-year 98th percentile value, which was not exceeded.

5.0 Previous Assessment

The operations within the bus garage facility and the on-site bus movements have previously been assessed by Novus. This assessment considered emissions from bus movements on-site, buses idling on site prior to going into operation and during maintenance activities, comfort heating equipment, the paint booth and shop areas, liquid storage tanks and the employee parking lot. **Table 2** shows the predicted concentration of the CAC's, the combined contaminant concentrations and the predicted additional exceedances of the guideline due to emissions from the facility.

Table 2: Worst-Case Predicted Concentrations as a Percentage of the Guideline

Contaminant	Averaging Period	Maximum Concentration Due to Facility Alone (µg/m³)	Maximum Concentration Due to Facility Alone (as % of Standard)	Combined Concentration as % of Standard (Ambient + Project)			Additional # of Guideline Exceedances due to Project Over 5 Years
				Maximum	90th Percentile	Average	
NO_2	1-hour	158	40%	79%	53%	47%	
	24-hour	32	16%	61%	40%	30%	
CO	1-hour	79	0.2%	6%	1%	1%	
	8-hour	22	0.1%	12%	3%	2%	
$PM_{2.5}$[1]	24-hour	1.6	6%	139%	53%	30%	3
PM_{10}	24-hour	2	4%	137%	51%	29%	1
Acetaldehyde	24-hour	0.11	0.02%	1%	<1%	<1%	
Acrolein	24-hour	0.02	5%	38%	25%	20%	
Benzene	24-hour	0.19	8%	107%	50%	35%	6
1,3-Butadiene	24-hour	0.01	0.1%	3%	1%	1%	
Formaldehyde	24-hour	0.25	0.4%	13%	8%	5%	

1 – CWS guideline for $PM_{2.5}$ is based on an average annual 98th percentile concentration, averaged over 3 consecutive years. The maximum combined 3-year rolling average of the annual 98th percentile concentration was 22.14, which is 82% of the guideline.

6.0 Assessment Methodology

This assessment followed the methodologies established in the air quality assessment for the garage. Emission rates, bus and car volumes and receptor locations were all consistent with the previous report with the exception of vehicle emission rates at 60 km/hr which were modelled for this assessment (in comparison to lower speeds modelled on-site). Traffic signal parameters at the proposed Redlea Avenue and McNicoll Avenue intersection were assumed based on the traffic signal parameters at the existing intersections to the east and west of the proposed intersection (Kennedy Road and Silver Star Boulevard).

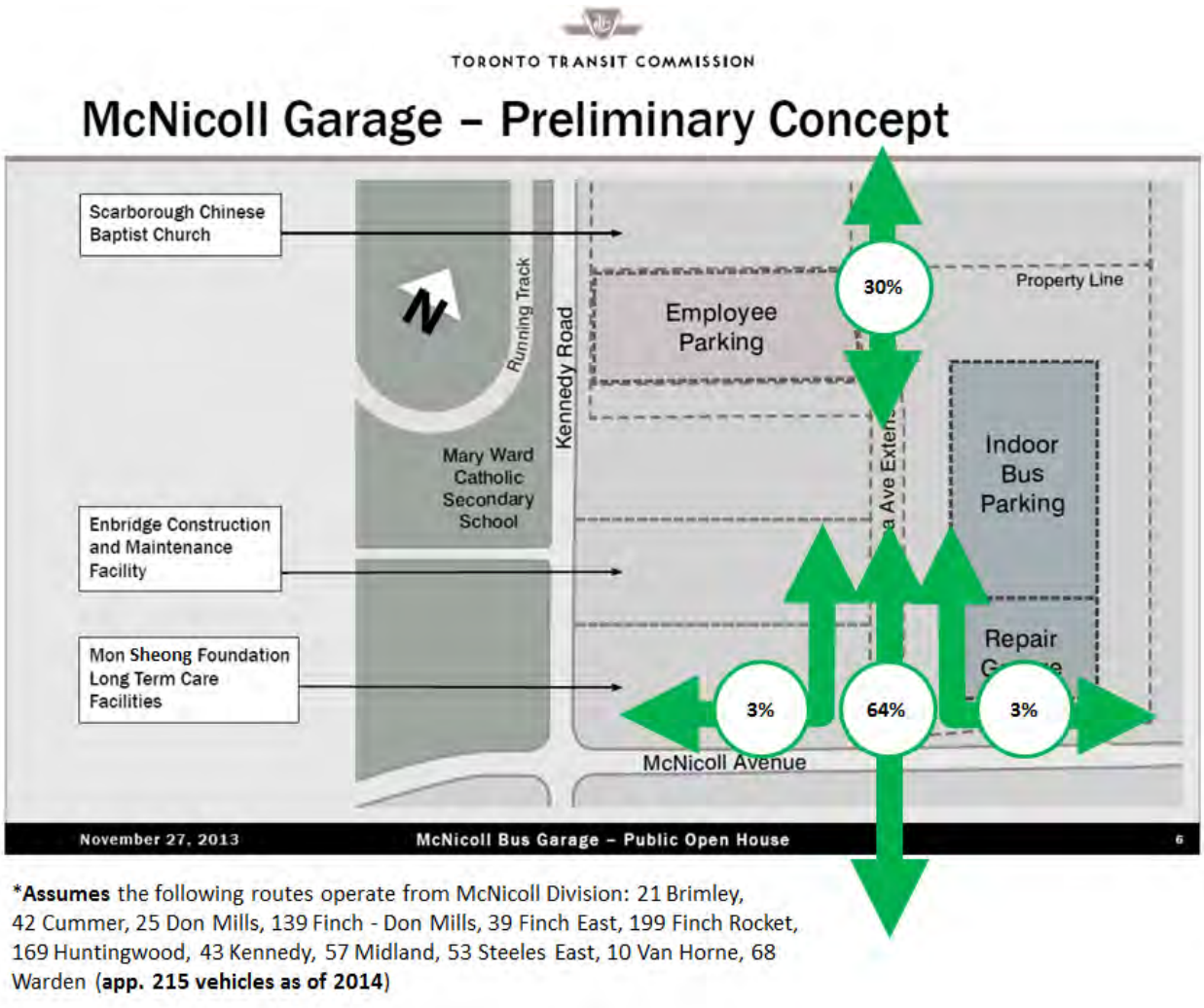
6.1 Traffic Volumes

Hourly bus counts entering and leaving the existing Mount Dennis facility (which is similar to the proposed facility) were provided by AECOM, as well as a maximum vehicle count of 220 buses at the proposed McNicoll Bus Garage. The hourly vehicle distribution at the Mount Dennis facility was applied to the maximum number of buses proposed at the McNicoll Bus Garage to determine the number of buses that would be leaving / entering the facility during any given hour for this assessment. The same hourly vehicle distribution was assumed for every day of the week. The projected bus movements in and out of the facility were used to determine traffic volumes north and south on Redlea Avenue for each hour. **Table 3** gives the estimated daily bus and car volumes as a result of the facility, and **Figure 4** shows the bus movements from the facility. It was assumed that 50% of employee vehicles would arrive / leave north on Redlea Avenue, and 50% would arrive / leave south.

Note that traffic was not modelled on McNicoll Avenue because only the buses operating on the existing bus route along McNicoll Avenue will take this route from the facility. Therefore, there is no additional bus traffic on McNicoll Avenue due to the facility. Buses and vehicles were, however, modelled idling at the new traffic light to be installed at the intersection of McNicoll Avenue and the proposed Redlea Avenue in all four directions.

Table 3: Predicted Vehicle Volumes at the Facility

Segment	Daily Bus Volume	Daily Car Volume
Redlea Ave North of the Facility	192	262
Redlea Ave South of the Faciltiy	428	594



***Assumes** the following routes operate from McNicoll Division: 21 Brimley, 42 Cummer, 25 Don Mills, 139 Finch - Don Mills, 39 Finch East, 199 Finch Rocket, 169 Huntingwood, 43 Kennedy, 57 Midland, 53 Steeles East, 10 Van Horne, 68 Warden (**app. 215 vehicles as of 2014**)

Figure 4: Project Bus Movements in and out of the Facility

6.2 Emission Rates

Modelled emissions rates were determined from the US EPA's MOVES model. **Table 4** presents the predicted emission rates from the contaminants of concern. In addition to the emission rates presented below, re-suspended silt loading was also considered as a source of particulate matter emissions.

Table 4: Predicted Vehicle Emission Rates (g/s)

	Carbon Monoxide	Oxides of Nitrogen	Benzene	1,3-Butadiene	Formaldehyde	Acetaldehyde	Acrolein	Nitrogen Dioxide	PM10	PM2.5
Bus - idle	3.5E+01	1.6E+02	1.2E-03	4.5E-04	1.2E-02	5.6E-03	1.0E-04	1.2E+01	7.8E+00	7.1E+00
Bus - 60 km/hr	3.1E+00	9.0E+00	4.6E-05	1.7E-05	4.7E-04	2.1E-04	3.9E-06	7.1E-01	6.6E-01	5.1E-01
Car - idle	3.6E+01	5.2E+00	1.5E-03	1.6E-04	5.0E-04	1.9E-04	2.7E-06	5.5E-01	1.8E-01	1.6E-01
Car - 60 km/hr	4.4E+00	6.1E-01	7.7E-05	6.8E-06	2.5E-05	9.3E-06	1.3E-07	7.3E-02	6.8E-02	2.4E-02

7.0 Results

Table 5 presents the worst-case concentrations from the roadway as well as from background and from the facility assessment. It can be seen that the contribution of the roadway is marginal, with the highest concentration as a percent of the standard being $PM_{2.5}$ at 5.2%. There are a predicted two additional exceedances of both the PM_{10} and $PM_{2.5}$ standards as a result of the roadway traffic over the 5-year period and no additional exceedances of benzene. This equates to less than 1% of the time.

Table 5: Worst-Case Predicted Concentrations as a Percentage of the Guideline including the Roadway Assessment

Contaminant	Averaging Period	Maximum Concentration Due to Roadway Alone (µg/m³)	Maximum Concentration Due to Roadway Alone (as % of Standard)	Combined Concentration as % of Standard (Ambient + Facility + Roadway)			Additional # of Guideline Exceedances due to Project Over 5 Years (Exceedances due to Roadway)
				Maximum	90th Percentile	Average	
NO_2	1-hour	18.5	4.6%	84%	58%	52%	
	24-hour	2.3	0.4%	61%	40%	30%	
CO	1-hour	72	0.2%	6%	1%	1%	
	8-hour	30	0.2%	12%	3%	2%	
$PM_{2.5}$[1]	24-hour	1.4	5.2%	144%	58%	35%	5 (2)
PM_{10}	24-hour	1.7	3.4%	140%	54%	32%	3 (2)
Acetaldehyde	24-hour	0.10	0.02%	1%	<1%	<1%	
Acrolein	24-hour	0.02	4.7%	43%	30%	25%	
Benzene	24-hour	0.05	2.1%	109%	52%	37%	6 (0)
1,3-Butadiene	24-hour	0.01	0.1%	3%	1%	1%	
Formaldehyde	24-hour	0.23	0.4%	13%	8%	5%	

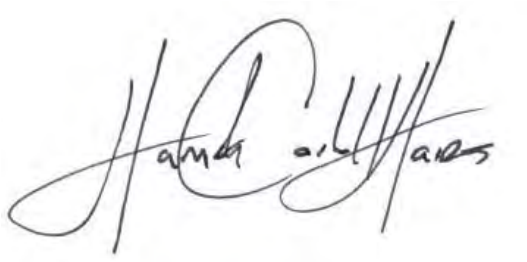
1 – CWS guideline for $PM_{2.5}$ is based on an average annual 98th percentile concentration, averaged over 3 consecutive years. The maximum combined 3-year rolling average of the annual 98th percentile concentration was 22.14, which is 82% of the guideline.

It should be reiterated that despite the minimal impact of the roadway, these predicted concentrations are likely over-conservative. The chances that the maximum impacts from ambient, the garage, and the roadway would occur simultaneously is very small.

8.0 Conclusions

This assessment shows that the impact of the additional bus and vehicle traffic on Redlea Avenue and McNicoll Avenue is very low. Given the conservative nature of the modelling and the predicted low number of exceedances of the guidelines, mitigation measures are not warranted.

Sincerely,
Novus Environmental Inc.



Hamish Corbett-Hains, M.A.Sc., P.Eng.
Air Quality Engineer

Scott Shayko, Hon.B.Comm, B.Sc.
Principal