Detroit River International Crossing Study

Air Quality Impact Assessment Supplementary Documentation

Prepared for:

MTO

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1 INTRODUCTION

This report was prepared to address the comments of the Ontario Ministry of Environment (MOE) on the air quality assessment performed in support of the Detroit River International Crossing (DRIC) Environmental Assessment (EA) study (MOE Memorandum dated 19 February 2009). As the EA was undertaken over several years, it was considered important to provide an overview of how the air quality assessment developed over time. Also, given the broad interest in the findings of the air quality study, it is also considered important to provide additional context to the information presented in the Practical Alternatives Evaluation Working Paper: Air Quality Impact Assessment (May 2008) and the Air Quality Assessment: Technically and Environmentally Preferred Alternative, December 2008 (TEPA report). Overall, the current document may be viewed as a "bridging" document, intended to respond to the MOE's questions and provide additional context to these two reports.

Several clarifications were requested by the MOE in their February 19, 2009 memorandum and are discussed in this "bridging" document, including

- The differences between the two reports;
- Additional sample calculations of inputs;
- The conservative nature of the 90^{th} percentile background;
- The positive impacts of the TEPA;
- The air quality within the green spaces and trail systems along the corridor;
- Illustrative examples of data presentation.

For ease of reference to the MOE's comments, a summary disposition table is presented below (Table 1.1).

Table 1.1 MOE Comment Disposition Table

General Topic	MOE Comment	Comment
Graphical illustrations	Maps showing the modelled area and selected locations. Provide discussion on choice of locations	Figures 3.2 and 3.3 and Table 3.3 of the TEPA report show receptor locations and Tables in Appendix D of TEPA report should be examined in conjunction with these figures and Tables.
	Maps indicating concentrations at regularly spaced points.	Provided under separate cover
Green Space	Include modelling results for publicly accessible areas on the right of way.	Section 4.5.2 of the TEPA report included a limited discussion of impacts at tunnel portals. Section 5 this document expands the discussion.
Model Use	Provide discussion on results farther from the road, inputs should be included	Section 3.2 of this document discusses model performance at further distances
	More information should be provided on model inputs	Chapter 3 of the TEPA report provided discussion on the model inputs and Appendix C of the TEPA report provided sample calculations. Section 4 of this document provides detailed discussion of the appropriate use of background and the conservatism of silt loading in the TEPA assessment, Appendix A discusses silt loading in the Practical Alternatives report and Appendix B provides additional sample calculations
	Assessment of sensitivity for a five year model run	Table 3.2 of the TEPA report illustrated differences in Concentrations for NO_x and PM and Appendix F compared results of the meteorology at the illustrative sensitive receptors for all horizon years and for PM_{10} and PM. Section 3.1.2 of this document repeats some of the information provided in the TEPA report.

General Topic	MOE Comment	Comment
Exceedances	Include discussion on how frequently the particulate concentrations reaches the 30ug/m^3 level. It is not clear where this level occurs as it does not appear on the list of sensitive receptors.	Table 4.2 of the TEPA report shows that there are no exceedances of the Canada Wide Standard for $PM_{2.5}$ beyond the ROW. $PM_{2.5}$ exceedances within the ROW are discussed in Section 5 of this document.
	Locations of exceedances (for NO_x) should be indicated on a map and would it be possible to alter protocols at the plaza to reduce or eliminate these peaks in conditions where they are likely to occur?	See Section 7.2 of this document
	Because the use of the 90th percentile background is conservative 90% of the time, suggest that model results be separated from background to be evaluated on their own merits.	A detailed discussion on the impact of background is presented in Section 4 of this document.
Other variables	Provide discussion on how sanding and salting may effect downwind concentrations and note if model has included this effect.	Included in discussion of silt loading for controlled and uncontrolled roads in Section 2.2 of this document
Positive Impacts of the TEPA	Concern is that modelled substances do not appear to change significantly over time. Provide more discussion on sensitive receptors and be clear in the report if there will be offsetting decreases elsewhere because the movement of some traffic to the new route.	See Section 7 of this report for discussion on impacts beyond ACA
	Model concentrations along the existing truck route and effects should be contrasted with the status quo situation for target years.	See Section 7 of this report for discussion on impacts beyond ACA
Traffic Impacts	Provide rational for “Page 36 of AQ report” that suggests in the event that there is no additional border crossing traffic on the 401 through Windsor will not increase in the period 2015 to 2025.	See Section 3.1.3 of this document
	Discuss sensitivity of the model to (significantly) increased wait times at the border.	See Section 3.1.3 of this document

2 PREVIOUSLY PUBLISHED REPORTS

It is first helpful to briefly review the differences between the two different air quality reports that have been published and reviewed. In brief, and as further described below, the two reports differ primarily in their purpose.

The Practical Alternatives report was meant to assess the relative differences among alternatives including a future No Build Scenario. The comparative assessment was to provide information on selecting the preferred alternative using two health based indicator substances. Thus, the indicator of concern was the relative difference among the Practical Alternatives and No Build Scenario.

The TEPA report examined predicted impacts on air quality for both the preferred alternative and the future No Build Scenario. This data was also used to support the Health Risk Assessment. The results reported in the TEPA report indicate both the relative difference between the two options (No Build or TEPA) and the actual estimates of future air quality.

The air quality reports followed the structure identified in the DRIC Air Quality Workplan, (February 2006) which was circulated to regulatory agencies for review and comment prior to publication in 2006.

2.1 PRACTICAL ALTERNATIVES REPORT

The **Practical Alternatives report** assessed the relative differences among six practical alternatives and a future "No Build" alternative. Consistent with the Air Quality Workplan, this comparative assessment examined two health-based indicator substances, nitrogen oxides (NO_x) and fine particulate matter ($PM_{2.5}$). The information gained through this assessment contributed to the (relative) evaluation of alternatives, leading to the selection of the Technically and Environmentally Preferred Alternative (TEPA).

Summaries of the findings for five initial practical alternatives were presented at the Public Information Open House (PIOH) 5 in August 2007. The report documenting the analysis of the initial five practical alternatives was available on the Partnership website as of August 14, 2007. The City of Windsor did not provide any comments on this report.

Through the analysis of the practical alternatives, and in conjunction with ongoing consultation efforts, a sixth alternative was developed that combined beneficial features of the initial alternatives. This alternative was identified as the "Parkway" in August 2007 and the air quality analysis of practical alternatives was updated to include it. A summary of the updated analysis was presented on May 1, 2008. The Practical Alternatives report was updated to include the Parkway and was subsequently made available on the website on June 6, 2008.

Chapter 4 of the Practical Alternatives report focused on a comparative analysis of the maximum impacts of the alternatives as they compared to the future “No Build” scenario. For the purpose of this comparative analysis, the corridor was divided into a series of “road segments.” Thus, the maximum impacts of each alternative were compared to the future “No Build” scenario on a road segment by road segment basis. The purpose of the document was to perform a comparative analysis among the alternatives to assist in the selection of an environmentally preferred alternative. Consistent with the Workplan, data were presented for each road segment comparing relative NO_x and $PM_{2.5}$ maximum concentrations and exceedances for all alternatives at 50 m, 100 m, and 250 m from the Right of Way (ROW). These distances were chosen as indicators since multiple traffic studies (including the MOE’s own studies) indicate that impacts are typically limited to the first few hundred metres. Therefore, distances of up to 250 m were considered within the zone of influence of the traffic corridor.

For each alternative including “No Build”, the Practical Alternatives report assessed the maximum predicted concentration and the greatest number of days predicted to exceed the guidelines (i.e., exceedances) on a relative basis along road segments within the transportation corridor. All receptors along the road segment were considered, but only the highest value of the maximum concentrations of those receptors within a particular road segment was reported for each alternative. Therefore, all other receptors within that road segment would have lower predicted maximum concentrations.

Due to differences in road alignment and traffic volumes, these maximum predicted concentration points may not occur at the same location for the practical alternatives and the “No Build” alternative. A highest maximum location for the “No Build” alternative may not have been the highest maximum location for the other alternatives if, for example, traffic was moved away from or closer to the “No Build” point.

As the Practical Alternatives report compared the highest maximum predicted concentrations relative to one another, these comparisons are neither indicative of actual expected concentrations along the entire road segment, nor of the predicted changes within the road segment for most receptors. This is particularly important to note given that the maximum concentrations predicted at each of the receptors occur only once per year and not necessarily on the same day as the receptors have to be downwind of the source to be impacted by it and not all receptors can be downwind simultaneously.

The Practical Alternatives report was clearly stated to be a comparative analysis of the various alternatives. Moreover, the analysis was based on maximum concentrations predicted to occur only once per year. As indicated, the analysis showed no clear preference amongst the alternatives, as all alternatives would provide similar contaminant loading. The conclusion of the report was that the mass of contaminants released into the air was the same for any alternative but was nonetheless, less than that of the "No Build" scenario due to reduced idling and traffic congestion.

The ranking in Table 5.1 of the Practical Alternatives report used a (qualitative relative) ranking system where a score of "1" represented a "High Impact", a score of "2" represented "Medium Impact", a score of "3" represented a "Low Impact", and a score of "4" represented a "Neutral/No Impact", with higher scores representing benefits. All alternatives were below criteria for the annual concentrations of $PM_{2.5}$ and the applicable NO_x criteria. However, all alternatives had locations where the Canada Wide Standard (CWS) for $PM_{2.5}$ (24 hour averaging time) was exceeded according to the (conservatively) modelled conditions. The differences for each alternative were in the locations of the exceedances.

Because exceedances were predicted using the conservative modelling conditions for all alternatives, including the Tunnel, none of the alternatives were deemed to have "No Impact". In this respect, it is important to understand that tunnels do not clean the air rather they move the impact from one location to another.

It then became a choice of whether the alternatives should be considered to have a "Medium" or "Low" impact. With no exceedances of the annual $PM_{2.5}$ criteria, a notable improvement of the NO_x concentrations, and with limited exceedances of the $PM_{2.5}$ 24-hr criteria under the conservative modelling conditions within the first 50 m of the ROW for all alternatives, the impacts were deemed to be "Low Impact" for all alternatives.

A review by the City of Windsor's air consultant, AMEC, indicated that the Practical Alternatives report did not sufficiently consider the benefits of the Tunnel and that the conclusions should have come out strongly in favour of the Tunnel. SENES disagrees with the AMEC conclusions and continues to support the SENES conclusions with the following discussion.

2.1.1 An Analysis of the Tables Presented in the Practical Alternatives Report

Another way of looking at the conclusions in the Practical Alternatives report is to examine the tables in Chapter 4 to determine whether there are significant differences among any of the alternatives. To simplify the issue, the focus of the following discussion is on the comparison of the Parkway to the Full Length Tunnel. In the Practical Alternatives report differences of less than 10% were considered negligible and differences between 10%-20% were considered marginal, while differences of more than 20% were considered notable when comparing the alternatives. For exceedances, a difference of more than 8 days was considered appreciable. For the analysis presented here, any difference greater than 10% or differences of 8 days or more were considered to be sufficient to indicate that one alternative is preferred to another.

Each table within Chapter 4 was compared to determine the differences among the alternatives. A sample analysis of one of these tables for two different road segments is presented in Table 2.1. For each road segment, $PM_{2.5}$ emissions were compared to the No Build scenario and are presented as a percent of the No Build emissions. As seen in the table below, the Parkway is the preferred option for the 2035 year for the Malden to Labelle Road Segment for distances of up to 100 m for Plaza B for $PM_{2.5}$ hourly, annual, and exceedance criteria. At 250 m there is no clear preference for any of the criteria. The Tunnel is preferred in Labelle to Pulford Road Segment for the 24 hr criteria at 50 and 100 m and for exceedances at 50 m with no clear distinction beyond those distances for both Plaza alignments.

Each of the comparisons below is considered a "point of distinction". Therefore, for the Malden to Labelle Road Segment there are 3 different distances (50 m, 100 m, and 250 m), 2 different alignments (Plaza A and Plaza B), and 3 criteria (24 hr, Annual, and Exceedances), or a total of 18 possible points of distinction. And for the Labelle to Pulford Road Segment there are also 18 Points of distinction. In the sample below, of the 36 points of distinction, there are nine instances or points of distinction where the Parkway would be preferred over the Tunnel, 6 instances where the Tunnel would be preferred over the Parkway, and the balance of the points of distinction show No Difference.

Table 2.1 Sample Table of $PM_{2.5}$ Comparison

Alternative in 2035		Malden Rd to Labelle						Labelle to Pulford					
		Plaza A			Plaza B			G-H - Plaza A			G-H - Plaza B / C		
2035	Distance from Roadway (m)	24 Hour	Annual	Exceed ances	24 Hour	Annual	Exceed ances	24 Hour	Annual	Excee dances	24 Hour	Annual	Excee dances
Tunnel	50	95%	94%	-44	100%	94%	-25	67%	75%	-74	70%	81%	-74
	100	103%	93%	-16	115%	115%	-3	77%	79%	-15	77%	86%	-15
	250	100%	100%	0	107%	117%	2	89%	92%	0	93%	92%	0
Parkway	50	81%	75%	-47	81%	75%	-51	88%	75%	-51	86%	81%	-54
	100	88%	86%	-23	100%	86%	-19	94%	79%	-9	94%	86%	-12
	250	97%	92%	0	100%	92%	0	93%	83%	0	93%	83%	0
Differences	**50**	**P**	**P**	**ND**	**P**	**P**	**P**	**T**	**ND**	**T**	**T**	**ND**	**T**
	100	**P**	**ND**	**ND**	**P**	**P**	**P**	**T**	**ND**	**ND**	**T**	**ND**	**ND**
	250	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**

ND = 10% or less difference between alternative, P = Parkway < Tunnel by more than 10% or more than 8 days, T = Tunnel < Parkway by more than 10% or more than 8 days

The complete analysis of "points of distinction" comparisons from the Practical Alternatives report (see Tables 4.1-4.12 of the Practical Alternatives report) of the differences between the Tunnel and the Parkway for all road segments, road alignments, and for all years is summarized in Table 2.2. From Table 2.2 it is clear that the majority of the comparisons result in no difference between the Tunnel and Parkway with 246 points of distinction of No Difference, 77 points of the Parkway being preferred, and 37 points of the Tunnel being preferred.

Table 2.2 Summary of Analysis of Points of Distinction by Horizon Year

	No Difference		Parkway		Tunnel	
	NO_x	**$PM_{2.5}$**	**NO_x**	**$PM_{2.5}$**	**NO_x**	**$PM_{2.5}$**
2015	23	64	23	4	2	4
2025	32	47	15	13	1	12
2035	36	44	12	10	0	18
Total	91	155	50	27	3	34
	246		77		37	

2.2 TEPA REPORT

The **TEPA report** examined predicted impacts on air quality for both the TEPA and the future "No Build" alternative. This data was also used as input to the Human Health Risk Assessment. The results reported in the TEPA report describe both the relative difference between the TEPA and the future "No Build" alternative and the actual estimates of future air quality with the TEPA in place. As described in the Air Quality Workplan (2006), the TEPA report assesses 14 contaminants.

Pollutant concentrations reported in the TEPA report are maximum predicted concentrations (i.e., the single worst pollutant levels). It is important to note that the maximums are not usual but rather are predicted to occur only once per year. Where no specific air quality modelling receptors are identified, these maximum concentrations represent the maximum concentrations at any of the receptors assessed (i.e., the maximum concentration of 30 $\mu g/m^3$ listed in the TEPA report for $PM_{2.5}$ in Table 4.20 occurs only at **one** of the 2400 receptors assessed) and are not indicative of the "typical" concentrations at each individual receptor, nor are they indicative of the maximum concentrations at all receptors. All other receptors will be exposed to lower concentrations under all meteorological conditions.

The Practical Alternatives report used a very conservative silt loading factor to calculate impacts of $PM_{2.5}$. In fact, during the assessment of the Practical Alternatives it was noticed that the silt loading factor used for $PM_{2.5}$ may have been overly conservative relative to published data in the literature. The effect of this conservatism was most notable within close proximity to the roadway. Predicted concentrations close to the roadway were higher than measured values published in literature for similar traffic volumes. The Practical Alternatives report indicated that refinements of modelling parameters would be undertaken for the analysis of the TEPA, and this was carried out in the TEPA report. For the TEPA report, an effort was made to develop a more realistic, yet still conservative silt loading factors which is consistent with the silt loading levels used in the U.S. EPA AP 42 document for applicable traffic volumes for **uncontrolled roads**. (See Appendix A for more information on the assessment of $PM_{2.5}$.silt loading.)

As stated in the TEPA report, modelled PM_{10} exceedances are also likely over-predicted due to a number of factors. For example, precipitation, which has a mitigating effect (precipitation scavenges particulate from the air), was not considered in the model. Background concentrations that occur only 10% of the time were assumed to have occurred for the entire year. This approach, while established practice likely overly conservative for estimating the frequency of exceedances. For receptors further from the road, consideration of plume depletion would also lead to lower concentrations. These same considerations apply to receptors within the ROW.

The model input parameters for the road dust portion of the particulate emissions include silt loading factors that are dependent on the type of roadway and traffic volume. For high volume roads there is a further distinction on whether the road is fully-controlled with limited access points or whether it is an uncontrolled arterial road. While the Windsor-Essex Parkway is considered to be a fully controlled access freeway, due to the complexities of the model inputs, it was not feasible to distinguish in the model between the freeway and the arterial service road for silt loading. Therefore, the more conservative (i.e., high) silt loading of the arterial road was used for all roads, including the Windsor-Essex Parkway. If the emission factor for fully-controlled roads with limited access points was applied to the freeway segments only, and not to all roads, the impacts from the road dust attributable to these segments could be reduced by up to approximately one half. This overly conservative estimate should compensate for any winter increases of particulate emissions associated with salting and sanding of the road.

The analysis of the practical alternatives showed that there is effectively no difference in air quality between the below-grade alternatives and the end-to-end tunnel alternative beyond about 100 m from the ROW, and only minor differences occur between 50 m and 100 m. In the TEPA report, the results for health based contaminants were either negligible relative to background concentrations or were well below the guidelines even under maximum conditions.

3 MODELLING

3.1 INPUTS AND EMISSIONS CALCULATIONS

Both the Practical Alternatives report and the TEPA report relied on information obtained from computer modeling of future conditions, which in turn depends on a variety of input parameters.

For a comparative analysis, it is important to have most of the input parameters remain constant with variation limited to traffic data and roadway geometry. For each change in roadway geometry or traffic, a roadway link was created for input into the model. The TEPA roadway is characterized by surface roads, below grade roads, intersections, and Highway 401 ramps. As a result, modelling required the use of over 1000 traffic links. The input files generated are over 47,000 lines long. Sample calculations of traffic volumes and excerpts of the input files for PM_{10} for the TEPA 2035 horizon year are presented in Appendix B.

These input parameters were described in detail in Chapter 3 of both the Practical Alternatives and the TEPA report. The parameters which were kept constant for the "No Build" alternative, the TEPA and all other alternatives included: meteorological data, emission factors for tailpipe emissions, U.S. EPA road dust calculation methodology, receptor locations, vehicle weight and length, background ambient concentrations, and horizon years (2015, 2025, and 2035).

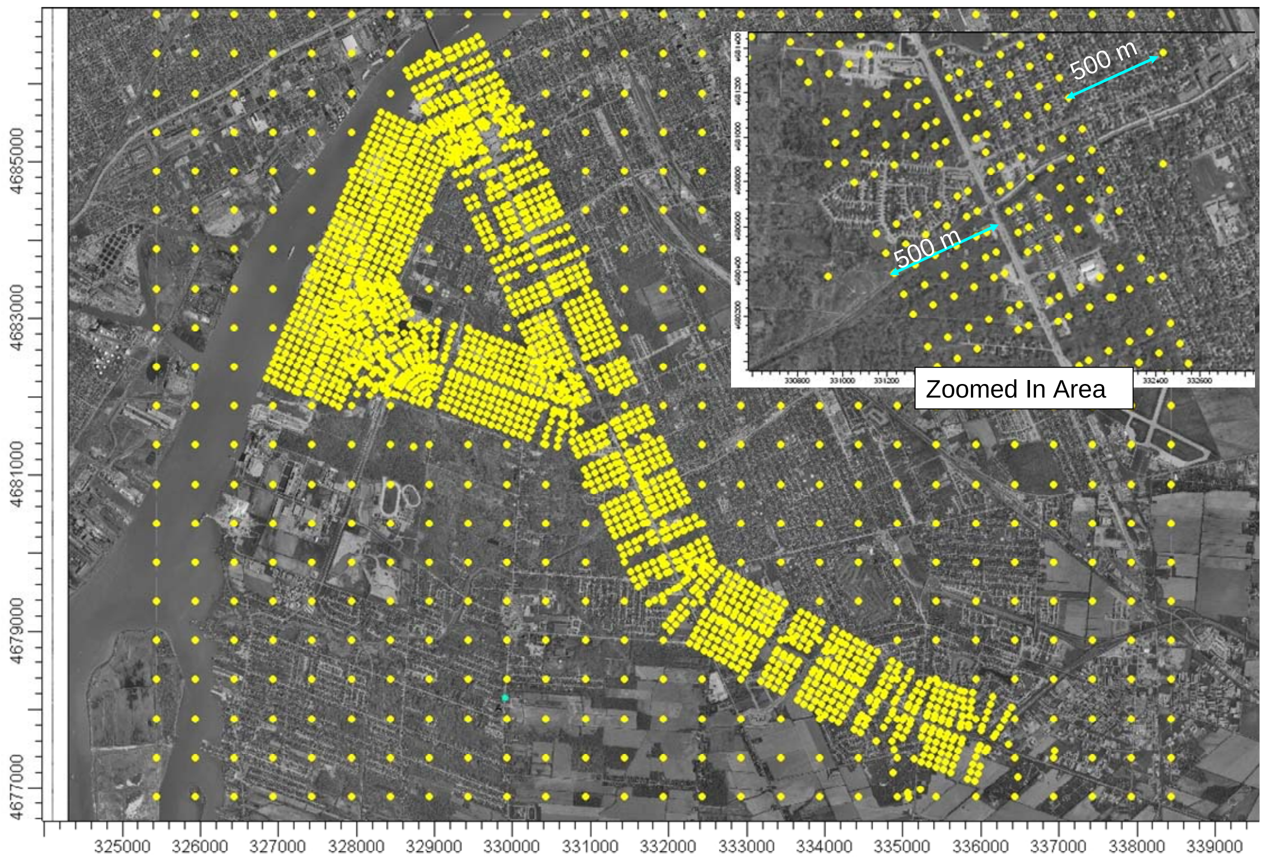
Appendix C of the TEPA report documented how emissions were calculated; however, to better illustrate the calculation methodology, Appendix B of this report contains additional sample calculations for PM_{10} for the 2035 horizon year. PM_{10} was chosen for the sample calculation as it includes elements of both road dust and tail pipe emissions. The calculation methodology for the gaseous contaminants is similar to the sample calculations, except that road dust emissions are not associated with the gaseous contaminants.

3.1.1 Receptors

Over 2400 modelled receptors were examined for impacts. These receptors were spaced to determine both near-distance and farther distance results from the roadways. The first two rows of receptors were placed at 50 m intervals from each side of the existing road, followed by 100 m intervals reaching a distance of 500 m from the road. Another grid with 500 m x 500 m spacing was then overlaid to cover the rest of the modelling domain, which was essentially all of west Windsor, and adjacent portions of LaSalle and Tecumseh.

Figure 3.1 below was presented in the TEPA report as Figure 3.2 and is repeated here to illustrate the receptor grid and modelling domain.

Figure 3.1 Receptor Grid and Modelling Domain



Due to the large number of receptors, contaminants, and horizon years, presenting the data in tabular format or even graphically presented challenges in the TEPA report. To simplify the date presentation in the TEPA report, the study team responded to comments received on the Practical Alternatives report, and highlighted 64 receptors of interest, representing specific neighbourhoods, schools, parks and churches and differing distances from the roadways. These were presented graphically in the TEPA report as Figure 3.3 and qualified in Table 3.3. Appendix D of the TEPA report should be read in conjunction with these figures and tables for better understanding of the potential impacts. These two items, Figure 3.3 and Table 3.3, are repeated in this report as Figure 3.2 and Table 3.1, respectively.

Figure 3.2 Sensitive Receptor Locations

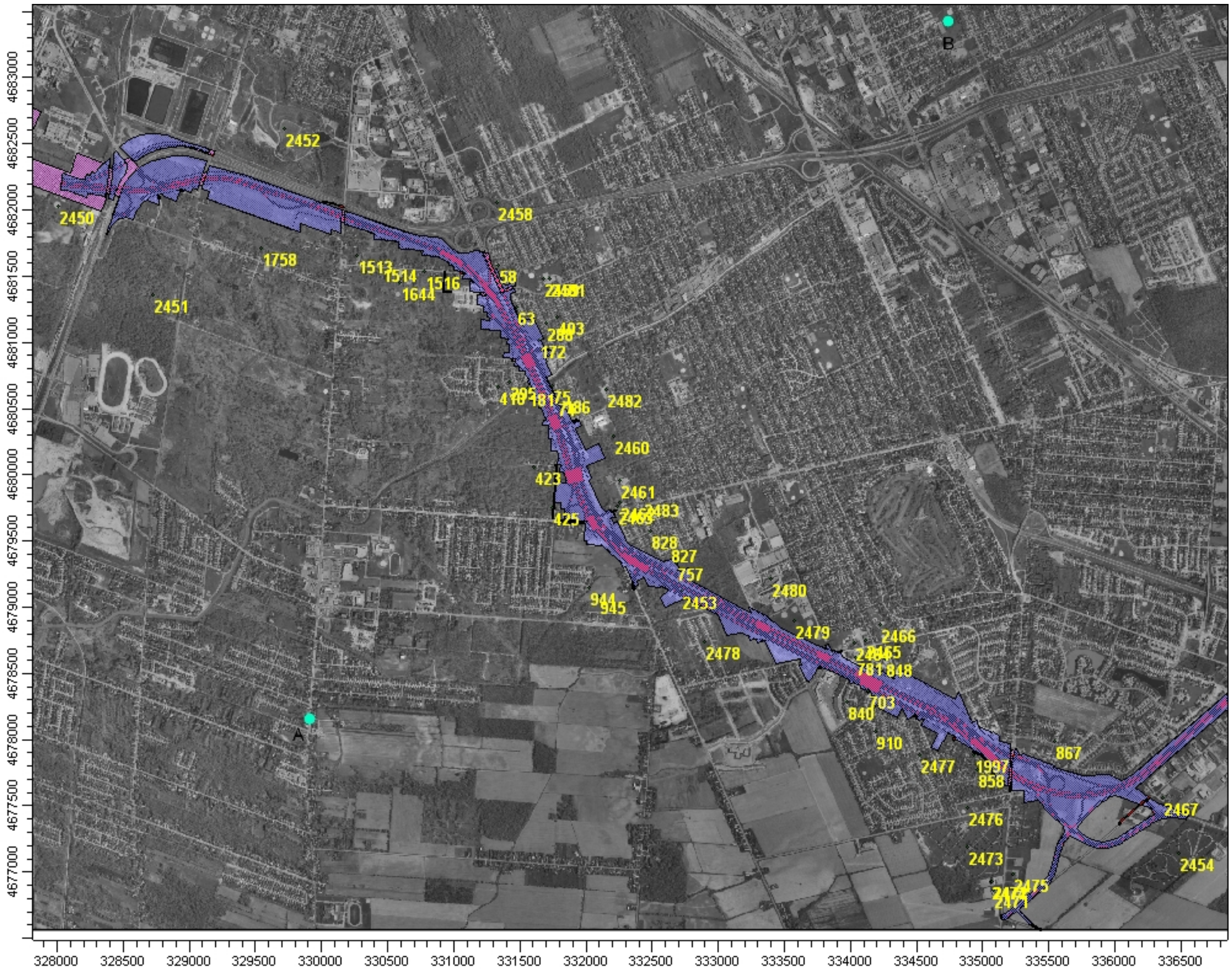


Table 3.1 Sample Sensitive receptors

Receptor Number	Receptor Description	Receptor Type	Distance to Road, m	Distance to 401, m
58	Fleming Crt	Residential	50	160
63	Mangin Cr	Residential	50	100
74	Northway and Norfolk	Northway and Norfolk	25	60
75	Northway and Norfolk	Northway and Norfolk	28	70
172	St. Cecile Academic Music - Grand Marais	School	70	120
181	Lambton - closest to ROW	Residential	100	100
186	Northway and Norfolk	Residential	75	120
288	Bellewood Estates	Residential	200	250
295	Lambton	Residential	175	175
403	Bellewood Estates	Residential	300	350
410	Huron Estates	Residential	270	270
423	Reddock	Residential	230	230
425	10th and Todd	Residential	100	200
703	Hearthwood	Residential	20	60
757	Villa Borghese	Residential	100	130
781	Kendleton Court	Residential	100	100
827	Villa Borghese	Residential	200	250
828	Villa Borghese	Residential	200	250
840	Hearthwood	Residential	170	210
848	Villa Paradiso	Residential	200	200
858	Grosvenor to Croydon	Residential	100	125
867	Alpen Rose	Residential	200	350
910	Heritage Estates	Residential	260	320
944	Royal Oak Senior Home	Senior Citizen Home	330	330
945	Royal Oak Senior Home	Senior Citizen Home	260	330
1513	Spring Garden	Residential	250	250
1514	Spring Garden	Residential	250	250
1516	Spring Garden	Residential	200	200
1644	Association for Persons with Physical Disabilities	Special Needs	300	300
1758	Armanda	Residential	350	40
1997	Chelsea	Residential	25	50
2450	Broadway Park	Parkland	150	150
2451	Ojibway Park	Parkland	800	800
2452	Malden Park (On Edge Within) 10 M	Parkland	400	500
2454	Victoria Memorial Park	Parkland	300	625
2455	Sandwich First Baptist	Church	1800	2100
2456	A-Unknown Church	Church	1625	1900
2457	Museum Land Mark	Museum	1800	2100
2458	Indian Memorial Park	Parkland	500	550
2459	Bellwood Park	Parkland	315	370
2460	Beals Park	Parkland	300	370
2461	Oakwood Public School	School	270	320
2462	Oakwood Bible Chapel	Church	60	225
2463	C-Unknown Church	Church	25	200
2464	Our Lady Of Mount Caramel Separate School	School	200	200
2465	Our Lady Of Mount Caramel Catholic Church	Church	250	250
2466	Veteran Memorial Park	Parkland	400	400
2467	St Charbel Maronite Catholic Church	Church	100	200
2468	1- Unknown - Park & Golf Course	Golf Course	200	650
2469	St Stevens Cemetery	Cemetery	300	1250
2470	St Stevens Church	Church	300	1250
2471	Sikh Cultural Society	Community Grp	200	800
2472	Apostolic Christ Church	Church	300	800
2473	Heavenly Rest Cemetery	Cemetery	500	625
2474	St. Nicholas Macedonian Easter	Church	300	800
2475	D-Unknown Church	Church	550	650
2476	J.Jenner Park	Parkland	325	400
2477	Heritage Park	Parkland	280	310
2478	St Clair Park	Parkland	250	300
2479	St Clair College Athletic Field 4 ball diamond	Athletic Centre	150	150
2480	St Clair College	School	350	350
2481	Bellwood Public School	School	370	415
2482	Ecole Monseigeur Jean-Noel	School	380	425
2483	B-Unknown Church	Church	225	400

3.1.2 Meteorology

The TEPA report used one year of meteorology for the assessment due to the large number of model runs required for the analysis. However, sensitivity tests were included in the TEPA report to determine the variability within the five year meteorological data set. Table 3.2 from the TEPA report illustrates the differences in concentrations for NO_x and PM and is repeated here for ease of reference.

Table 3.2 Maximum Concentrations (μg/m³) and Number of Exceedance days by Meteorological Year

	2000	2001	2002	2003	2004	Max	Difference to 2003
NO_x 1 hr[1]	210	197	188	218	218	218	0
NO_x 24 hr	104	97	99	103	102	104	1
PM 24 hr[2]	305	289	279	325	300	325	0
PM Exceedances	260	261	241	250	248	261	11

1 – NO_x modeled using 2015 TEPA data
2 – PM modeled using 2035 TEPA data

In addition to the previous Table, Appendix F of the TEPA report modelled all five years at the illustrative receptors used in the TEPA report for all horizon years for PM and PM_{10}.

3.1.3 Traffic

The traffic analysis completed by IBI and URS (and provided to SENES for incorporation into the modelling) for based on a free-flow condition from the access road into the plaza, with no queues extending out of the plaza to the access road. The Canadian international customs plaza has been designed to accommodate projected border traffic to beyond the 2035 horizon year, and is much larger than the existing plazas at either the Ambassador Bridge or the Detroit-Windsor Tunnel. The design of the plaza has been completed through consultation with the Canada Border Services Agency (CBSA), with consideration of anticipated processing times, border processing improvements such as the NEXUS and FAST systems, anticipated staffing levels of the plaza, and the need for both primary and secondary inspection areas. An operations analysis of the plaza was completed by the CBSA using the CAN-SIM software program, revealing acceptable plaza operations. Both the Canadian and U.S. governments are committed to building the new plazas and border crossing to meet future travel demands along with providing the necessary staffing to meet processing demands. While it is recognized that rare delays at the plaza could occur as a result of events such as 9/11, the chance of and effects of any such incidents are beyond the scope of this assessment.

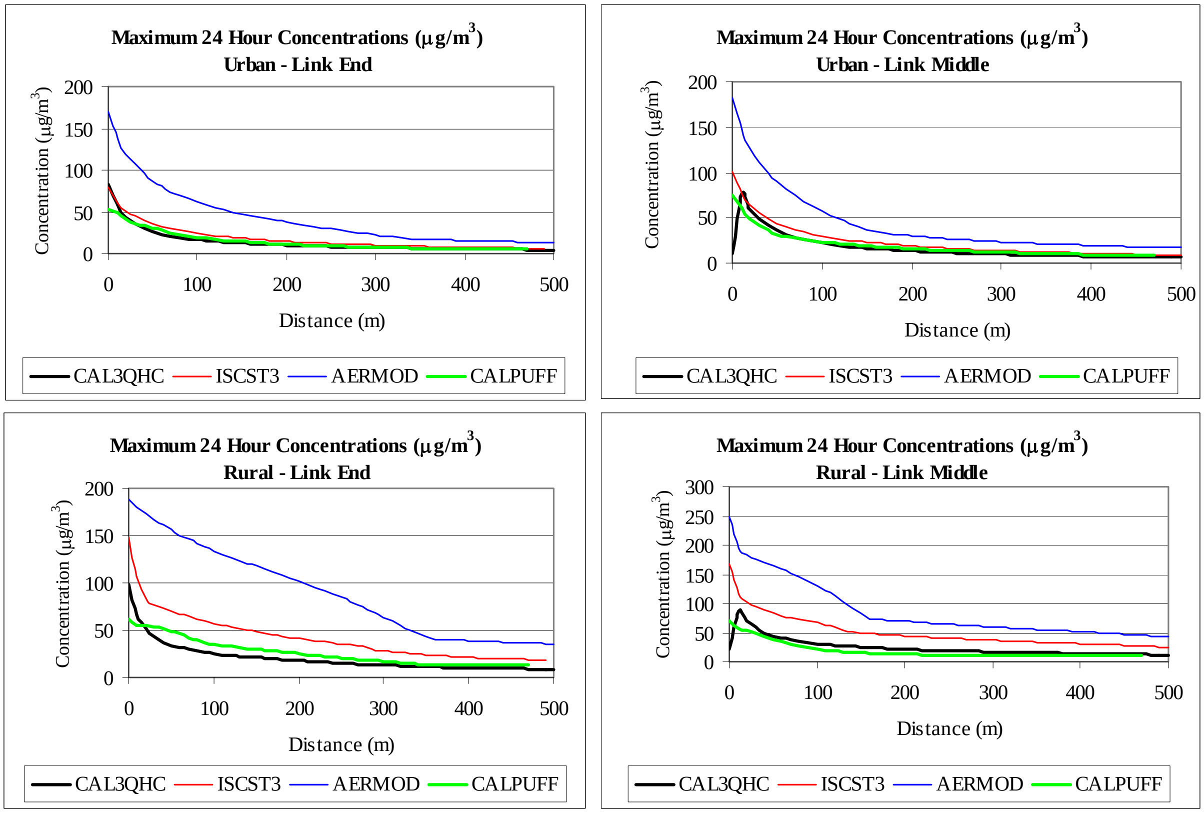
Table 3.5 of the TEPA report shows that in the event of no additional border crossing (i.e., the No Build option), traffic on Highway 401 through Windsor will not increase during the period of 2015-2025. Overall, traffic volumes on Huron Church Road/Talbot Road increase between 2015 and 2025 in the no-build scenario. However, the traffic model shows decreasing growth from the north/west to the south/east with slightly negative or no growth along some sections of Talbot Road at the east end of the study area. This is primarily due to anticipated diversion of international traffic to other improved routes as the condition in the corridor reaches capacity after 2015. These improved routes include the widening of E.C. Row Expressway from four to six lanes between Huron Church Road and Lauzon Parkway, and the construction/upgrading of Lauzon Parkway as a four lane arterial road between Highway 3 and E.C. Row Expressway. This explains the higher growth in traffic volumes on Huron Church Road between E.C. Row Expressway and the Ambassador Bridge when compared to other sections to the south/east.

3.2 MODEL CHOICE

The model selected for air quality assessment was the CalTrans CAL3QHCR roadway dispersion model, which is accepted for use in Ontario by the MOE and is supported by Environment Canada for transportation assessments. As per the MOE Letter, the model choice is appropriate for this purpose. According to the MOE, the model choice is most appropriate for receptors within 200 m of the road, and may be less conservative at further distances from the road.

In a paper presented at the Air and Waste Management Association Specialty Modelling Conference in October 2003, SENES conducted a sensitivity test of CAL3QHCR, ISCST3, AERMOD and CALPUFF at varying distances from a modelled road. The results showed that the model compares very well with both ISTC and CALPUFF for most scenarios, but is less conservative at distances further from the road. However, for distances greater than a few hundred meters, the air quality effects of the road are very small. Without entering into an argument about the models, it is widely agreed that CAL3QHCR is the model of choice for assessing air quality effects of roads. For a comparative analysis beyond distances where effects might be observed, all of the models show similar patterns (see Figure 3.3). The paper as presented at the conference is included in Appendix C.

Figure 3.3 Maximum 24 Hour Average Concentrations- Model Comparison



4 CONSERVATIVENESS OF MODEL INPUTS FOR THE CALCULATION OF EXCEEDANCES

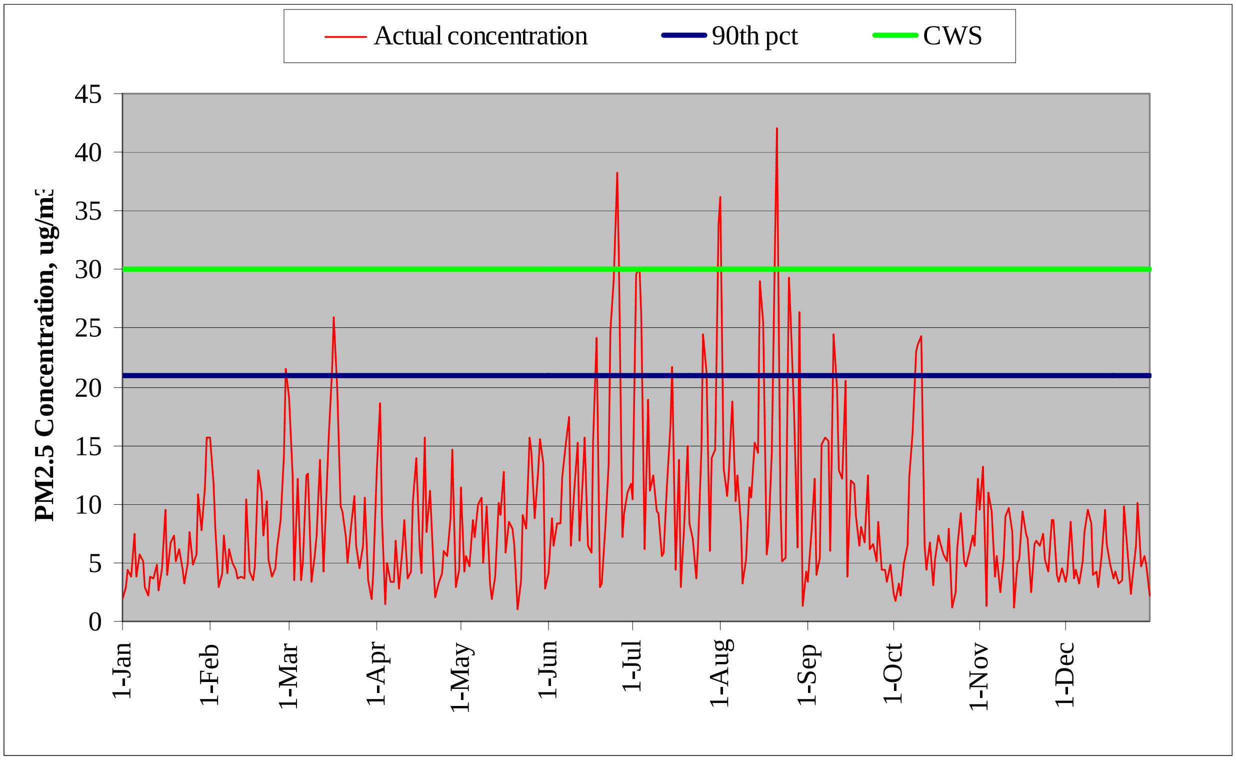
PM_{10} concentrations and exceedances predicted by the CAL3QHCR model for the Detroit River International Crossing (DRIC) project as stated in the Technically and Environmentally Preferred Alternative (TEPA) Report were considered to be very conservative, particularly with respect to exceedances resulting from limitations in the assessment approach (i.e., the use of the 90th percentile background as understood to be consistent with past practice and the MOE's expectations). Several locations within the study area were predicted to have exceedances more than six months of the year. The number of exceedances predicted has been the subject of much discussion within the Windsor media and this section provides further context into reported exceedances.

4.1 CONSERVATIVENESS OF 90TH PERCENTILE BACKGROUND FOR THE CALCULATION OF EXCEEDANCES

An important consideration for Environmental Assessment projects that require air quality analysis is the ambient concentration of a contaminant that would occur without the inclusion of the transportation element. This is commonly referred to as the "background" concentration. In order to attempt to capture the highest 24 hour concentration to compare against MOE criteria, the MOE typically requires the assessment be completed using a 90th percentile background concentration which is reflective of a background concentration that is actually lower 90% of the time. Alternatively, 10% of the time the background concentrations will be higher.

While the choice of the 90th percentile background may under-predict the absolute maximum concentrations reported, it tends to over-predict the number of exceedances because the background is artificially elevated. This concept is illustrated in Figure 4.1. For $PM_{2.5,}$ the 90th percentile background concentration is 21 $\mu g/m^3$ in Windsor based on data reported by the MOE's air quality stations in Windsor. As seen from the figure, the use of the 90th percentile value overestimates the background exposure for a significant part of the year. In addition, Figure 4.1 shows that the day-to-day variability in ambient (background) concentrations is typically several $\mu g/m^3$ and can be as high as 30 $\mu g/m^3$. Based on MOE monitoring data, Windsor currently experiences approximately seven days of exceedances of the $PM_{2.5}$ 24 hour criteria of 30 $\mu g/m^3$ per year.

Figure 4.1 Windsor $PM_{2.5}$ Daily Background Concentrations

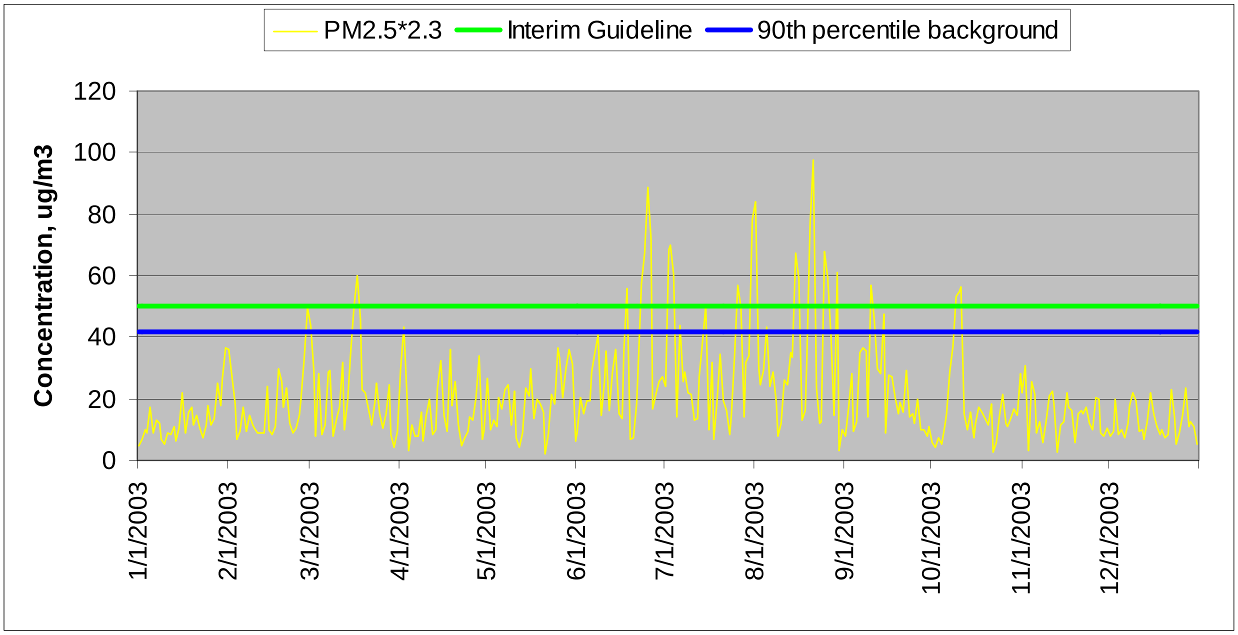


Most of the contaminants modelled in the TEPA either have a limited number of exceedances, were well below criteria, or the traffic increment (the contribution of traffic alone) was low relative to background concentrations. However, PM_{10} and PM showed elevated exceedances for most horizon years this section further illustrates the conservativeness of the approach of using the 90th percentile for predicting exceedances. Predicted concentrations for $PM_{2.5}$ were below criteria for locations beyond the ROW in all horizon years and are therefore not discussed in the context of variable background. Predicted $PM_{2.5}$ concentrations are discussed in greater detail in Section 5.

4.1.1 PM_{10} variable background

Because PM_{10} is not monitored on a daily basis at the two Windsor Monitoring Stations which were used for the development of the $PM_{2.5}$ background concentrations, it was important to determine a suitable multiplier (i.e., PM_{10} / $PM_{2.5}$) to use to develop a background concentration for PM_{10}. Appendix D contains details of the development of the ratio of 2.3 that was applied to $PM_{2.5}$ background concentrations to calculate the daily background concentration for PM_{10}. The daily background PM_{10} concentrations are shown in Figure 4.2. As can be seen in the figure, the 90th percentile background of 42 µg/m^3 is close to the MOE Interim Guideline of 50 µg/m^3.

Figure 4.2 Windsor PM_{10} Calculated Daily Background Concentrations



4.1.2 Receptors

It was expected that the frequency of exceedances is artificially inflated when the 90th percentile background is used and a sensitivity test of the impacts in the Spring Garden area was conducted for PM_{10} concentrations in the year 2035. The area of investigation is the same as that used for the Spring Garden realignment modelling performed in October 2008 as part of the development of the Recommended Plan, and it also has the most updated traffic and road alignment. Yellow numbers in Figure 4.3 indicate the receptor numbers used in the modelling. These receptor numbers are mentioned in the discussions below.

Several discussions focus on the highest concentration and highest exceedance receptors. These are the receptors that experience the 10 highest maximum concentrations or the 10 highest number of exceedance days in the area of investigation. The highest receptor locations are shown in Figure 4.4. There is some overlap between the top ten highest of these categories (i.e., a receptor may have one of the highest maximum concentrations and the highest number of exceedance days) and therefore, fewer than 20 receptors are identified. These were among the receptors considered in the original TEPA and assessed as part of the non-sensitive receptor concentrations. Findings for these receptors are applicable to findings for other receptors. Maximum exceedances and concentrations for these receptors are shown in Table 4.1.

Figure 4.3 Receptors within Sensitivity Analysis Area

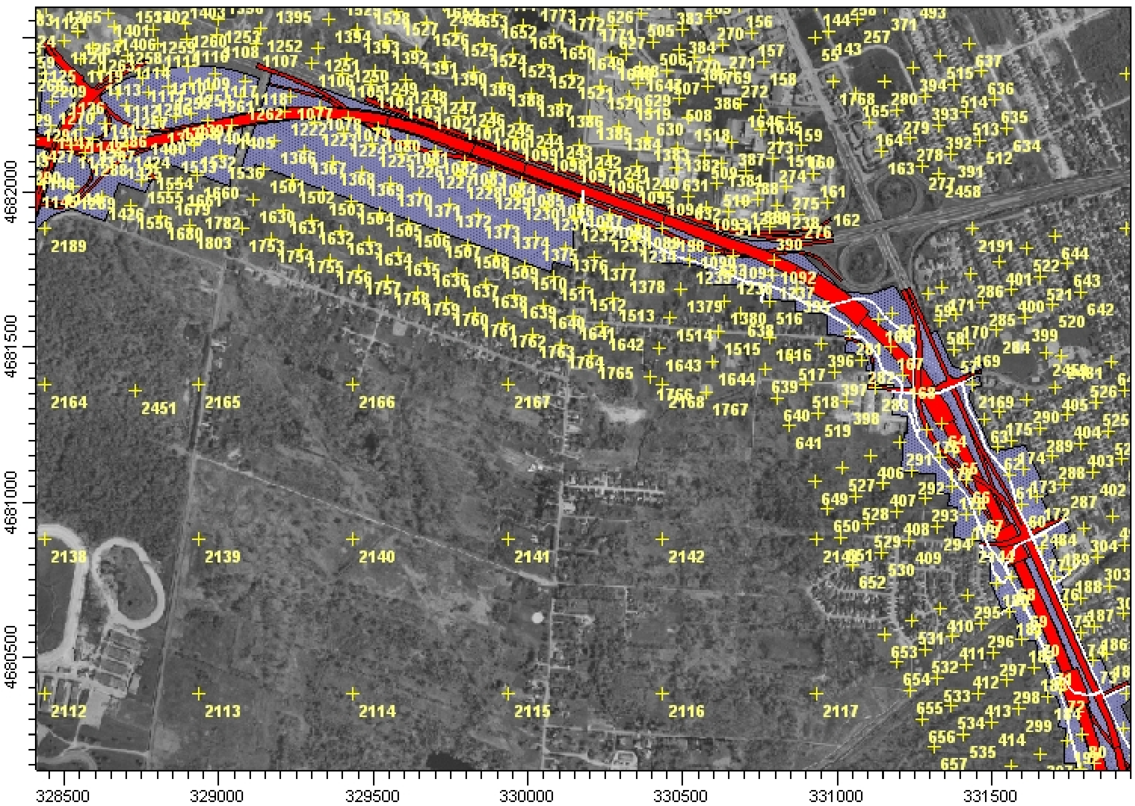
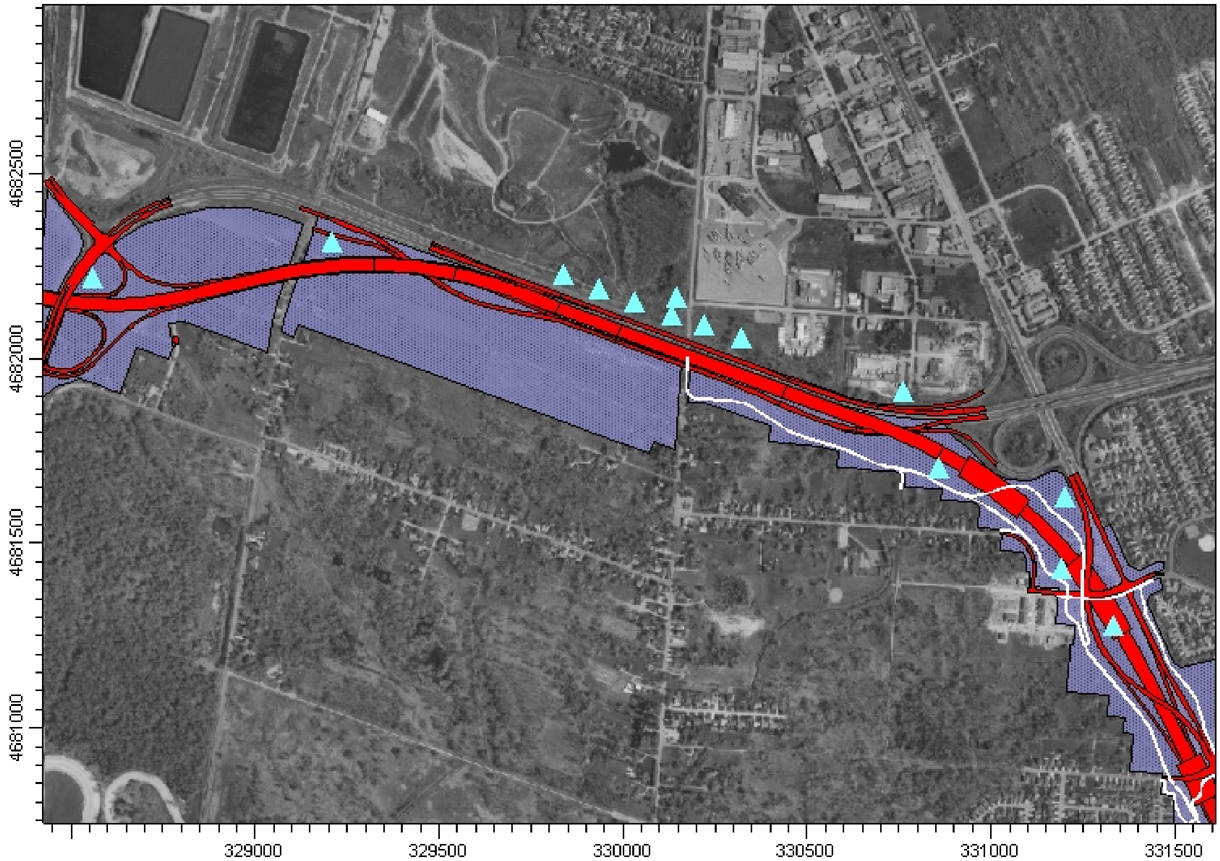


Table 4.1 Maximum PM_{10} Concentrations and Exceedances for Highest Receptors for 2035 Horizon Year

Receptor	Highest Category[1]	Distance to Parkway, m	Concentration, μg/m³	Exceedances, days
56	C	55	105.4	232
64	C	10	394.6	209
68	C	25	108.1	193
168	C	35	163.1	181
390	E	78	99.4	259
395	C	30	126.3	212
1077	E	32	101.6	254
1095	E	58	95.2	256
1096	C,E	61	104.5	263
1097	C,E	50	119.1	282
1098	C,E	66	107.6	260
1099	C,E	62	105.7	253
1100	E	73	101.1	251
1142	E	31	86.9	286
1242	C,E	112	114.5	280

[1]C = receptor one of the 10 highest concentration receptors, E = receptor one of the 10 highest exceedance receptors

Figure 4.4 Highest Receptor Location



4.1.3 Results

Daily PM_{10} background concentrations for 2003 were paired with daily model results to determine the impacts on concentrations. Highest receptor differences are presented in Table 4.1 and Figure 4.5 and show that three to four months of exceedances can be eliminated when a background concentration is adjusted to the daily background. It is interesting to note that the maximum concentrations can actually increase, but overall, these impacts are driven largely by the daily background concentrations alone.

To illustrate the importance of the choice of a background concentration for assessment of exceedances, daily concentrations of two different receptors at differing distances are compared when using a 90^{th} percentile background and a daily background in Figure 4.6. The burgundy colour in the figure represents the background concentration and the turquoise colour is the background concentration combined with the model results. As can be seen in the figure, background concentrations predominate for both the 90^{th} percentile and the daily background. At a receptor closer to the road, the traffic increment is more obvious in both the 90th percentile and daily background than for the receptor located further away. At a receptor further from the road (the lower charts in Figure 4.6), the traffic increment appears elevated; however, the number of exceedances actually increases because there are 24 exceedances predicted by the background concentrations alone, without traffic.

As with the other comparisons, average maximum concentrations and exceedances were calculated for receptors at varying distances from the road. Results are presented in Table 4.2 and Figure 4.7 Overall, the number of exceedance days drops significantly (on average, by about 66%).

Table 4.2 Comparison of Maximum PM_{10} Concentrations and Exceedances for Highest Receptors for 2035 Horizon Year with different backgrounds

			TEPA 2035		Daily Background		Percent Reduction	
Rec No	**Highest Category[1]**	**Distance to Parkway, m**	**Concentration, µg/m^3**	**Exceedances, days**	**Concentration, µg/m^3**	**Exceedances, days**	**Concentration**	**Exceedances**
56	C	55	105.4	232	110.4	63	5%	-73%
64	C	10	394.6	209	370.3	138	-6%	-34%
68	C	25	108.1	193	113.9	92	5%	-52%
168	C	35	163.1	181	128.4	70	-21%	-61%
390	E	78	99.4	259	119.7	75	20%	-71%
395	C	30	126.3	212	117.3	86	-7%	-59%
1077	E	32	101.6	254	125.4	85	23%	-67%
1095	E	58	95.2	256	114.8	74	21%	-71%
1096	C,E	61	104.5	263	119.3	84	14%	-68%
1097	C,E	50	119.1	282	127.2	97	7%	-66%
1098	C,E	66	107.6	260	120.7	80	12%	-69%
1099	C,E	62	105.7	253	119.5	79	13%	-69%
1100	E	73	101.1	251	117.1	77	16%	-69%
1142	E	31	86.9	286	118.7	77	37%	-73%
1242	C,E	112	114.5	280	122.6	84	7%	-70%
average			129	245	136	84	10%	-66%

[1]C = receptor one of the 10 highest concentration receptors, E = receptor one of the 10 highest exceedance receptors

Figure 4.5 Changes to Exceedances with Highest Receptors and Variable Daily Background

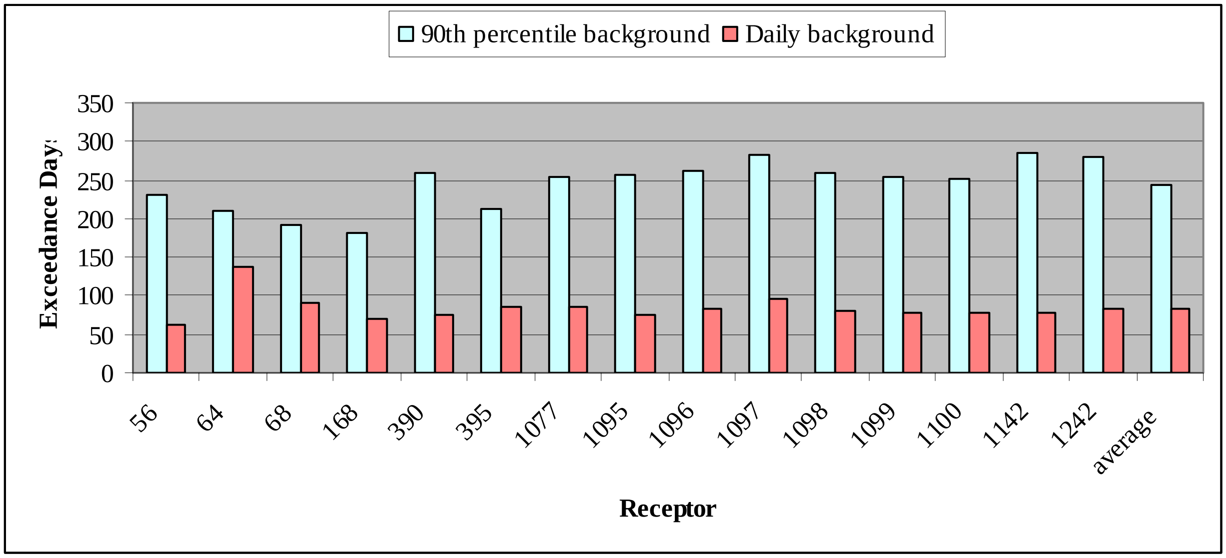
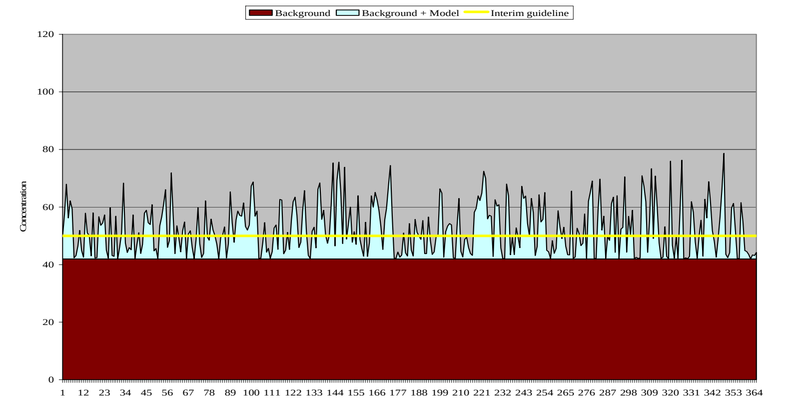
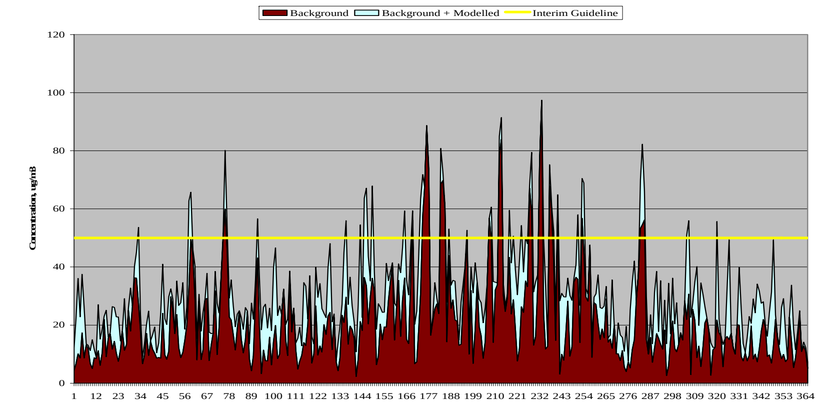


Figure 4.6 Comparison of 90th Percentile and Daily Background Concentrations and Exceedances

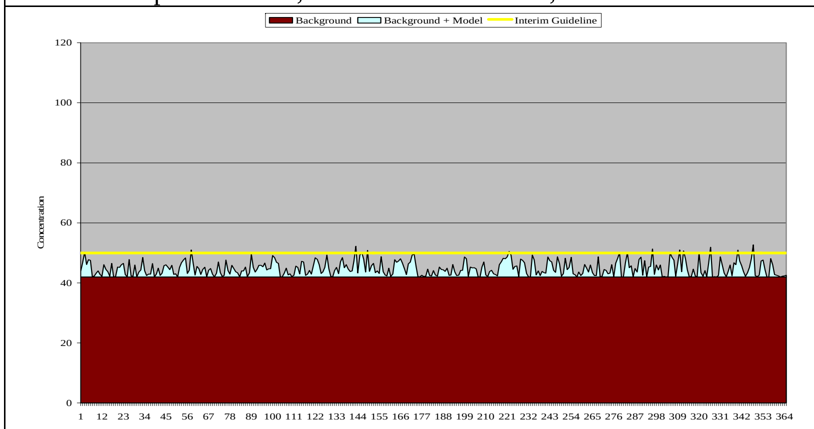
Receptor at 50 m, as modelled for TEPA, 191 exceedances



Receptor at 50 m, modelled with daily background, 49 exceedances



Receptor at 350 m, as modelled for TEPA, 16 exceedances



Receptor at 350 m, as modelled with daily background, 28 exceedances

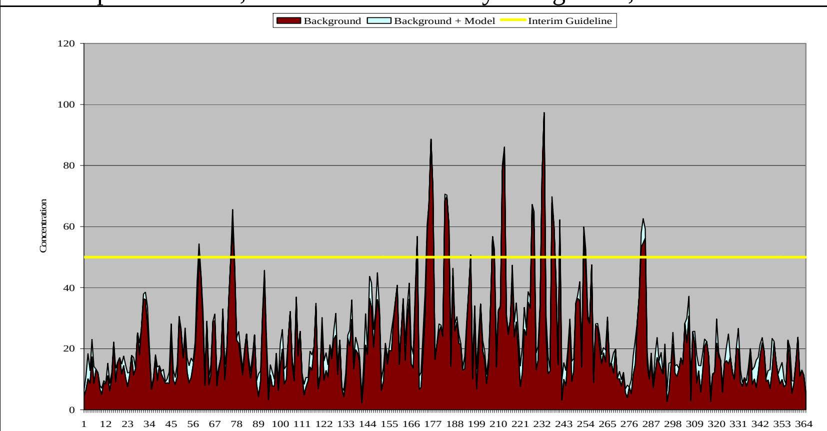
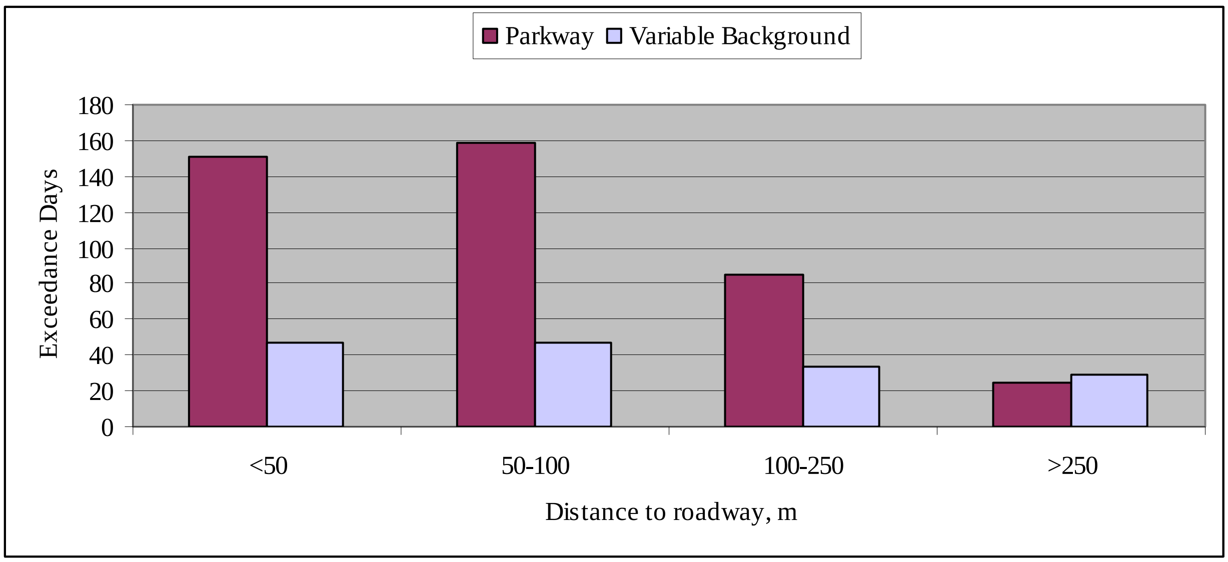


Table 4.3 Change in Concentration and Exceedance Days at varying distances from the Roadway

	Parkway 2035		Variable Background		Percent Reduction	
Distance to Road, m	**Concentration, µg/m³**	**Exceedances, days**	**Concentration, µg/m³**	**Exceedances, days**	**Concentration**	**Exceedances**
<50	83	151	109	47	32%	-69%
50-100	77	158	105	47	36%	-70%
100-250	63	85	101	34	60%	-60%
>250	56	24	100	29	78%	20%

Figure 4.7 Changes to Exceedances with Distance and Variable Daily Background



In summary, the number of exceedances predicted with a 90th percentile background concentration can overestimate the frequency of exceedances by up to 200 days and overestimates of 100 days are common within the first 100 m of the roadways. Caution should be used when interpreting differences in exceedance days, and when using the total number of exceedance days as absolute indicators of air quality.

4.2 OTHER SENSITIVITY TEST RESULTS

SENES also conducted sensitivity testing on the impacts of considering plume depletion, precipitation, and controlled road silt loading versus uncontrolled road silt loading.

The next most significant element of conservatism built into the model results next to use of a 90^{th}% background, is the issue of controlled roads and uncontrolled roads as previously discussed in Section 2.2 of this report.

4.2.1 Uncontrolled and Controlled Roads

The U.S. EPA AP 42 document allows for a silt loading distinction of a controlled road and an uncontrolled road. According to the AP 42:

> *"Limited access roadways pose severe logistical difficulties in terms of surface sampling, and few silt loading data are available for such roads. Nevertheless, the available data do not suggest great variation in silt loading for limited access roadways from one part of the country to another. For annual conditions, a default value of 0.015 g/m2 is recommended for limited access roadways. Even fewer of the available data correspond to worst-case situations, and elevated loadings are observed to be quickly depleted because of high traffic speeds and high ADT rates."*

Due to the complexity of the model inputs, it was not feasible to differentiate within the model input between a controlled road such as the Parkway, and an uncontrolled road such as the service roads and intersections. The silt loading factor of 0.03 for uncontrolled roads was used for both Parkway and for No Build scenarios. This leads to a conservative assessment of the Parkway emissions in areas that are impacted more by the Parkway than by the service roads; however, this approach could be representative of service road configurations and other major intersections.

The Spring Garden area (which is an area not impacted by service roads) was reassessed using controlled road emission factors for all roads. While this could under-represent the emissions from uncontrolled roads such as cross roads and Huron Church, it will likely more accurately represent emissions from EC Row and the Parkway. It is also consistent with the approach used by the City of Windsor in their Air Quality Assessment as we understand it.

Results are presented in Table 4.4 for the highest receptors and Table 4.5 for receptors located at varying distances from the Parkway. Maximum concentrations decreased by approximately 20% for receptors located within 50-100 m of the roadways and the number of exceedance days was reduced by up to two months within the first 200 m of the Parkway. Additionally, predicted exceedances drop to almost zero beyond 250 m as is shown in Table 4.5.

With more than two months of exceedance reductions for receptors within a few hundred metres of the road, the use of controlled road emission factor could be an important consideration when predicting impacts.

Table 4.4 Highest Receptor Decrease in Concentrations and Exceedances for Controlled Roads

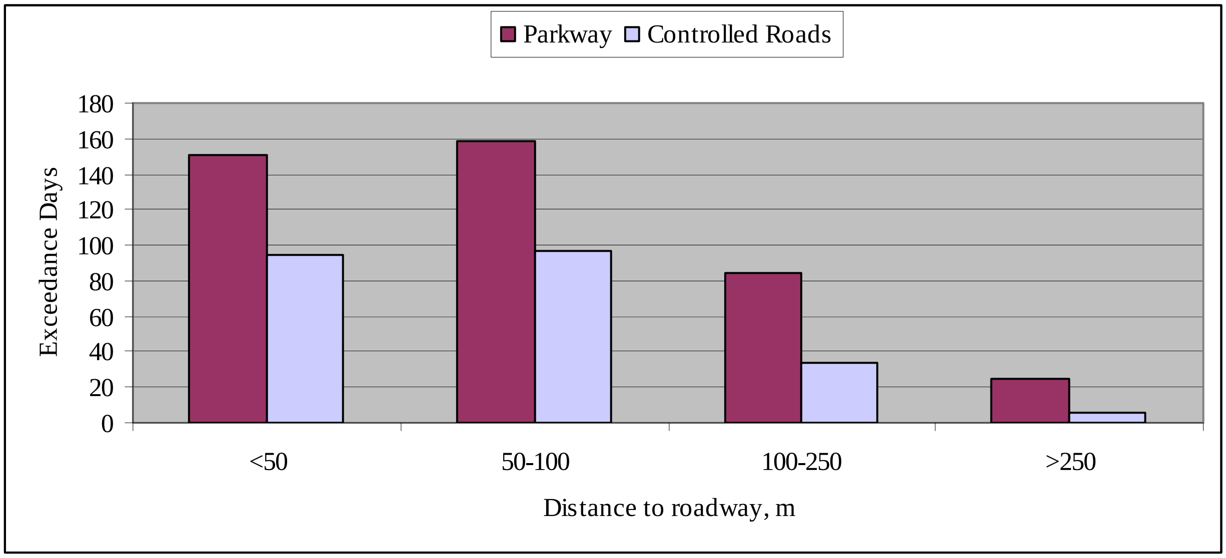
			Parkway 2035		Controlled Roads		Percent Reduction	
Rec No.	**Highest Category[1]**	**Distance to Parkway, m**	**Concentration, µg/m³**	**Exceedances, days**	**Concentration, µg/m³**	**Exceedances, days**	**Concentration**	**Exceedances**
56	C	55	105.4	232	81.6	173	-23%	-25%
64	C	10	394.6	209	262.1	168	-34%	-20%
68	C	25	108.1	193	82.5	150	-24%	-22%
168	C	35	163.1	181	117.7	121	-28%	-33%
390	E	78	99.4	259	76.2	186	-23%	-28%
395	C	30	126.3	212	94.3	165	-25%	-22%
1077	E	32	101.6	254	78.2	195	-23%	-23%
1095	E	58	95.2	256	75.8	214	-20%	-16%
1096	C,E	61	104.5	263	84.2	234	-19%	-11%
1097	C,E	50	119.1	282	98.9	247	-17%	-12%
1098	C,E	66	107.6	260	87.3	212	-19%	-18%
1099	C,E	62	105.7	253	85.3	201	-19%	-21%
1100	E	73	101.1	251	79.5	188	-21%	-25%
1142	E	31	86.9	286	70.9	223	-18%	-22%
1242	C,E	112	114.5	280	100.2	235	-12%	-16%
Average			129	245	122	227	-7%	-7%

[1]C = receptor one of the 10 highest concentration receptors, E = receptor one of the 10 highest exceedance receptors

Table 4.5 Decrease in PM_{10} 24 hour Concentration and Exceedance for Controlled Roads

	Parkway 2035		Controlled Road		Percent Reduction	
Distance to Road, m	**Concentration, µg/m³**	**Exceedances, days**	**Concentration, µg/m³**	**Exceedances, days**	**Concentration**	**Exceedances**
<50	83	151	68	94	-18%	-38%
50-100	77	158	65	97	-17%	-39%
100-250	63	85	56	34	-12%	-60%
>250	56	24	51	5	-9%	-78%

Figure 4.8 Decrease in PM_{10} Exceedance Days for Controlled Roads



5 AIR QUALITY WITHIN THE RIGHT OF WAY

As with most environmental assessment studies, the focus of the TEPA report was on the assessment of locations of permanent sensitive receptors (i.e., residential areas) hence most of the tables presented in the report are for receptors beyond the right-of-way (ROW).

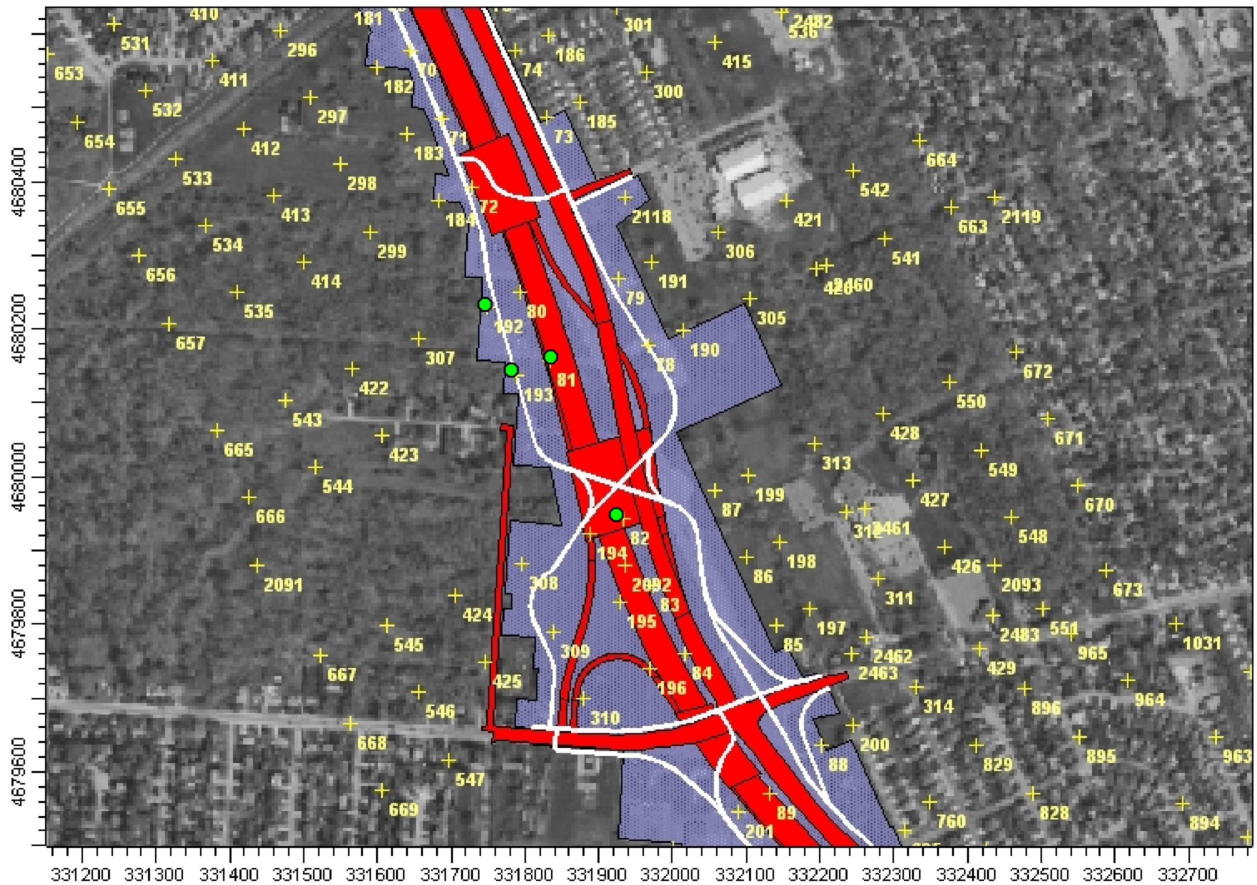
The green spaces were not ignored however, and were included as a description in the TEPA report under section 4.5.2 where concentrations at the tunnel portals were discussed. As exceedances are predicted for the particulate contaminants, an additional comparison with the Ministry of Labour criteria for short term exposure was also included. As with other sections of the TEPA report, the analysis examined the maximum concentrations that are predicted to occur once per year.

5.1 RECEPTORS WITHIN THE RIGHT OF WAY

Over 2400 receptors in the Windsor Airshed were examined within the Air Quality modelling. The first two rows of receptors were placed at 50 m intervals from each side of the existing road, followed by 100 m intervals up to a distance of 500 m from the roadway. Another grid with 500 m x 500 m spacing was then overlaid to cover the rest of the modelling domain, which was essentially all of west Windsor and the surrounding communities. When these receptors are overlaid upon the Recommended Plan, 232 of them fall within the proposed ROW. Of these 232 receptors, 141 are either located on a roadway, roadway shoulder, or embankment or are otherwise in an area not considered for recreation uses. 7 of the 141 receptors are identified as being located on tunnels, but four of these receptors are located within 10 m of the tunnel portals and are not considered to be areas used for recreation. This leaves a total of 91 receptors that are considered as “within usable spaces” and provide a reasonable basis for assessing air quality within the recreational use areas.

Figure 5.1 provides an example of receptor locations relative to the TEPA. The white lines in the figure are the proposed trails of the TEPA. Receptor 81 in the figure below would be considered on the road. Receptor 82 is within 10 m of the tunnel portal and is not considered within the usable spaces of the ROW. Receptors 192 and 193 are examples of receptors that are within the usable spaces and are located on the trail system.

Figure 5.1 Sample of Receptor Locations within ROW



5.2 AIR QUALITY OF CONTAMINANTS WITHIN THE ROW

Section 4.5.2 of the TEPA report states that all gaseous contaminants are below criteria for the 2035 horizon year, with isolated instances of NO_x hourly exceedances for the 2015 and 2025 horizon years. Table 5.1 summarizes the predicted maximum concentrations for health based criteria contaminants within the ROW for contaminants below the criteria for the 2035 horizon year. .

Table 5.1 Maximum Modelled Concentrations of Contaminants within ROW for the Horizon Year 2035

Contaminant	Averaging time	MOE AAQC, μg/m^3	Environment Canada, μg/m^3	90th Percentile Background, μg/m^3	Maximum concentration within ROW, μg/m^3	Max within Usable Spaces, μg/m^3	Usable space Percent of Criteria
NO_x (as NO_2)	1 h	400	400	64	235	173	43%
	24 h	200	200	56	90	79	39%
$PM_{2.5}$	24 h	30	30	21	53.8	32.3	108%
Acrolein	24 h	0.08	-	0.160	0.21	0.192	240%
SO_2	1 hr	690	900	43	46	45	7%
Carbon Monoxide	1 hr	36,200	36,200	897	3109	2815	8%
VOC	24 hr	-	-	147	169	164	
1,3 Butadiene	24 hr	-	-	0.17	0.27	0.24	
Benzene	24 hr	-	-	2.7	3.3	3.2	
Acetaldehyde	½ hr	500	-	2.4	3.7	3.2	1%
Formaldehyde	24 hr	65	-	4.1	4.8	4.5	7%

5.3 AIR QUALITY OF $PM_{2.5}$ WITHIN THE ROW

$PM_{2.5}$ is the only health based criteria contaminant with exceedances attributable to the traffic increment; thus, the exceedances of $PM_{2.5}$ are discussed further. A summary of the number of receptors within the ROW showing exceedances for $PM_{2.5}$ is shown in Table 5.2. There are isolated instances of $PM_{2.5}$ exceedances within the ROW and these are discussed in greater detail; however, concentrations not considered to be within usable spaces are not discussed further. This table demonstrates that under all modelled conditions, including worst case meteorology, most receptors are expected to be below the $PM_{2.5}$ criteria even when the 90th percentile background is assumed to occur 100% of the time.

Table 5.2 Number of Receptors with Exceedances

	Number of Receptors	Number of Receptors with Exceedances of $PM_{2.5}$, 24 hr criteria
All Receptors within ROW	232	47
Receptors in usable areas	91	5

5.3.1 Receptors within Usable Spaces

There are 91 modelled receptors located within the usable spaces of the ROW at varying distances from the Parkway. Of these 91 receptors, only 5 receptors are predicted to have exceedances as indicated in Table 5.3 and Figure 5.2.

Maximum concentrations, which consist of the 90th percentile background plus the predicted increment due to the road, are marginally above the criteria of 30 µg/m^3 and exceedances would occur for up to 10 days per year if the background 90th percentile concentration of 21 µg/m^3 were to remain constant for the full year. The use of the 90th percentile background in these calculations provides a very conservative assessment of the number of exceedances and in reality, the numbers of exceedances are likely to be much lower or would be resulting from the variability in background concentration as shown previously in Figure 4.1.

The other 86 receptors within the usable spaces which are not listed in the following table or figure, are located at similar distances to the roadways and do not have predicted exceedances of the $PM_{2.5}$ 24 hour criteria of 30 µg/m^3.

Table 5.3 Exceedances and Maximum Concentrations for Receptors within Usable Spaces

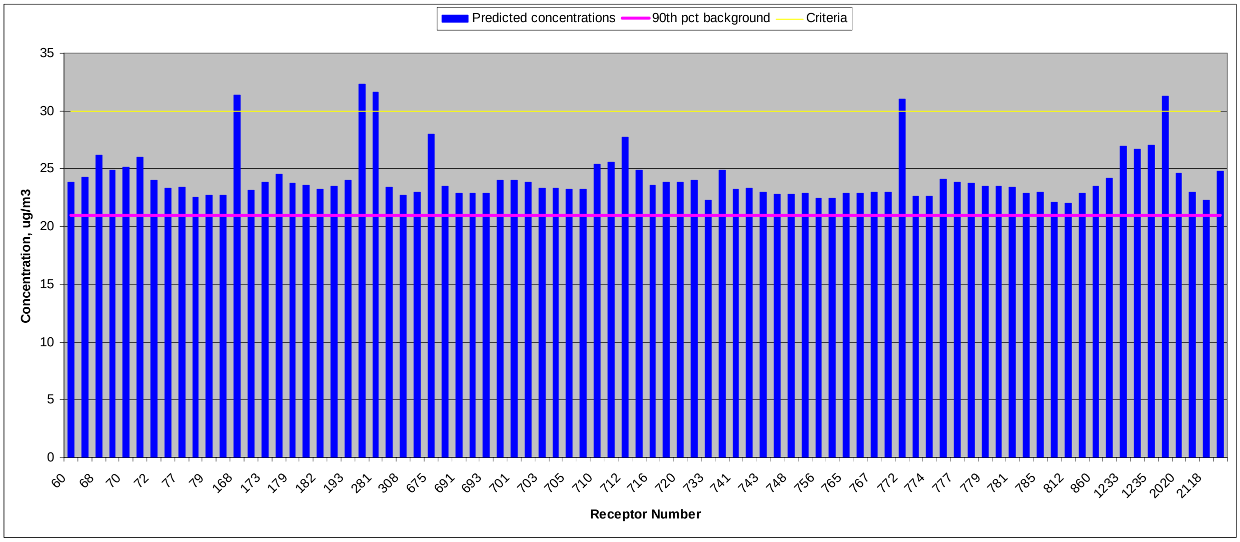
<table>
<tr><th>R_NO</th><th>Location</th><th>Criteria, µg/m³</th><th>90th percentile background, µg/m3</th><th>Exceedance Days</th><th>Max Concen tration, µg/m3(1)</th><th>Distance to Parkway, m</th></tr>
<tr><td>168</td><td>West side of Malden/Labelle tunnel</td><td rowspan="5">30</td><td rowspan="5">21</td><td>2</td><td>31.4</td><td>25</td></tr>
<tr><td>201</td><td>Near south portal of Todd/Cabana</td><td>10</td><td>32.3</td><td>7</td></tr>
<tr><td>281</td><td>Near Spring Garden tunnel portal</td><td>1</td><td>31.6</td><td>20</td></tr>
<tr><td>722</td><td>East of Howard, centre of tunnel</td><td>1</td><td>31</td><td>130</td></tr>
<tr><td>1236</td><td>Spring Garden near off ramp to EC Row</td><td>10</td><td>31.3</td><td>50</td></tr>
</table>

(1) – Maximum concentration includes 90th percentile background and traffic increment

Figure 5.2 Receptor Locations with $PM_{2.5}$ Exceedances for Horizon Year 2035

Maximum predicted concentrations of $PM_{2.5}$ for the different receptors within the ROW are presented in Figure 5.3. As shown in Figure 5.3, the background concentration (the pink line) accounts for a substantial portion of the predicted $PM_{2.5}$ concentration with traffic impacts (total of background and traffic in blue) adding a minor additional increment. As these are the maximum concentrations predicted at the receptors and occur only once per year, background levels and the traffic increment will be lower for majority of the time. In addition, as discussed previously, the silt loading factor used in the assessment is conservative and the traffic increment could be further reduced.

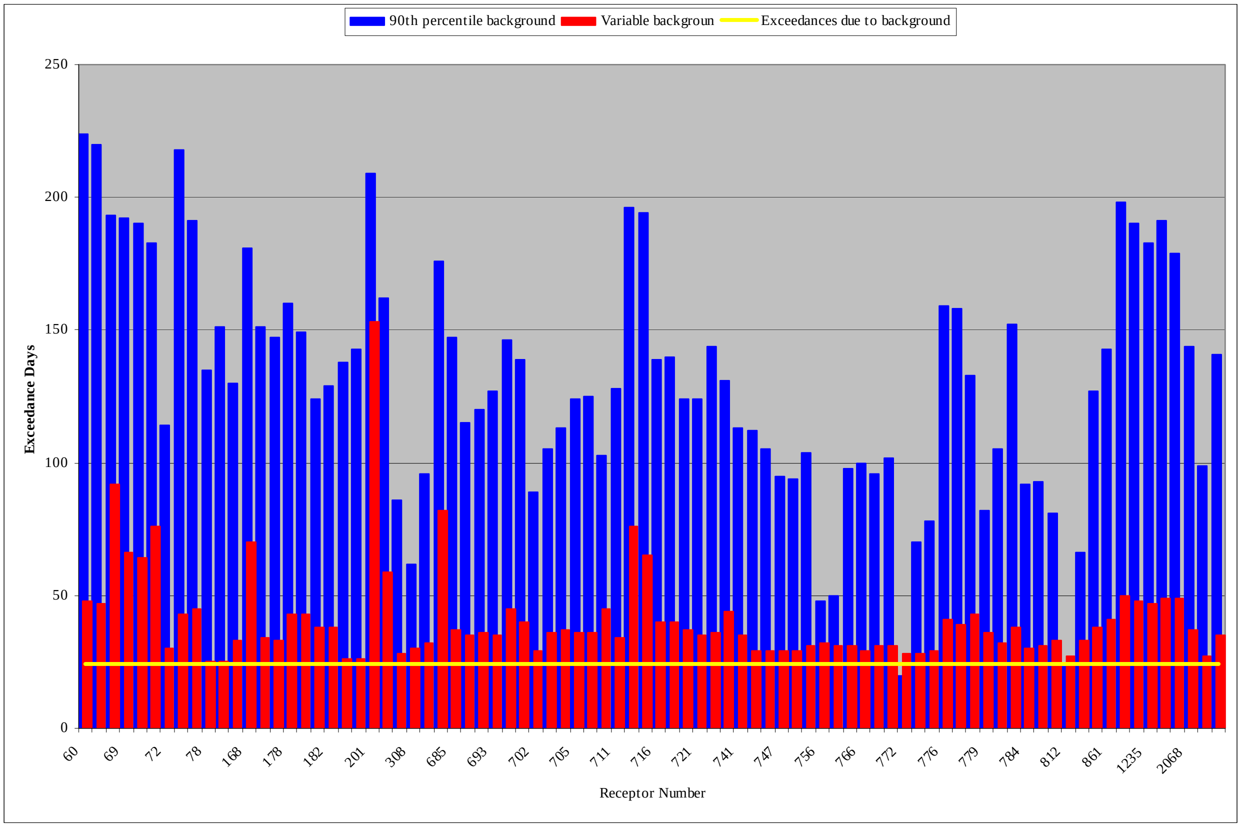
Figure 5.3 Maximum $PM_{2.5}$ Predicted Concentrations for Receptors within Usable Spaces of ROW



5.4 AIR QUALITY OF PM_{10} WITHIN THE ROW

As indicated in the TEPA report, PM_{10} concentrations and Exceedances are elevated within the ROW. Exceedances were thought to be overly conservative as per the earlier discussion on variable background. Both the 90th percentile and daily average maximum concentrations exceed the MOE Interim Guideline of 50 µg/m^3 for PM_{10} 24 hour averaging period for most receptors within the ROW. However, the frequency of exceedances is greatly reduced when a daily average background component is added. This is illustrated graphically in Figure 5.4 and for many receptors within the ROW the number of exceedances is slightly higher than what would be expected due to the fluctuation in ambient background conditions.

Figure 5.4 Difference in number of Exceedance days with variable background versus 90^{th} percentile background for PM_{10} 2035 Horizon Year

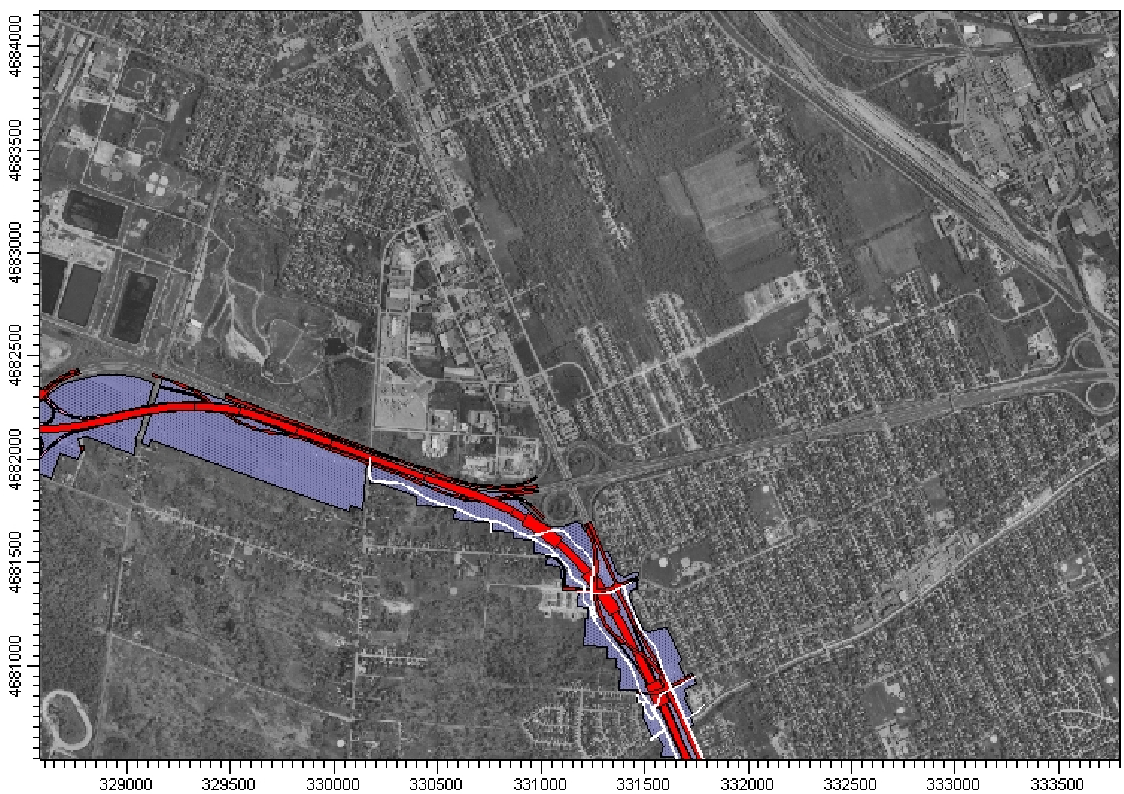


6 AIR QUALITY BEYOND THE AREA OF CONTINUED ANALYSIS

One of the requests in the MOE's memorandum is to improve documentation of the air quality impacts beyond the Area of Continued Analysis ACA. Air quality for receptors along the corridor north of EC Row was modelled with the TEPA analysis, but the results were not presented in the TEPA report and there was a limited qualitative discussion on air quality beyond the ACA in the TEPA report. This memo documents the PM_{10} impacts along the Huron Church corridor north of EC Row as modelled with the TEPA. These impacts can be considered indicative of other air quality improvements that would occur in other locations.

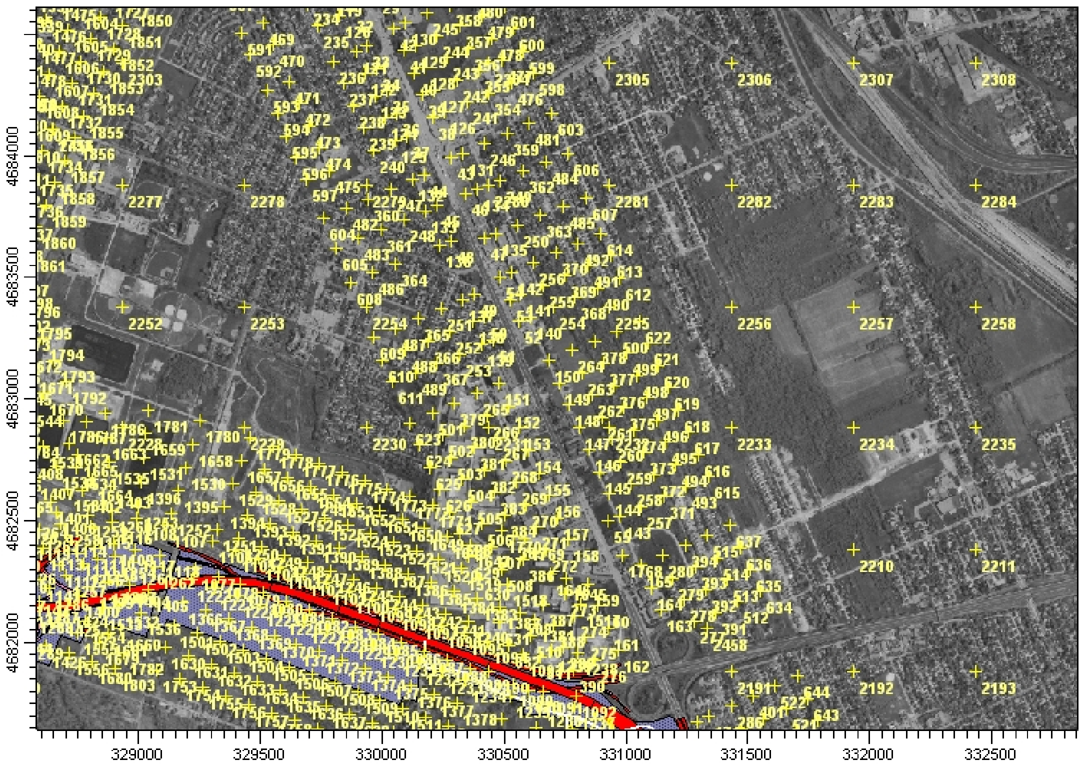
The TEPA originates at the existing Highway 401 terminus in Windsor and follows Highway 3 to Huron Church until Huron Church intersects with EC Row. At EC Row, the TEPA changes alignment and moves west with EC Row. Therefore, traffic along Huron Church north of EC Row is reduced and there should be localized improvements in air quality. The TEPA north of Grand Marais Drain is shown in Figure 6.1.

Figure 6.1 TEPA Alignment



Receptor locations north of the TEPA follow the same grid spacing as used in the TEPA analysis and are shown in Figure 6.2.

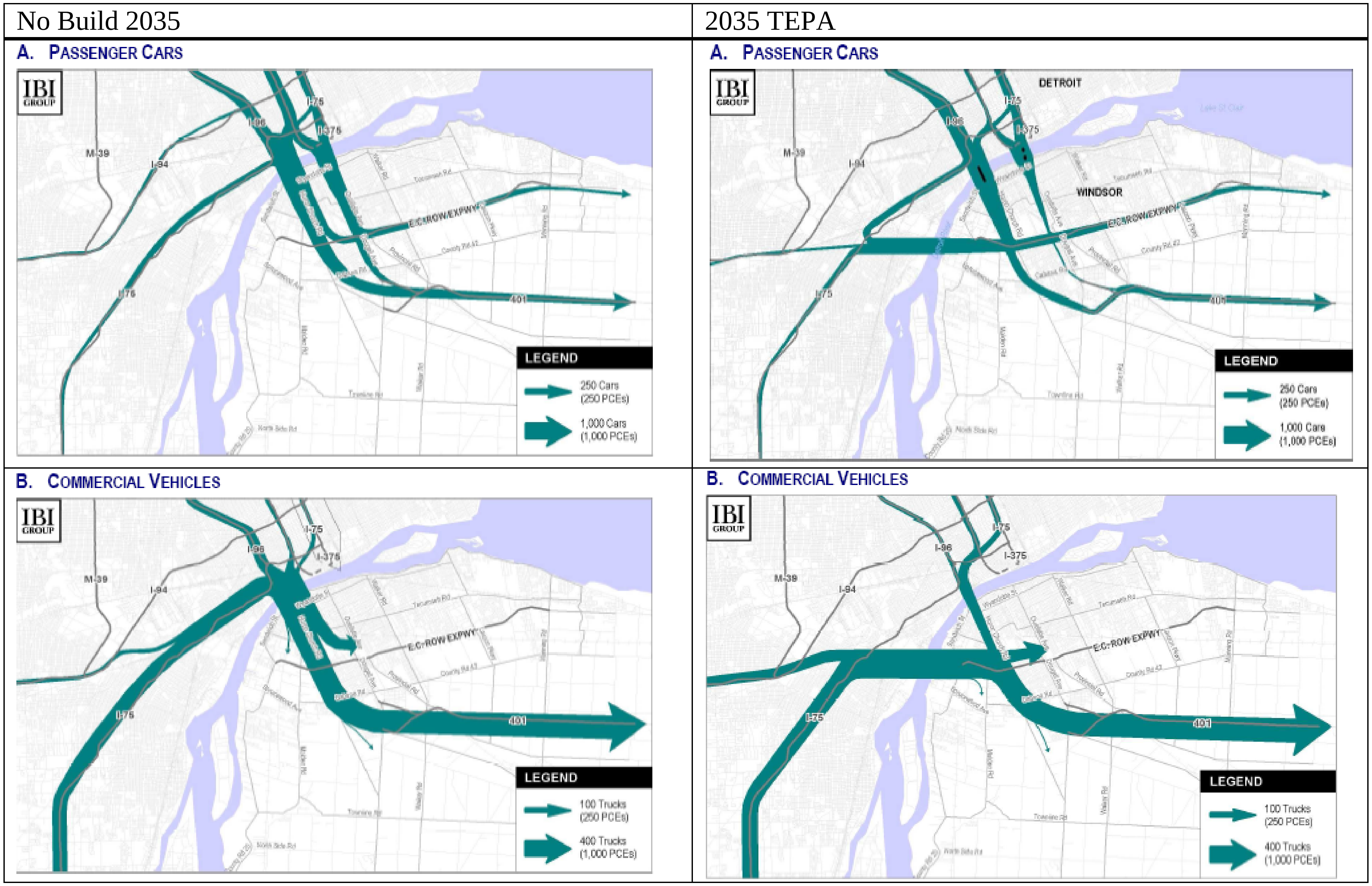
Figure 6.2 Receptor Grid Spacing North of ACA



6.1 TRAFFIC

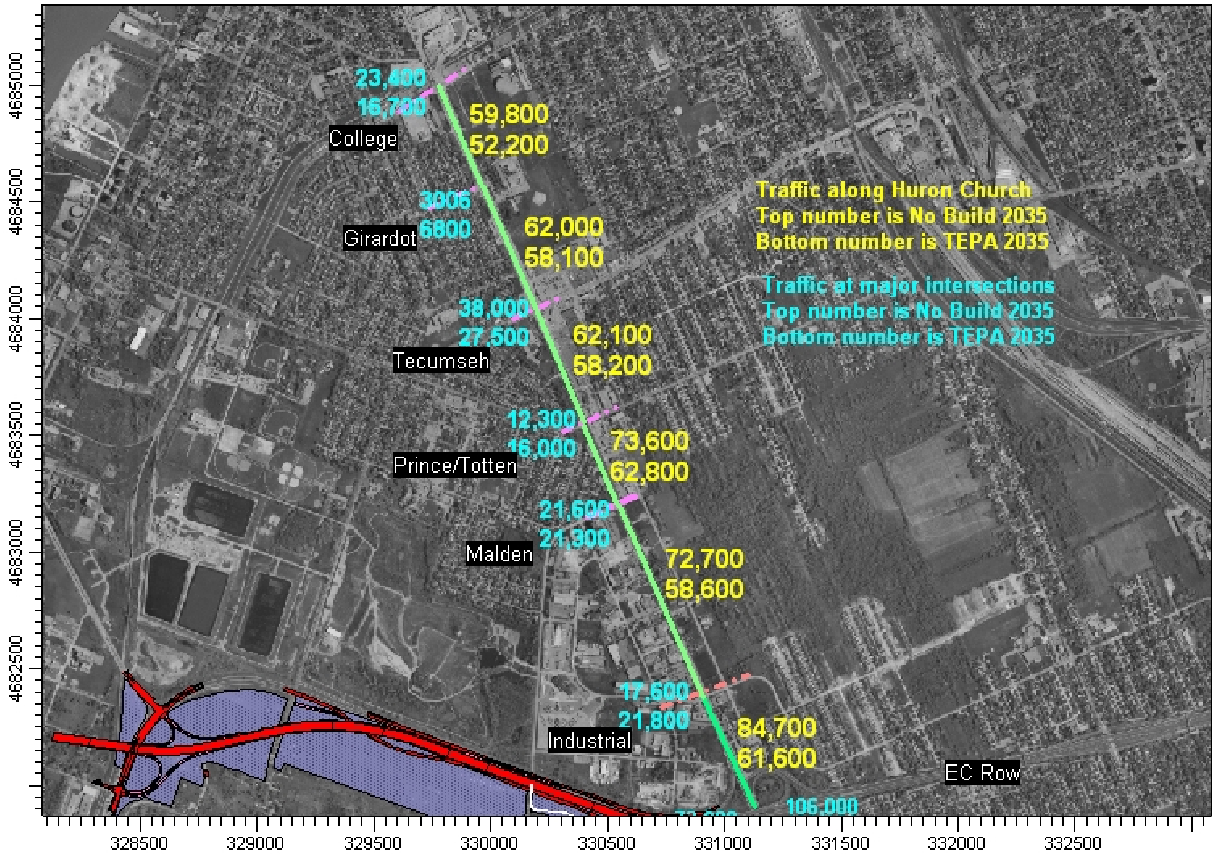
Overall, while traffic in Windsor is expected to be similar between No Build and the TEPA scenarios, the difference lies in the distribution of the traffic through other Windsor border crossing corridors. Traffic is expected to be reduced at both the Ambassador Plaza and the Windsor-Detroit Tunnel with the new crossing in place when compared to the No Build scenario. There will be additional increases in traffic along the TEPA as traffic currently moving through the Sarnia Blue Water Bridge will be diverted to the new crossing. In general, traffic with the Windsor-Essex Parkway and along the Huron Church corridor is expected to increase by 30-50% relative to the No Build scenario along the TEPA, and traffic north of EC Row along Huron Church is expected to decrease by approximately 10-20% relative to the No Build scenario. Traffic in other areas of Windsor is expected to decrease as the TEPA allows long-distance international traffic to travel unimpeded by traffic signals to a new inspection plaza and river crossing. The discussion of traffic impacts is more fully described in *The Level 2 Traffic Operations Analysis of Practical Alternatives (revised December 2008)* and some of the graphics are included as Figure 6.3 below. The thickness of the lines indicates the relative peak hour traffic volumes (i.e., a thicker line represents greater traffic volume). As shown in the figure, passenger vehicle volumes along Ouellette/Dougall are expected to decrease with the TEPA project and air quality relating to traffic volumes can be expected to improve during these times.

Figure 6.3 Peak Hour Vehicle Traffic



Annual Average Daily Traffic (AADT) volumes along the corridor north of EC Row are presented in Figure 6.4. As shown in the figure, traffic volumes are typically reduced by several thousand vehicles with the TEPA when compared with the No Build Scenario.

Figure 6.4 AADT Traffic North of EC Row



6.1.1 Intersection Traffic

As stated in the TEPA report, air quality is expected to improve due to reduced idling at intersections. Intersection function can be measured in terms of Level of Service (LOS) with an "A" rating representing operations with very low delay and an "F" rating representing very high delay values and considered to be unacceptable to most drivers. The Peak Level of Service represents the intersection performance during peak hours. *The Level 2 Traffic Operations Analysis of Practical Alternatives (revised December 2008)* provides for the LOS presented in Table 6.1. As shown in the table, the LOS improves with the TEPA. This could have a positive impact on air quality, but it is difficult to differentiate the impact from the overall results due to magnitude of traffic in the free-flow traffic conditions.

Table 6.1 2035 Level of Service (LOS*) for Intersections North of the ACA

	North Bound		South Bound	
Intersection	**No Build**	**TEPA**	**No Build**	**TEPA**
College	B	A	F	C
Girardot	B	A	B	A
Tecumseh	E	A	F	C
Prince/Totten	A	A	E	B
Malden	D	A	F	B
Industrial	D	A	F	C

* LOS of A is best and F is worst

6.2 RESULTS

Differences in concentrations between future No Build and the TEPA scenarios are not appreciable relative to background concentrations for most contaminants with the exception of particulate matter, carbon monoxide, and NO_x.

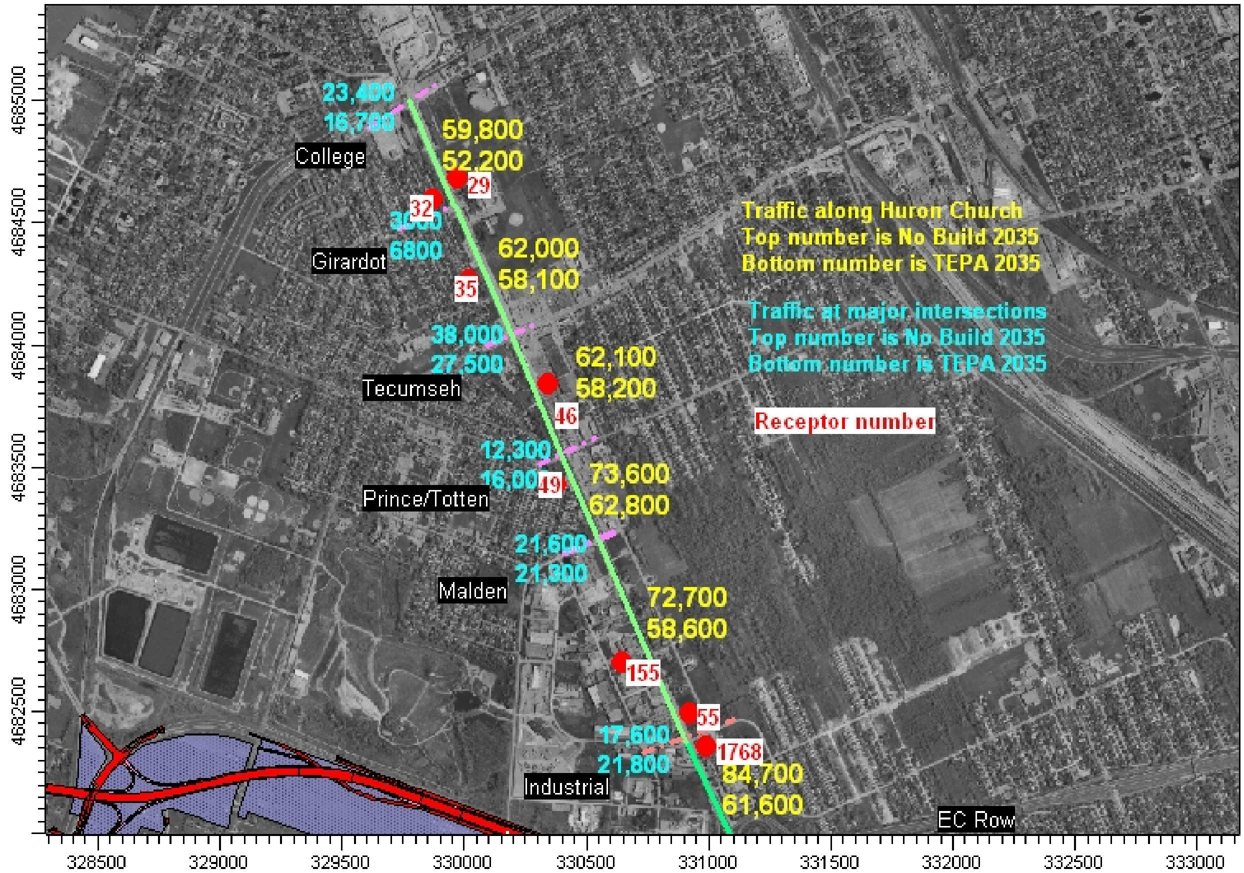
To show impacts at receptors within various road segments, sample receptors were chosen due to their proximity to the roadway. These receptors are shown in Figure 6.5 and comparisons of the No Build to TEPA scenarios are presented in Table 6.2.

The model results presented in this section are the predicted maximum concentrations for the 2035 horizon year. These maximum concentrations occur once per year. To see whether there was a correlation to traffic, the receptors were grouped according to general location north of the ACA. The average of the maximum concentrations was calculated by distance from the road within specific road segments. Results are presented in Table 6.3.

Air quality relating to PM_{10} at maximum conditions improves by over 35% at 50 m from the road and by more than 20% within 100 m of the road. In contrast, traffic decreases generally less than 20%. However, the traffic composition for the No Build scenario contains more than 30% trucks while with the TEPA the composition of trucks is approximately 10% of the total traffic north of EC Row. Cars emit more carbon monoxide than trucks and the carbon monoxide increase (though still well below criteria) from the change in vehicle mix with the TEPA is evident in Table 6.2.

As stated previously, the LOS at the intersections also improves with the TEPA. This element could also be part of the explanation for the 35% improvement noted above.

Figure 6.5 Illustrative Receptors for beyond ACA



Improvements are appreciable for maximum PM_{10} concentrations as they are up to 40 $\mu g/m^3$ lower with the TEPA than with No Build scenario and almost 50% lower for PM.

While this section of the roadway likely shows the most improvement due to the TEPA implementation, other areas such as the Dougall/Ouellette corridor and Sarnia could see similar improvements to air quality. The overall traffic volumes are not expected to change in Ontario for each horizon year, but the difference will be in the distribution of vehicular traffic. With the increased free-flow conditions that the TEPA will offer, it is expected that side streets currently in use for corridor traffic will revert to local traffic as the TEPA is implemented.

Table 6.2 2035 Contaminant Concentrations (μg/m^3) beyond ACA

		CO				NO_x		$PM_{2.5}$		SO_x		PM_{10}		PM	
		8 hr		1 hr		24 hr		24 hr		24 hr		24 hr		24 hr	
		Background	1000	Background	1000	Background	70	Background	21	Background	32	Background	42	Background	84
Receptor Number	Segment	No Build	TEPA	No Build	TEPA	No Build	TEPA	No Build	TEPA	No Build	TEPA	No Build	TEPA	No Build	TEPA
32	College to Girardot	1201	1252	1540	1667	134	89	25.4	21.5	32.2	32.2	87	59	240	137
29	College to Girardot	1235	1270	1421	1536	122	84	26.3	21.3	32.2	32.2	98	64	226	136
35	Girardot to Tecumseh	1195	1260	1542	1775	120	83	25.4	21.3	32.2	32.2	85	59	233	133
46	Tecumseh to Prince/Totten	1262	1336	1498	1713	127	84	24.9	21.3	32.2	32.2	97	66	221	144
49	Prince/Totten to Malden	1229	1328	1556	1876	106	84	24.5	21.6	32.2	32.2	90	60	248	139
55	Malden to Industrial	1337	1378	1605	1735	134	84	26.2	22.2	32.3	32.3	113	75	269	169
155	Malden to Industrial	1162	1203	1457	1603	94	75	24.3	22	32.1	32.1	76	59	191	125
1768	Industrial to EC Row	1332	1392	1596	1758	128	83	25.7	22	32.3	32.3	114	75	273	169

Table 6.3 Contaminant Concentrations at Different Distances from Road

							Average of Maximum 24 hr Concentrations, μg/m^3 and distance from road											
		Total AADT, 2035			Percent Trucks		No Build				TEPA				Change TEPA to No Build, %			
Road Segment		No Build	TEPA	Change, %	No Build	TEPA	50 m	100 m	200 m	300 m	50 m	100 m	200 m	300 m	50 m	100 m	200 m	300 m
Huron Church	College to Girardot	59,800	52,200	-13%	39%	10%	94	76	63	60	61	56	53	52	-35%	-26%	-17%	-13%
	Girardot to Tecumseh	62,000	58,100	-6%	35%	10%	92	76	65	62	62	57	54	54	-33%	-25%	-17%	-13%
	Tecumseh to Prince/Totten	62,100	58,200	-6%	33%	8%	92	76	65	60	63	58	55	53	-32%	-24%	-16%	-11%
	Prince/Totten to Malden	73,600	62,800	-15%	32%	7%	99	80	66	60	65	60	55	54	-35%	-26%	-17%	-11%
	Malden to Industrial	72,700	58,600	-19%	36%	7%	113	82	68	61	75	62	58	57	-33%	-24%	-14%	-7%
	Industrial to EC Row	84,700	61,600	-27%	32%	7%		87	73	65		73	69	65		-17%	-5%	0%
Inter-sections	College	23,400	16,700	-29%														
	Girardot	3,000	6,800	127%														
	Tecumseh	38,000	27,500	-28%														
	Prince/Totten	12,300	16,000	30%														
	Malden	21,600	21,300	-1%														
	Industrial	17,600	21,800	24%														

7 GRAPHICAL REPRESENTATION

As requested in the MOE's memorandum, further attempts are made to present the information in a graphical assessment. While it would be possible to present all contaminants graphically for all horizon years, as many of the contaminants either have a limited number of exceedances, are well below criteria, or are negligible relative to background, only limited information will be presented graphically in this section and in Appendix E. Other contaminants, horizon years, or road segments can be made available for review if requested.

7.1 CONTAMINANTS WELL BELOW CRITERIA OR DOMINATED BY BACKGROUND

As stated in Section 4.1.1 of TEPA report, several contaminants were either well below criteria or the transportation aspect of the concentrations was negligible relative to the background. Acetaldehyde, carbon monoxide, formaldehyde and sulphur oxides were well below criteria. Acrolein, benzene, and 1,3 butadiene are contaminants where the background dominates the exposure. A sample plot of the impacts of SOx is listed in Figure 3.1 below.

Figure 7.1 SO_x 24 hr Maximum Concentrations between Todd/Cabana and Cousineau

7.2 NITROGEN OXIDES

Exceedances

As stated in the TEPA report, there were limited exceedances of the NO_x 1 hr criteria near the Plaza with no exceedances of the criteria in other locations with the Parkway beyond the ROW. Due to the traffic increases, even with technology changes, maximum concentrations are highest in the year 2035. To illustrate this graphically, concentrations above 400 $\mu g/m^3$ (the 1 hr criteria) are plotted in Figure 7.2. All other areas in 2035 are expected to be below the NO_x 1 hr criteria. There are no exceedances of the NO_x 24-hr criteria anywhere along the TEPA. As shown in the TEPA report Figure 4.1, NO_x concentrations drop precipitously from the maximum concentrations. At the 99th percentile concentration (i.e., 99% of the time concentrations will be lower), there are only limited instances within the Plaza itself above the criteria) as illustrated in Figure 7.3. Due to the limited number of hours that NO_x concentrations are expected to be exceeded, implementation of vehicle traffic flow measures should not be necessary.

Figure 7.2 NO_x 1 hr Maximum Concentrations Above Criteria, 2035

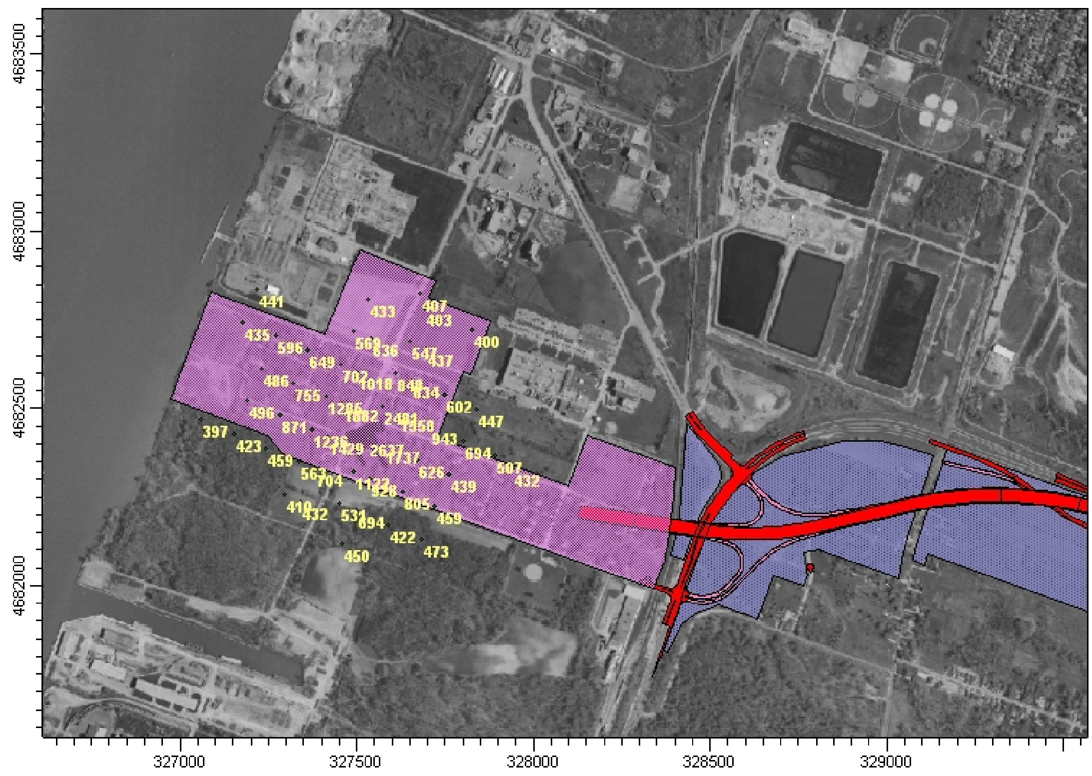
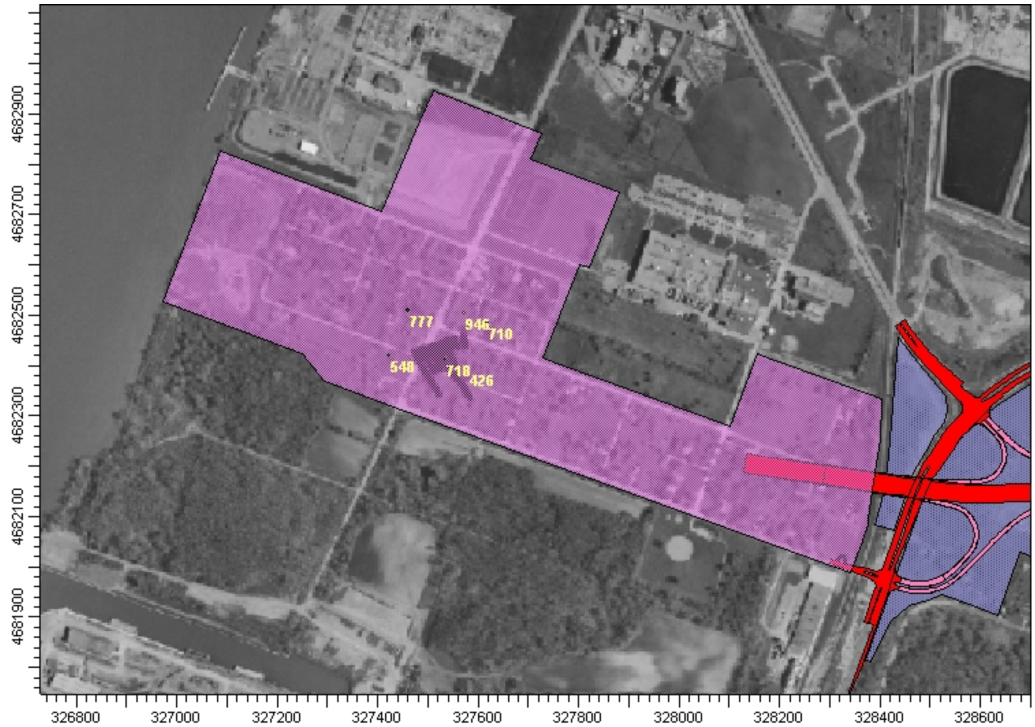


Figure 7.3 NO_x 1 hr 99th Percentile Concentrations Above Criteria, 2035



Maximum 24 Hour Concentrations

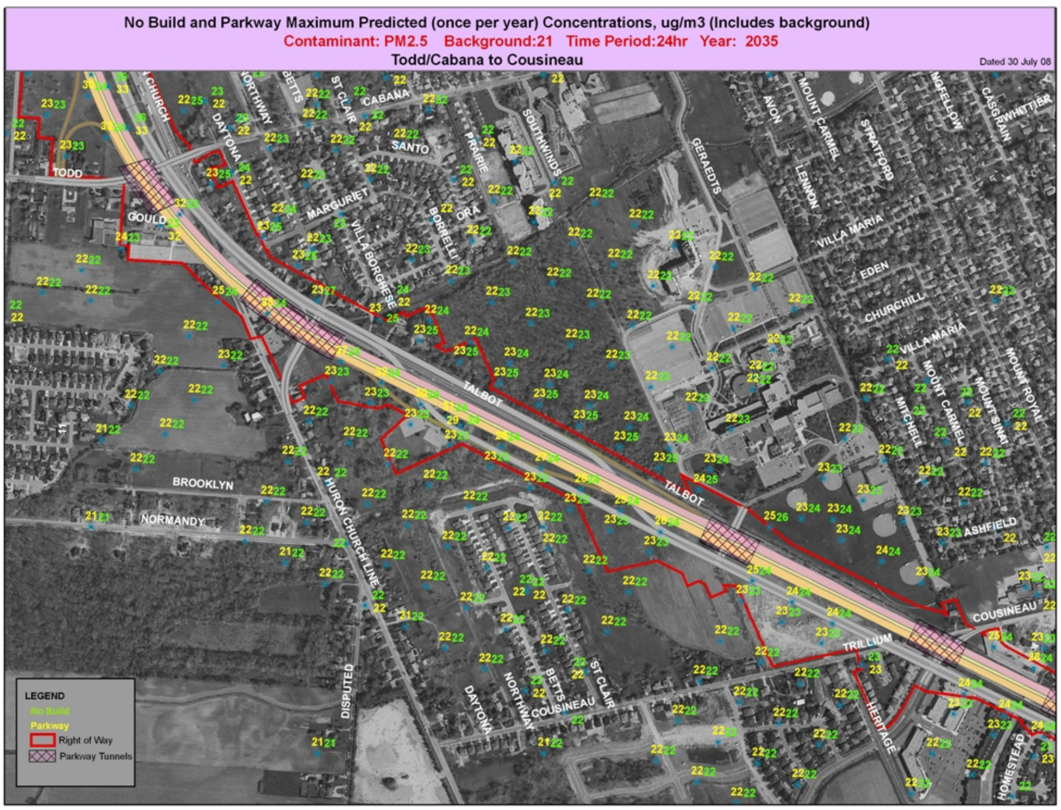
Maximum predicted NO_x concentrations do not exceed the criteria anywhere within the TEPA or for No Build. Due to technology changes, except for near the Plaza, predicted concentrations are generally higher in 2015 than in 2025 or 2035. Figure 7.4 below presents concentrations for 2015 between Todd/Cabana and Cousineau as an illustrative sample. Other NO_x sample plots are presented in Appendix E.

Figure 7.4 NO_x 24 Hour Maximum Concentrations Todd/Cabana to Cousineau, 2015

7.3 $PM_{2.5}$

As previously discussed both in this document and the TEPA report, maximum $PM_{2.5}$ concentrations are not predicted to exceed the CWS of 30 µg/m^3 for any of the horizon years beyond the ROW. All PM fractions including $PM_{2.5}$ are highest for the horizon year 2035. Figure 7.5 below presents concentrations for 2035 between Todd/Cabana and Cousineau as an illustrative sample. Other $PM_{2.5}$ sample plots are presented in Appendix E.

Figure 7.5 $PM_{2.5}$ 24 Hour Maximum Concentrations Todd/Cabana to Cousineau, 2035



7.4 PM_{10}

As stated in the TEPA report and as discussed in Section 4 above, PM_{10} maximum concentrations could be elevated due to the conservative nature of the silt loading and other model inputs. All PM fractions including $PM_{2.5}$ are highest for the horizon year 2035. Figure 7.6 below presents concentrations for 2035 between Todd/Cabana and Cousineau as an illustrative sample. Other PM_{10} sample plots, including PM_{10} exceedance days when using a 90th percentile background are presented in Appendix E.

Figure 7.6 PM_{10} 24 Hour Maximum Concentrations Todd/Cabana to Cousineau, 2035

7.5 PM

As stated in the TEPA report and as discussed in Section 4 above, PM maximum concentrations could be elevated due to the conservative nature of the silt loading and other model inputs. All PM fractions including $PM_{2.5}$ are highest for the horizon year 2035. Figure 7.7 below presents concentrations for 2035 between Todd/Cabana and Cousineau as an illustrative sample. Other PM sample plots, including PM exceedance days when using a 90th percentile background are presented in Appendix E.

Figure 7.7 PM 24 Hour Maximum Concentrations Todd/Cabana to Cousineau, 2035