Changes to Air Quality

Identifying how the Detroit River International Crossing (DRIC) study alternatives may change air quality is an important consideration in the DRIC Environmental Assessment.

Air quality effects of the Practical Alternatives have been assessed using a combination of existing air monitoring data and air dispersion modelling. Air dispersion modelling must be used to assess the impacts of future changes, such as implementation of the alternatives, and changes in fuels, vehicle technologies and traffic volumes. The predictive air quality model being used is specifically designed to assess impacts from roads and highways. The model incorporates the differences between moving vehicles, and queued vehicles that are idling, as well as differences in roads that are at-grade, below-grade, end-to-end tunnelled or elevated on bridges.

Existing concentrations of gaseous pollutants in Windsor such as sulfur dioxide (SO_2), carbon monoxide (CO), volatile organic compounds (VOCs) (such as acrolein) and others were examined as part of the assessment of Illustrative Alternatives and found to be well below Ontario Ministry of the Environment (MOE) Ambient Air Quality Criteria (AAQCs). Due to the number of alternatives and combinations being assessed, two indicator pollutants were selected for this phase of the analysis. Those chosen to represent one gaseous compound and one particulate compound are nitrogen oxides (NO_X) and particulate matter less than 2.5 microns ($PM_{2.5}$). These pollutants are generally the typical air pollutant indicator compounds with respect to transportation vehicle emissions. Changes in the total predicted concentrations of these two air pollutants were examined for each alternative in relation to the future no-build alternative.

How the Analysis was Done

The analysis was completed using the following approach:

- Compile data on existing $PM_{2.5}$ and NO_x concentrations
- Determine background concentrations
- Input traffic data for future conditions, including access road, plaza and crossing alternatives
- Calculate pollutant emissions from the highway corridor for existing and future conditions
- Use air dispersion model (CAL3QHCR) with meteorological data from Windsor Airport to determine future air pollutant concentrations in the vicinity of the corridor (essentially all of west Windsor) and at sensitive receptor locations (such as schools and residences).

Data on the existing air pollutant concentrations in the Windsor area was obtained from the two MOE air monitoring stations located on College Avenue and on University Avenue. Data from the two DRIC air monitoring stations, established in 2006, were also used to refine the background concentrations.

Traffic projections were developed for the DRIC study for all main roads in the corridor for each year considered in the assessment, which were 2015, 2025 and 2035. This included the future "do nothing" cases (i.e. expected traffic volumes if no new access road/crossing is built), as well as each of the Practical Alternatives for the access road, plaza and crossing.

Emission rates from these vehicles were input into the CalTrans CAL3QHCR roadway dispersion model, which is accepted for use in Ontario by the MOE and is supported by Environment Canada. The model incorporated meteorological data from Windsor Airport, to determine predicted air pollutant concentrations at various locations in west Windsor, in addition to specific sensitive receptor locations and receptors used in the Social Impact Assessment (SIA), such as schools and places of worship.

Findings to Date

Although this phase of the study focused on $PM_{2.5}$ and NO_x specifically, additional pollutants will be examined when assessing the technically and environmentally preferred alternative.

Presently, approximately 45 per cent of the total NO_x emissions in the Windsor airshed come from trucks and cars on the local road network. Emissions from the vehicles using the Huron Church Road corridor contribute approximately two per cent of the total NO_x emissions to the Windsor airshed. Recent and on-going improvements in emission control technologies and fuels will combine to substantially reduce the emissions from transportation sources. As of June 2006, the maximum amount of sulphur in on-road diesel fuel was reduced from 500 mg/kg to 15 mg/kg. These reductions were necessary for Canadian sulphur levels in on-road fuels to be consistent with U.S. levels, and to ensure that advanced emission control technologies on newer engines would be effective. In January 2007, additional engine standards for heavy-duty vehicles came into effect. These standards reduce NO_x and particulate matter emissions by 60 per cent and 90 per cent respectively over existing levels, and require the incorporation of additional emission control technologies on these newer engines to effect these reductions.

Based on these and other anticipated changes in both Canada and the U.S., preliminary estimates are that annual emissions of NO_x from road related transportation sources in Windsor will be reduced from approximately 4,000 tonnes in 2004 to 500 tonnes in 2035. These changes will occur over time as the vehicle fleet is replaced. Based on these projected decreases, cars and trucks will likely contribute less than 10 per cent of the total regional NO_x emissions.

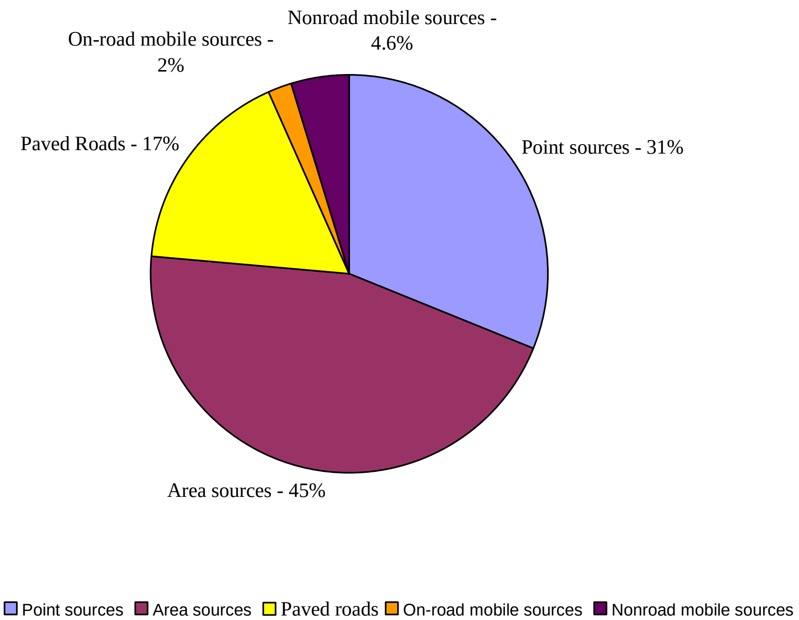
$PM_{2.5}$ emissions from road based transportation sources are comprised of two contributing fractions. The first is tailpipe emissions resulting from fuel combustion. The second, and higher fraction, is from road dust, which is generated from the re-suspension of surface material and debris, tire and brake wear, and roadway abrasion.

The figure below presents the breakdown of $PM_{2.5}$ emissions in southwestern Ontario. It is divided into:

- Point Sources (i.e. factory smoke stacks)
- Area Sources (farms, construction sites, unpaved roadways)
- Non-road Mobile Sources (rail transportation, marine transportation, construction equipment)
- Paved Roads
- On-road Mobile Sources (tailpipe emissions from cars and trucks on roads and highways).

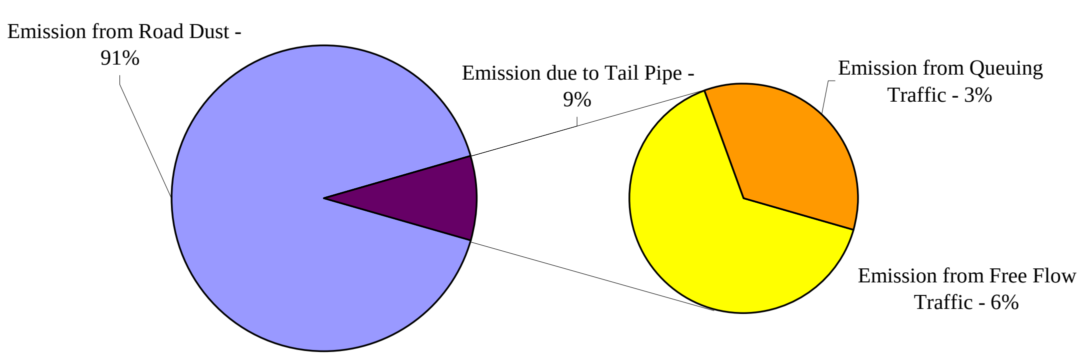
As can be seen in the chart, cars and trucks on paved roads and highways contribute 19 per cent of the total $PM_{2.5}$ emissions, and only two per cent of this is from tailpipes. Improvements in fuels and vehicle engine technologies will result in further decreases in the tailpipe portion of $PM_{2.5}$ emissions from road-based transportation.

$PM_{2.5}$ Emissions for Southwest Ontario (Year 2000)



Since total road emissions of $PM_{2.5}$ are predominantly comprised of road dust, $PM_{2.5}$ emissions will increase as traffic increases in the Highway 3/Huron Church Road corridor. However, the tailpipe fraction of $PM_{2.5}$ emissions is currently a maximum of 30 per cent of the total road based $PM_{2.5}$ emissions from the corridor. By 2015, this fraction will be reduced to less than 10 per cent of the total $PM_{2.5}$ emissions, because of the combined effect of cleaner fuels and provision of a freeway for international traffic. (Free flow conditions on a freeway avoid braking, idling and acceleration at traffic signals). This is shown in the following figure.

2015 $PM_{2.5}$ Emission Breakdown due to Vehicular Traffic in Windsor Area



By 2025, the tailpipe fraction of $PM_{2.5}$ will be further reduced to four per cent of the total roadway contribution from the corridor, as the vehicle fleet is fully replaced with vehicles that incorporate the new engine technologies.

Another important consideration is the role of contributions from upwind sources and transboundary (air pollution that originates outside of the local region) air flow on total $PM_{2.5}$ concentrations in Windsor. During typical conditions, these sources comprise approximately 56 per cent of the total concentration of particulate matter in the Windsor area. During a smog event, this contribution increases to over 80 per cent, as polluted air flows into the region from upwind sources in the U.S.

Practical Alternatives

Implementation of any of the alternatives that were assessed in this phase of the study result in decreased $PM_{2.5}$ and NO_x concentrations, and an improvement in air quality compared to the no-build alternative. All predicted NO_x concentrations in the vicinity of the corridor are predicted to be below relevant standards and guidelines.

Tunnel Ventilation Options

Four different options for ventilation of the cut and cover end-to-end tunnel option (Alternative 3) were assessed. These are as follows:

- Option 1A – two ventilation buildings each located approximately one third away from the main tunnel entrance/exits
- Option 1B – two ventilation buildings each located at the main tunnel entrance/exits
- Option 1C – a single ventilation building located approximately half-way between the tunnel main entrance/exits
- Option 2 – jet fans placed on the tunnel ceiling throughout the tunnel with pollutants being exhausted out the portals instead of ventilation buildings.

The results of the atmospheric dispersion modelling assessment indicate that of the four tunnel ventilation options studied, Option 2 (i.e. using jet fans to ventilate the tunnel through the portals instead of a vent building) results in unacceptably high concentrations of $PM_{2.5}$ and NO_x at the receptors compared to the other three ventilation options.

The results also indicate that there is little to no difference in the maximum predicted concentrations between the three ventilation building options assessed. For the purposes of comparison to at-grade and below-grade alternatives, Option 1A was assumed as the ventilation configuration for the end-to-end cut and cover tunnel. The two locations along the access road corridor developed in consultation with the public for the two ventilation buildings were in the vacant field in the northwest corner of the Todd Lane/Huron Church Road intersection, and the vacant field opposite St. Clair College.

At-grade vs. Below-grade vs. Cut and Cover End-to-End Tunnel

Air dispersion modelling of air quality impacts of the Practical Alternatives indicates that there are slight differences between these alternatives within 50 – 100 m (164 – 328 ft) from the right-of-way (ROW). Below-grade alternatives result in a reduction in maximum predicted $PM_{2.5}$ and NO_x concentrations in the vicinity of the ROW, in comparison to at-grade alternatives. For example, within 50 m (164 ft) from the ROW, below-grade sections show slightly lower predicted concentrations of $PM_{2.5}$ and NO_x than at-grade sections. At approximately 100 m (328 ft) and beyond, there is no discernible difference between at-grade and below-grade alternatives.

Within 50 m (164 ft) of the ROW, the end-to-end tunnel alternative results in lower maximum predicted concentrations of $PM_{2.5}$ compared to at-grade and below-grade alternatives. At 100 m (328 ft) from the ROW, there is little difference between the alternatives in terms of maximum predicted $PM_{2.5}$ concentrations. At 250 m (820 ft) from the ROW there is no difference between any of the alternatives in terms of $PM_{2.5}$ concentrations.

The end-to-end tunnel alternative results in increases in the maximum predicted 1-hour and 24-hour NO_x concentrations in the vicinity of the ROW, compared to at-grade and below-grade options. These increases are also indicated over a broader area in comparison to the at-grade and below-grade options. This reflects the effect of the tunnel entrance and exit portals, in addition to the dispersion characteristics of the exhaust stacks at the ventilation buildings.

Service Road Configurations

Air dispersion modelling of air quality impacts of the Practical Alternatives indicates that between Alternatives 1 (one-way service roads) and 2 (parallel two-way service roads), there is little difference in the predicted changes to $PM_{2.5}$ and NO_x concentrations. Maximum predicted $PM_{2.5}$ and NO_x concentrations are slightly higher with the one-way service road options compared to the two-way service road options. However, air quality conditions are the same on average for each option.

Route Alignments between St. Clair College and Howard Avenue

Two route alignment options were studied for the area between St. Clair College and Howard Avenue. Option 1 considers a widening of the present roadway corridor more to the north (Windsor) side of Highway 3, whereas Option 2 considers a widening of the corridor more to the south (LaSalle) side of Highway 3.

The air dispersion modelling results indicate that there is little difference in the change in $PM_{2.5}$ and NO_x concentrations between Option 1 and Option 2 at receptors located within 50 m (164 ft) of the ROW between St. Clair College and Howard Avenue. Receptors within 50 m (164 ft) of the proposed ROW experience slightly lower maximum predicted NO_x and $PM_{2.5}$ concentrations with the Option 2 alignment versus the Option 1 alignment. This difference is primarily due to the change in the proximity of these receptors to the proposed ROW. However, on average, there is little to no difference in air quality conditions between Option 1 and Option 2 alignments.

Plaza Alternatives

Four plaza alternatives were studied (Plazas A, B, B1 & C) in this phase of the assessment. The results indicate that each of the four plaza alternatives studied results in increases in the predicted maximum $PM_{2.5}$ and NO_x concentrations in the vicinity of the plaza. These increases are experienced up to 250 m (820 ft) away from the property boundaries of each plaza. The effects of Plazas B, B1 and C are predominantly seen in the area to the west of Ojibway Parkway/E.C. Row Expressway interchange at non-sensitive receptors. None of the plaza options would result in a discernible difference in the maximum predicted concentrations for Sandwich Towne.

In the vicinity of Armanda Street, implementation of any alternative results in increased $PM_{2.5}$ and NO_x concentrations in relation to the no-build Alternative. Plaza A results in marginally higher $PM_{2.5}$ and NO_x concentrations than Plaza B due to the proximity of the plaza to the adjacent residential area.

Crossing Alternatives

Three bridge crossing alternatives have been studied. The results of the atmospheric dispersion modelling indicate that each of the three crossing alternatives results in increases in the predicted $PM_{2.5}$ and NO_x concentrations within 250 m (820 ft) of the crossings and the approach roadways between each plaza and bridge. The area to the west of Ojibway Parkway/E.C. Row Expressway interchange will be impacted by changes in the predicted concentrations of $PM_{2.5}$ and NO_x resulting from Crossings A and B are primarily seen in the area to the west of Ojibway Parkway/E.C. Row Expressway interchange. In Sandwich Towne, there is no discernible difference in the predicted maximum $PM_{2.5}$ and NO_x concentrations from these crossing alternatives.

However, Crossing C (including the approach roadway to the crossing from the plaza sites) results in slight increases in the predicted maximum $PM_{2.5}$ and NO_x concentrations in the portion of Sandwich Towne within 250 m (820 ft) of this crossing compared to the no-build alternative. This occurs during certain worst-case meteorological conditions (light or no winds).

Next Steps

The following work will be undertaken as part of the assessment of the technically and environmentally preferred alternative.

- Model additional air pollutants and compare MOE criteria and guidelines
- Assess construction impacts
- Assess the need for mitigation measures.