Air Quality Assessments for Roadways

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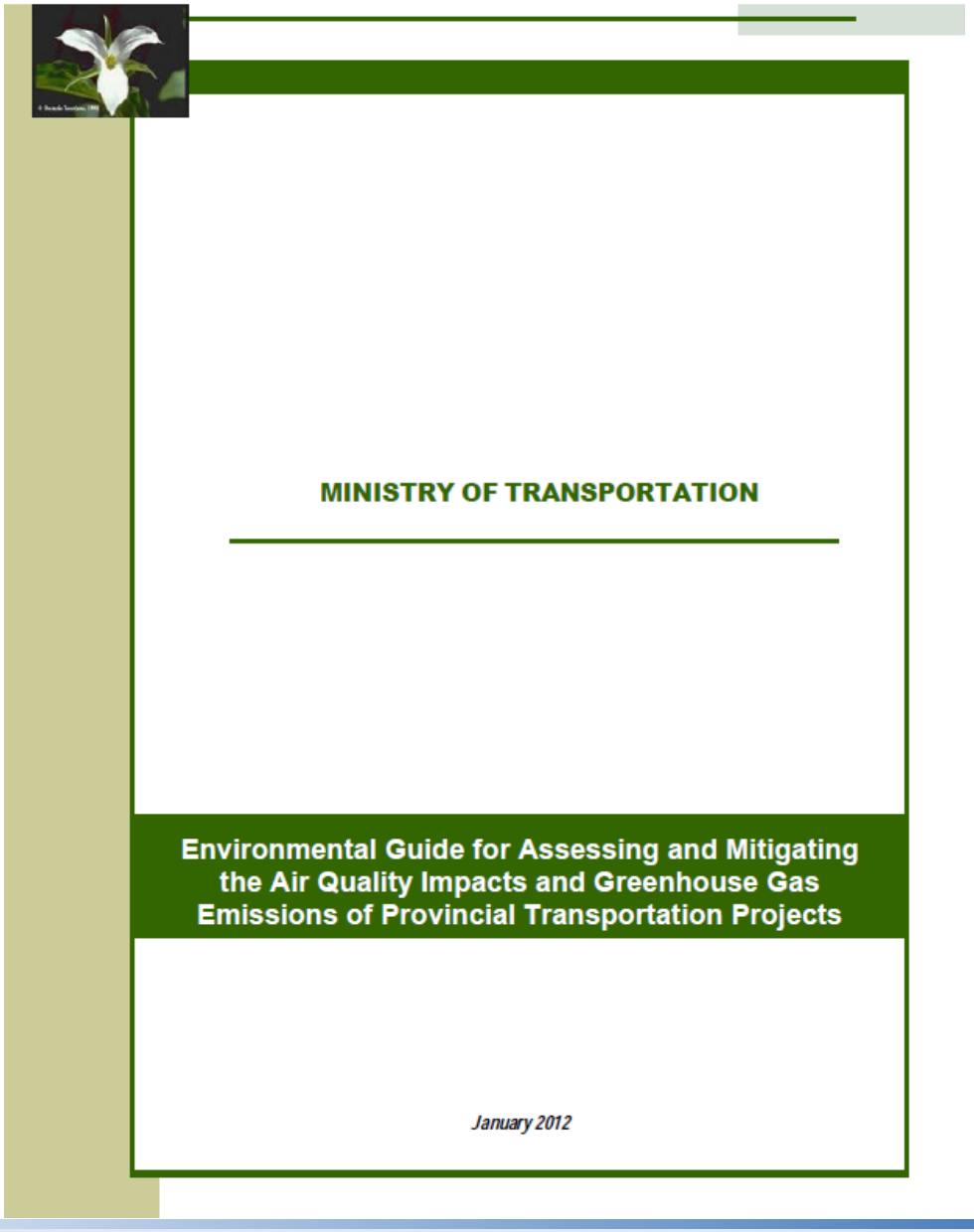
RWDI

Outline

- MTO Guideline
- Air Pollutants of Concern
- Factors influencing air emissions
- How air quality impacts are predicted
- Examples of Results
- Mitigation

MTO Guidance



Guideline Approach

Design Stage	Recommended Analysis
Planning Alternatives	- Burden (CAC & GHG)
Route Alternatives	- Burden (CAC & GHG) - Simplified Credible Worst-case Local Impact
Preferred Alternative	- Burden (CAC & GHG) - Credible Worst-case Local Impact - Comprehensive Local Impact - Mitigation Options

Local Air Quality Impact

1. Effects for people living within 200m
   - Increased cough, runny nose, wheeze in children
   - Reduced lung function in children (within 500m)
   - Higher prevalence of childhood asthma
   - Increased risk of COPD in women
   - 5% higher stroke mortality (7% for men)

Key Local Pollutants

PM10/PM2.5

- Respiratory/cardiovascular effects over long-term
  - WHO guidelines: 20 and 10 µg/m^3 (annual average)

- Increased mortality during short-term episodes
  - WHO guideline: 50 and 25 µg/m^3 (max 24 hr)
  - Ontario/Canada: 50 (max 24 hr) and 30 µg/m^3 (98th percentile 24 hr)

Key Local Pollutants (continued)

NO_2

1. Effects in asthmatics at short-term levels > 200 µg/m^3
2. Marker for combustion cocktail
   - Respiratory effects in infants at 40 µg/m^3 (annual avg.)
   - MOE criteria: 400 µg/m^3 (1-hr), 200 µg/m^3 (24-hr)

Key Local Pollutants (continued)

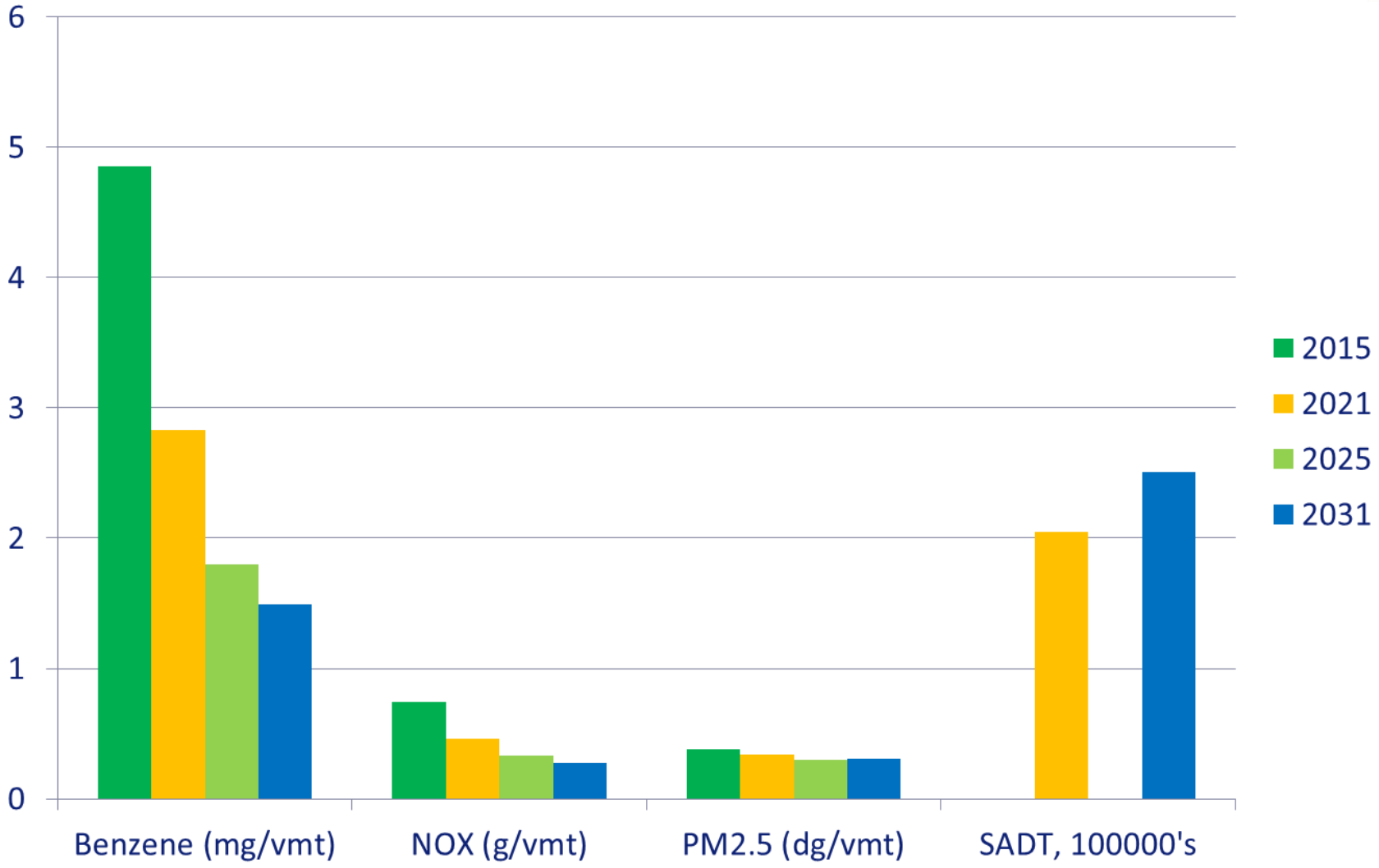
Benzene

- Cancer in workers exposed to high levels
- MOE criteria based on extrapolation to $1:10^6$ risk
- 0.45 $\mu g/m^3$ annual avg.
- 2.3 $\mu g/m^3$ for max 24-hr

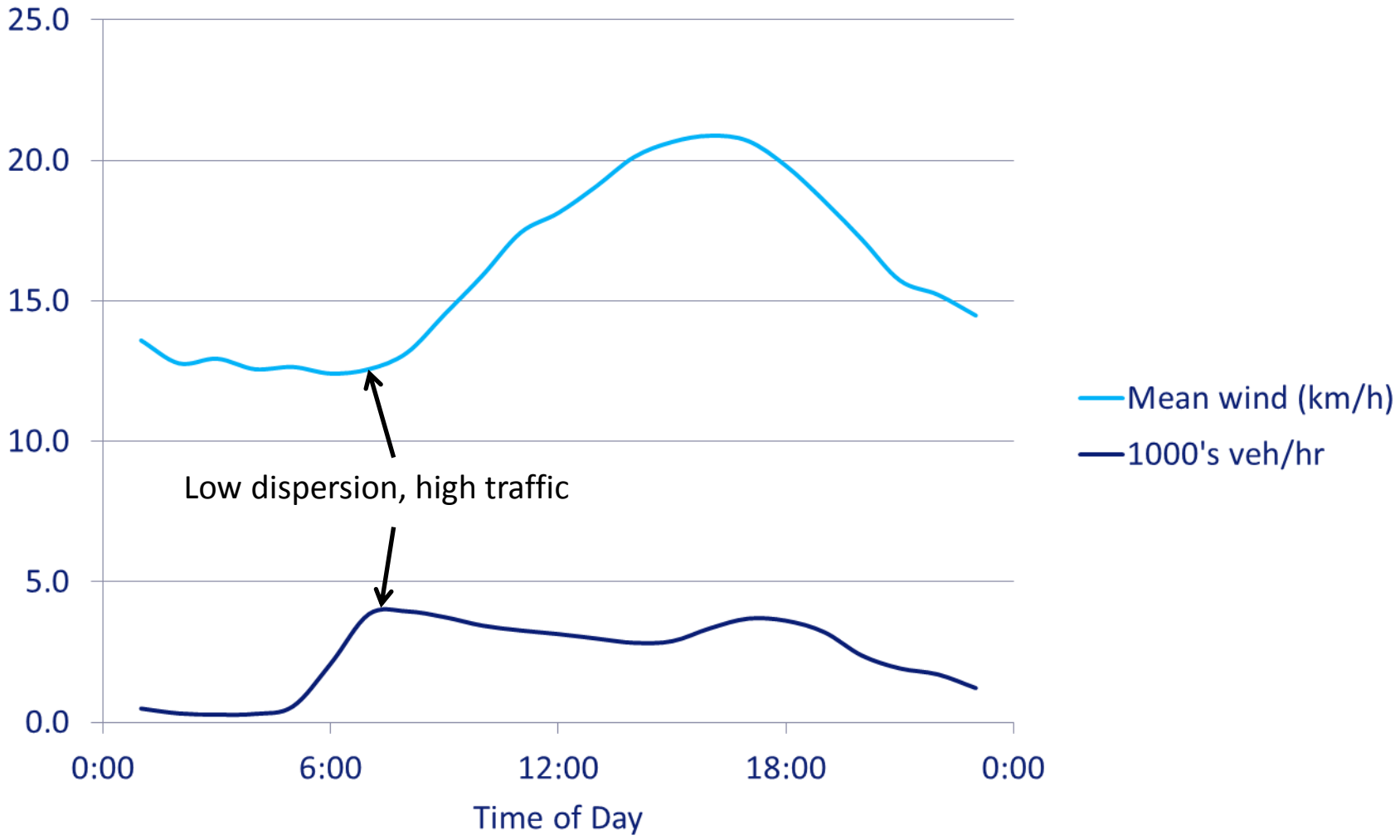
Guideline Scenarios

Time Horizon	No-Build	Build
Existing	√	
Year of Construction	√	√
10 Years after Construction	√	√
20 Years after Construction	√	√

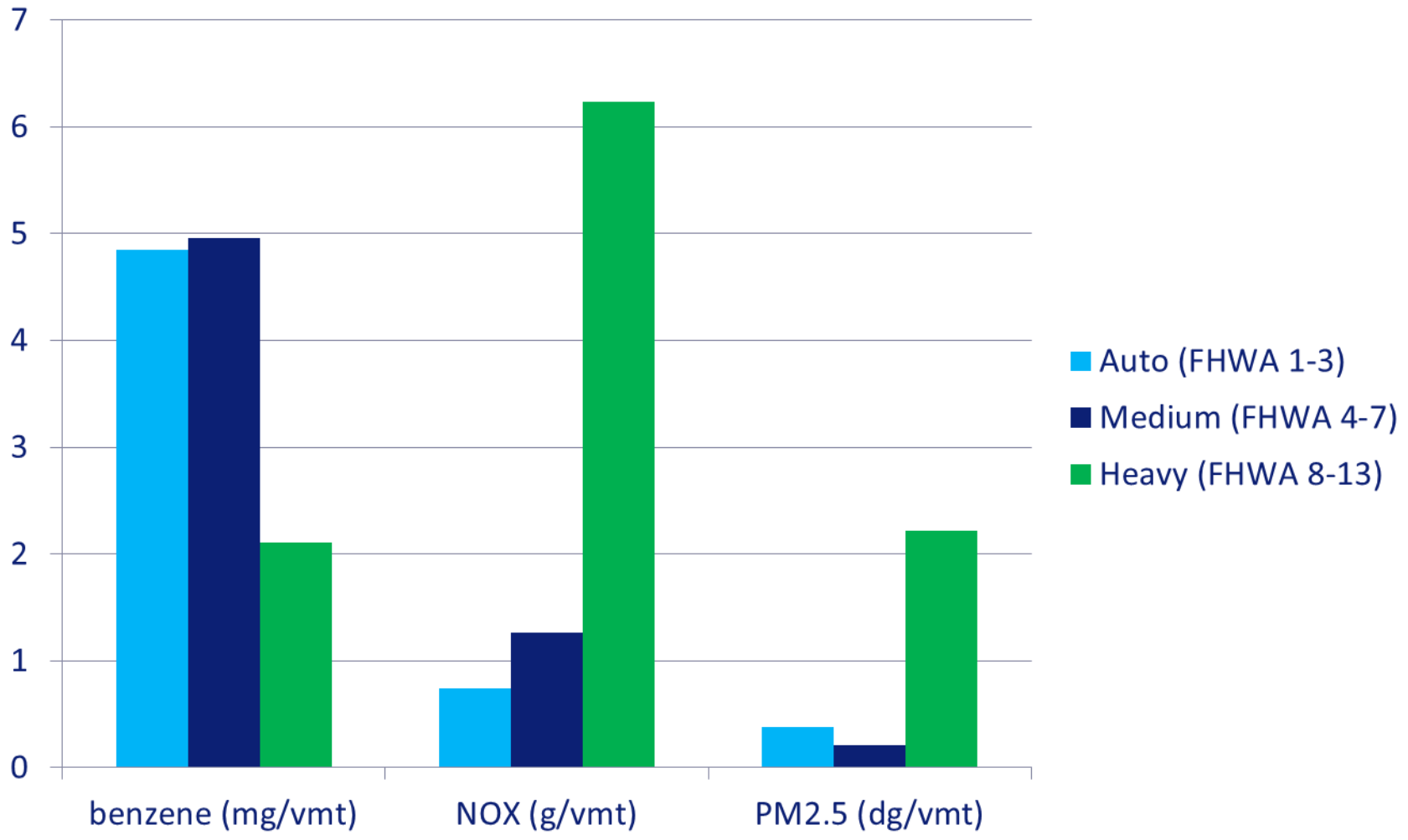
Why Multiple Horizon Years?



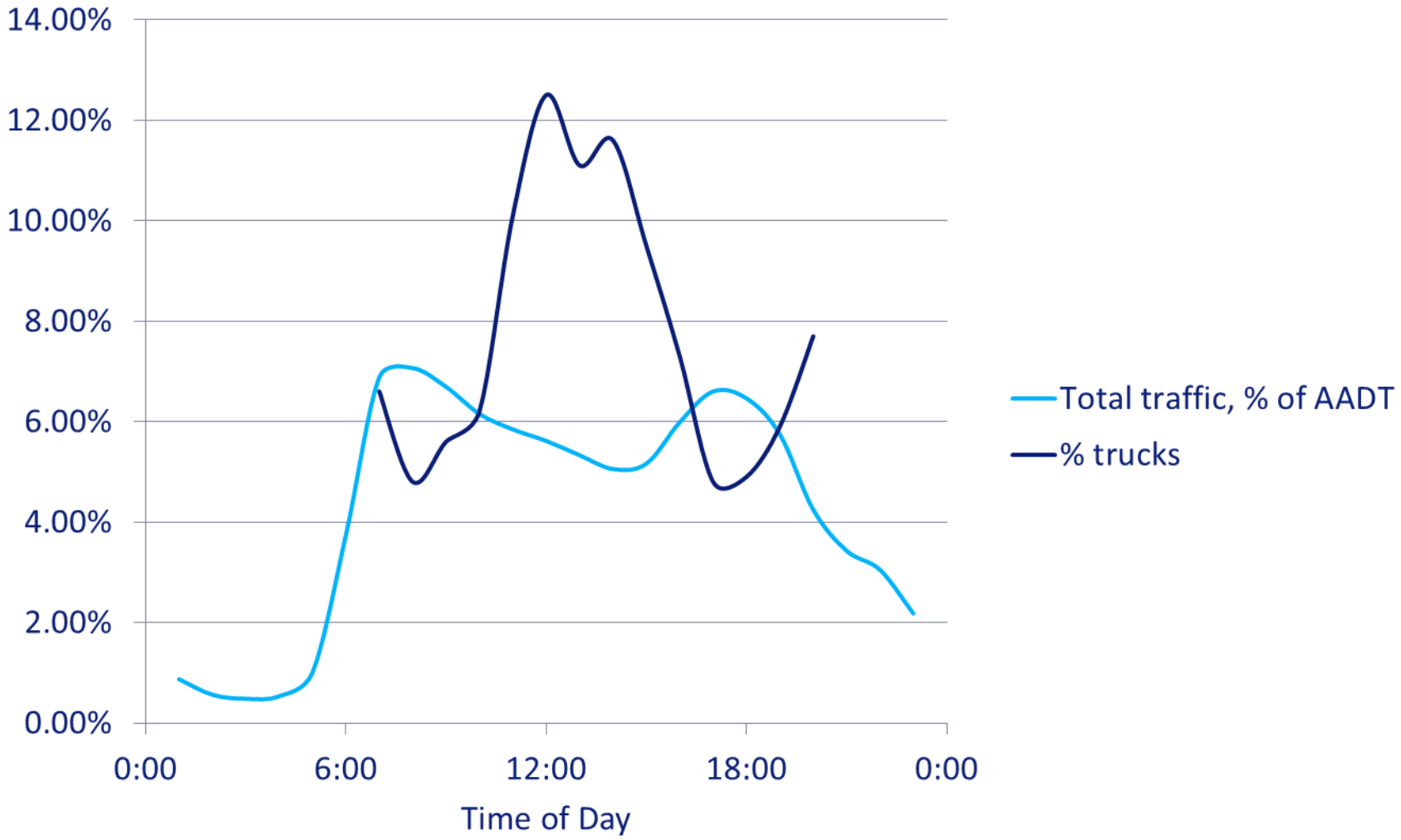
Traffic: Effect of Time of Day



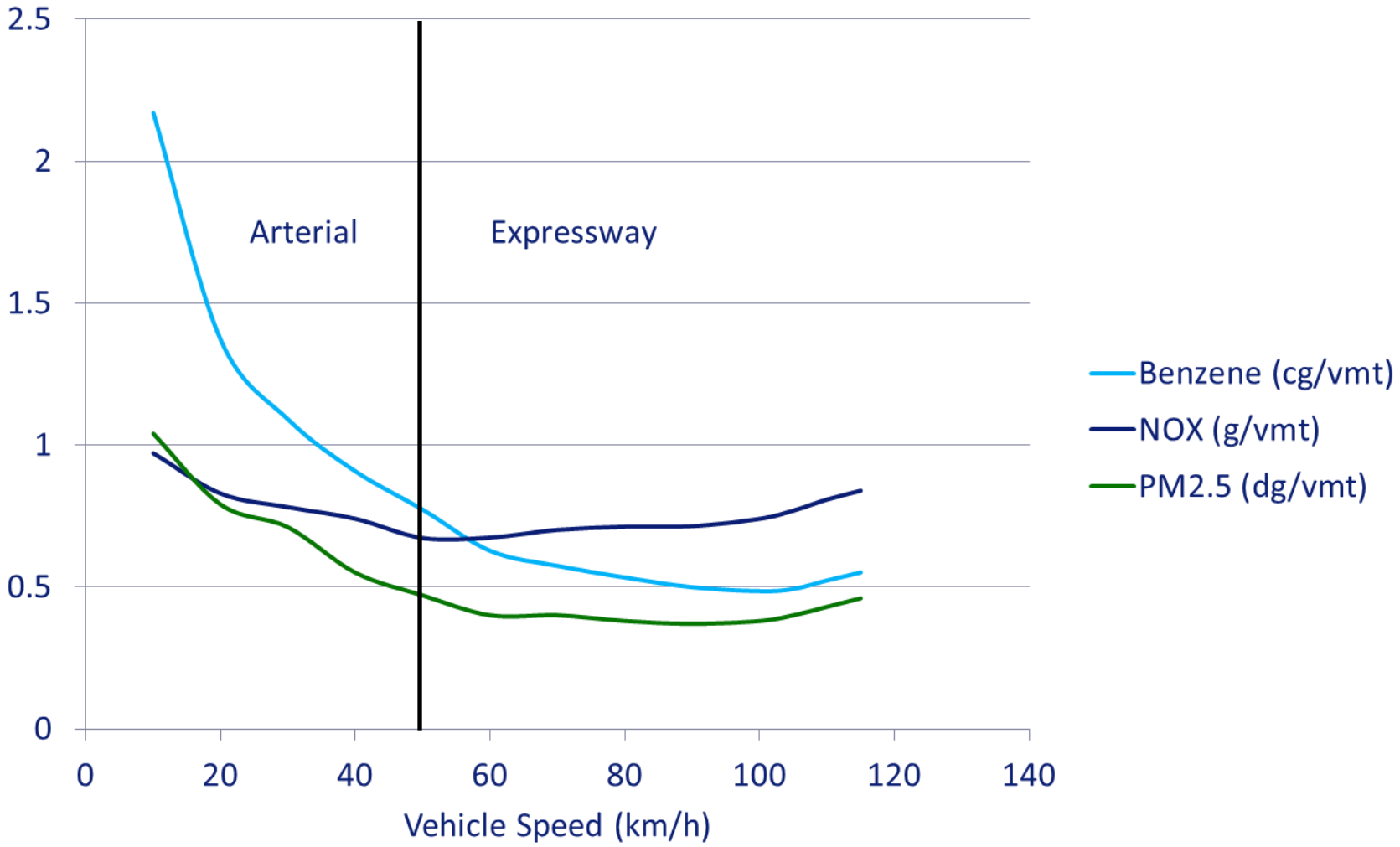
Effect of Vehicle Type



Effect of Vehicle Type (continued)



Effect of Traffic Speed



Predicting Local Air Quality Impact

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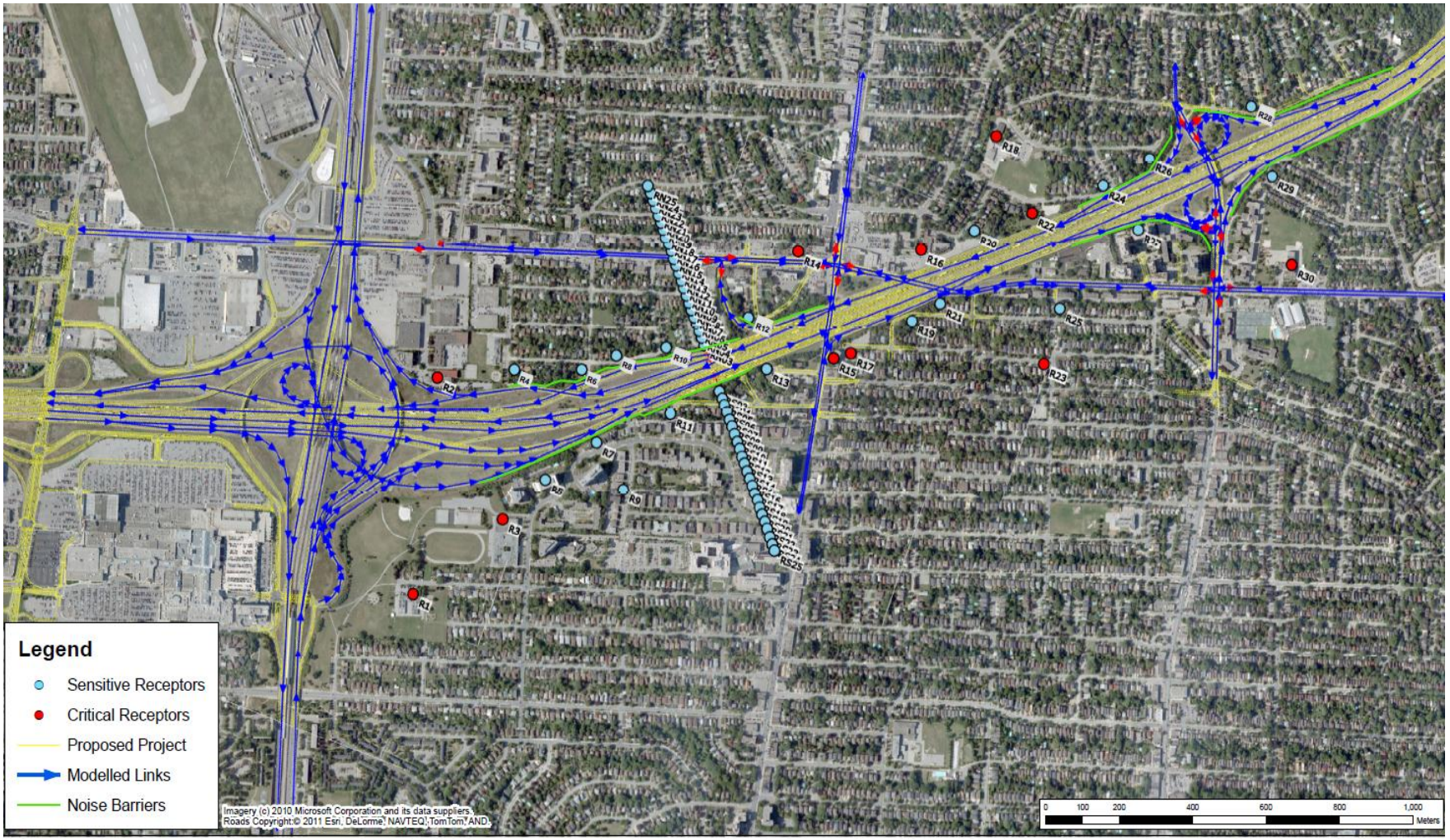
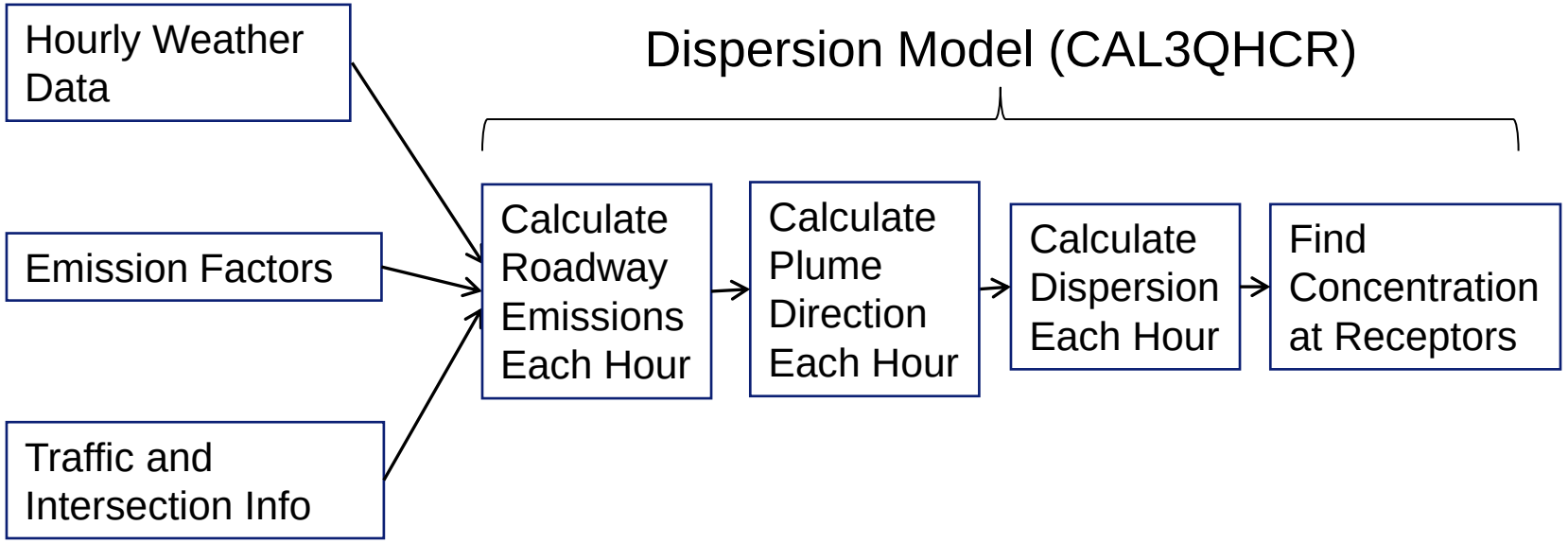


Dispersion Models – How They Work



Computer Simulation

Tiered Analysis

Two Tiers:

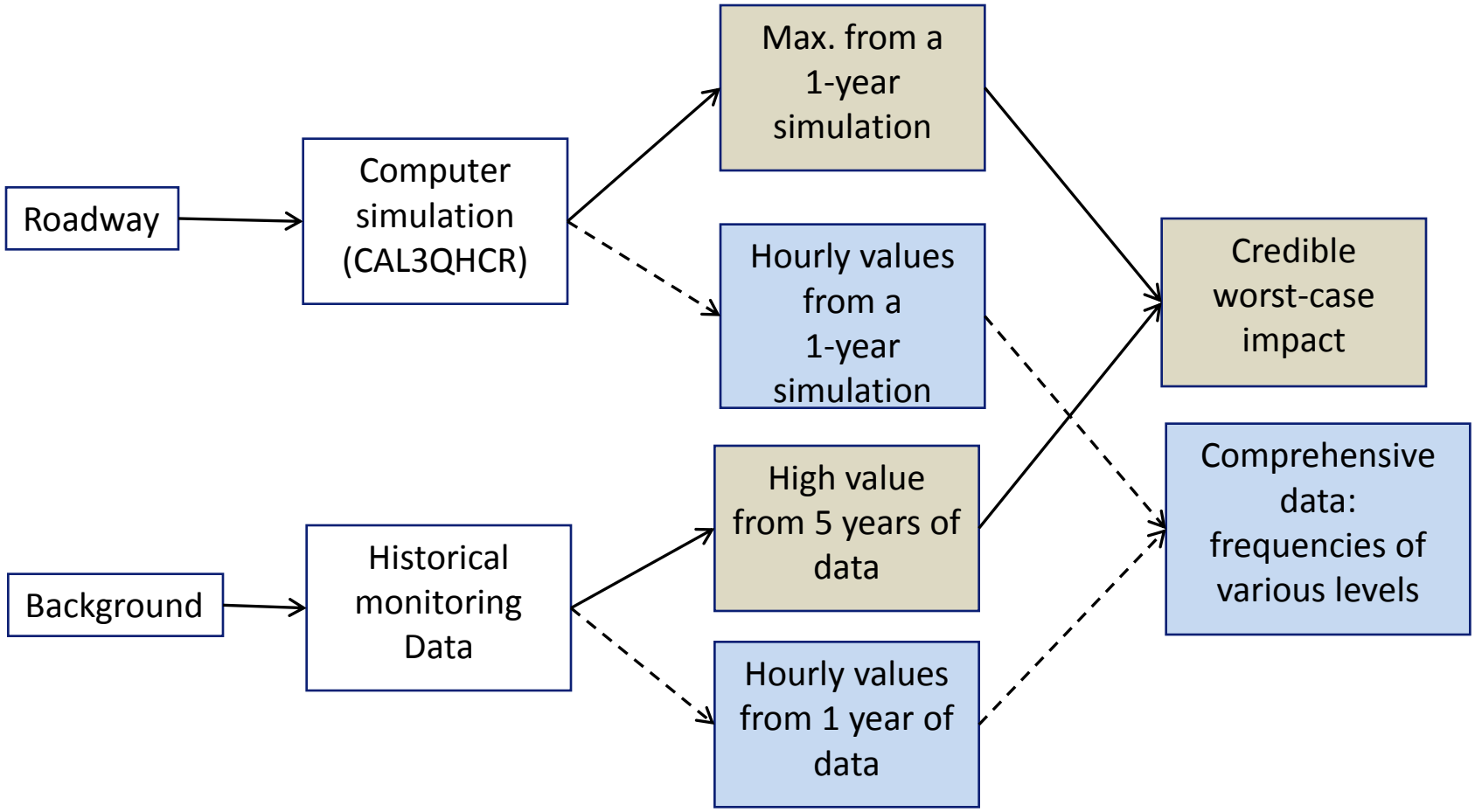
1. Credible worst-case analysis

   CO, NO2, PM, benzene, butadiene, aldehydes

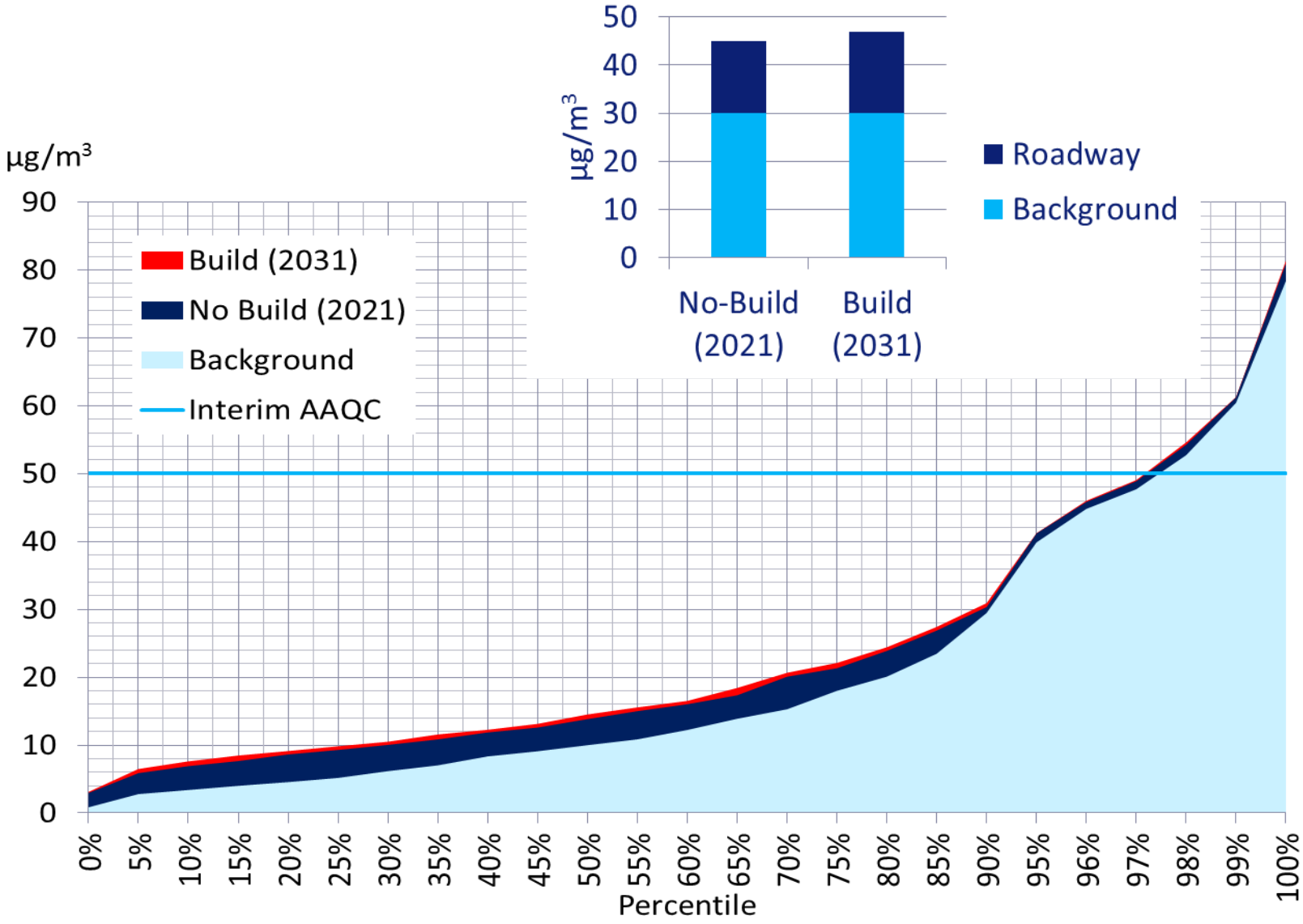
2. Detailed combined effects

   Contaminants whose credible worst-case concentration exceeds threshold

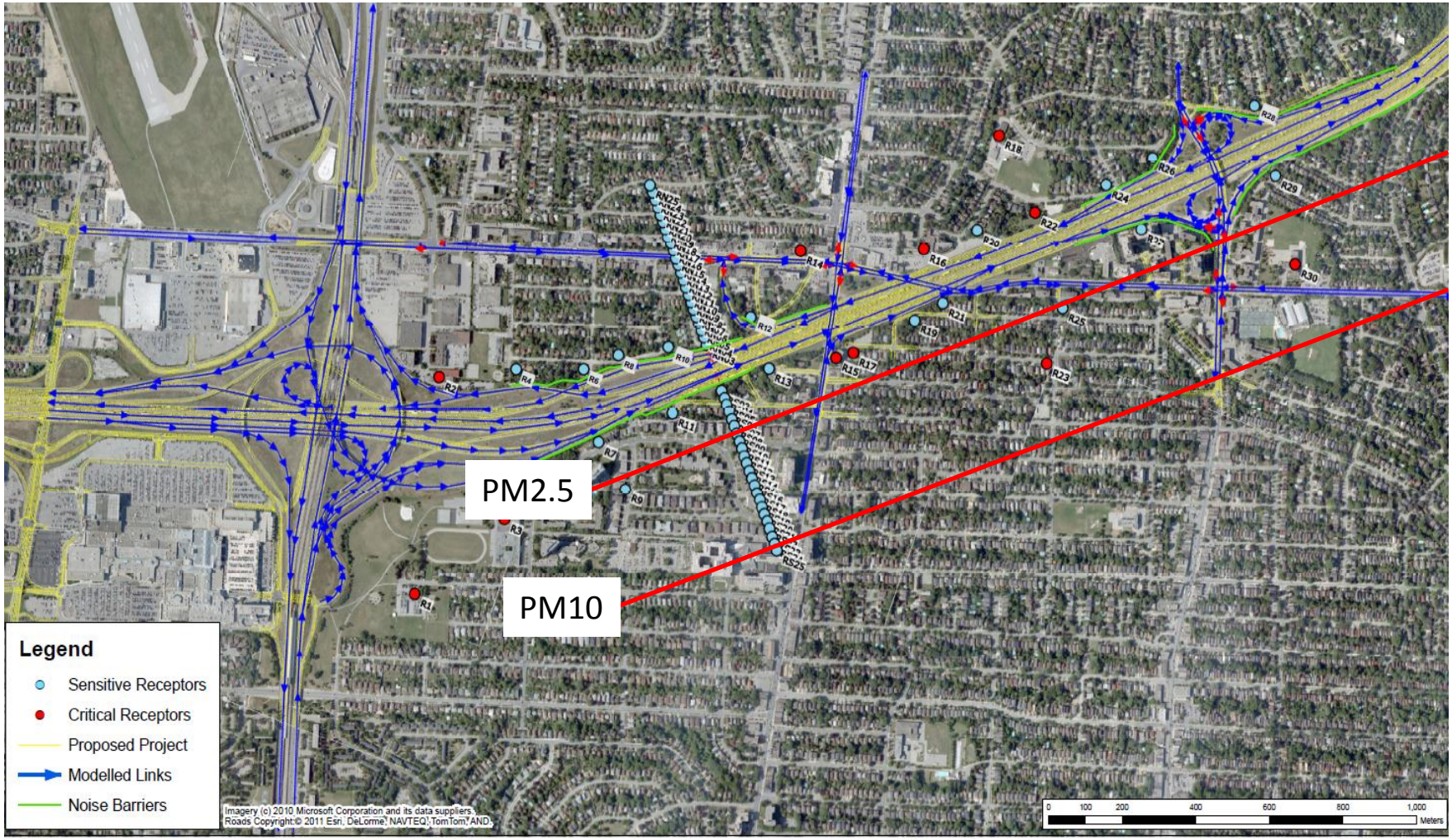
Tiered Analysis (continued)



Example: PM10



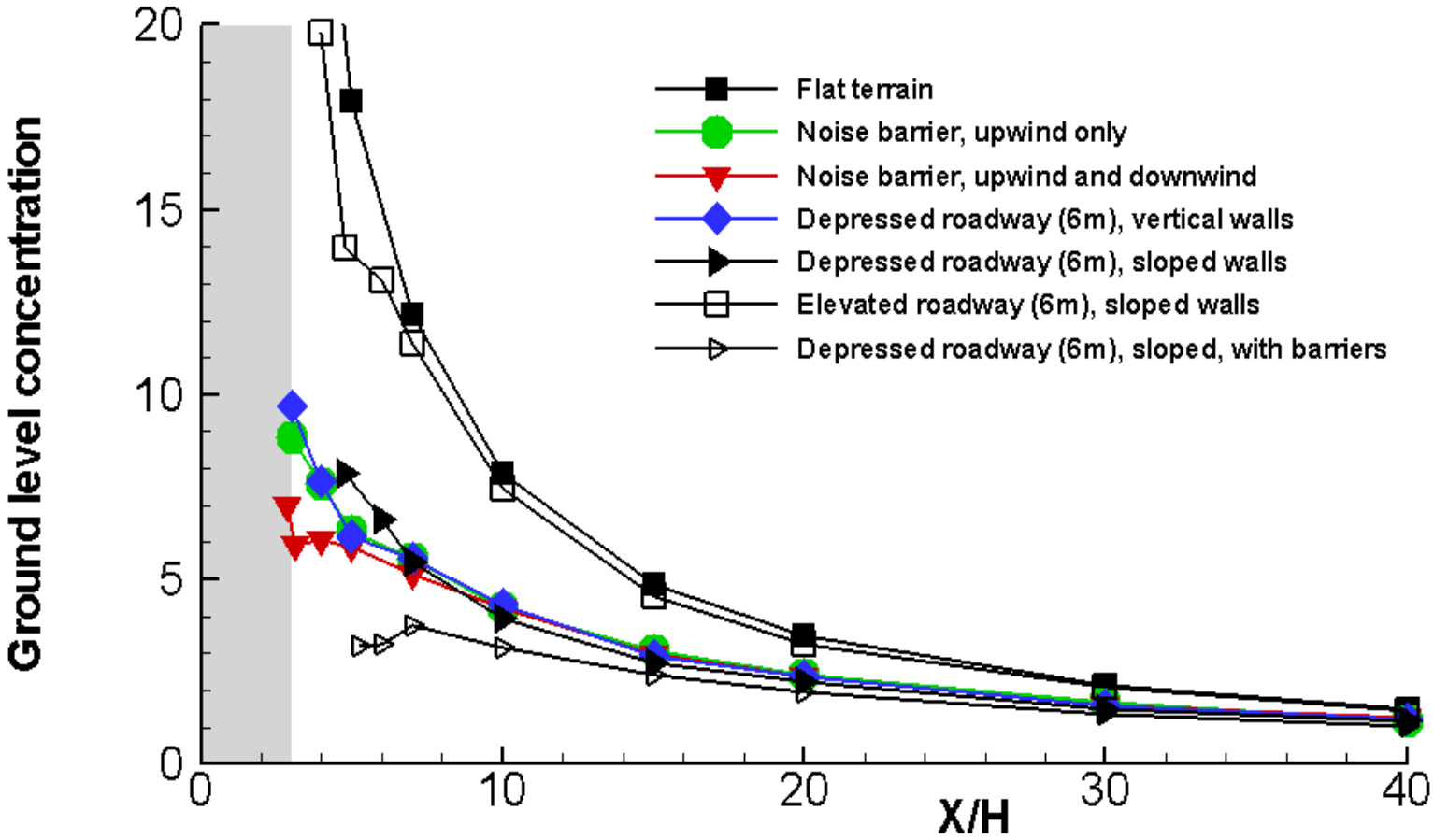
Worst-Case Credible Zone of Impact



Mitigation

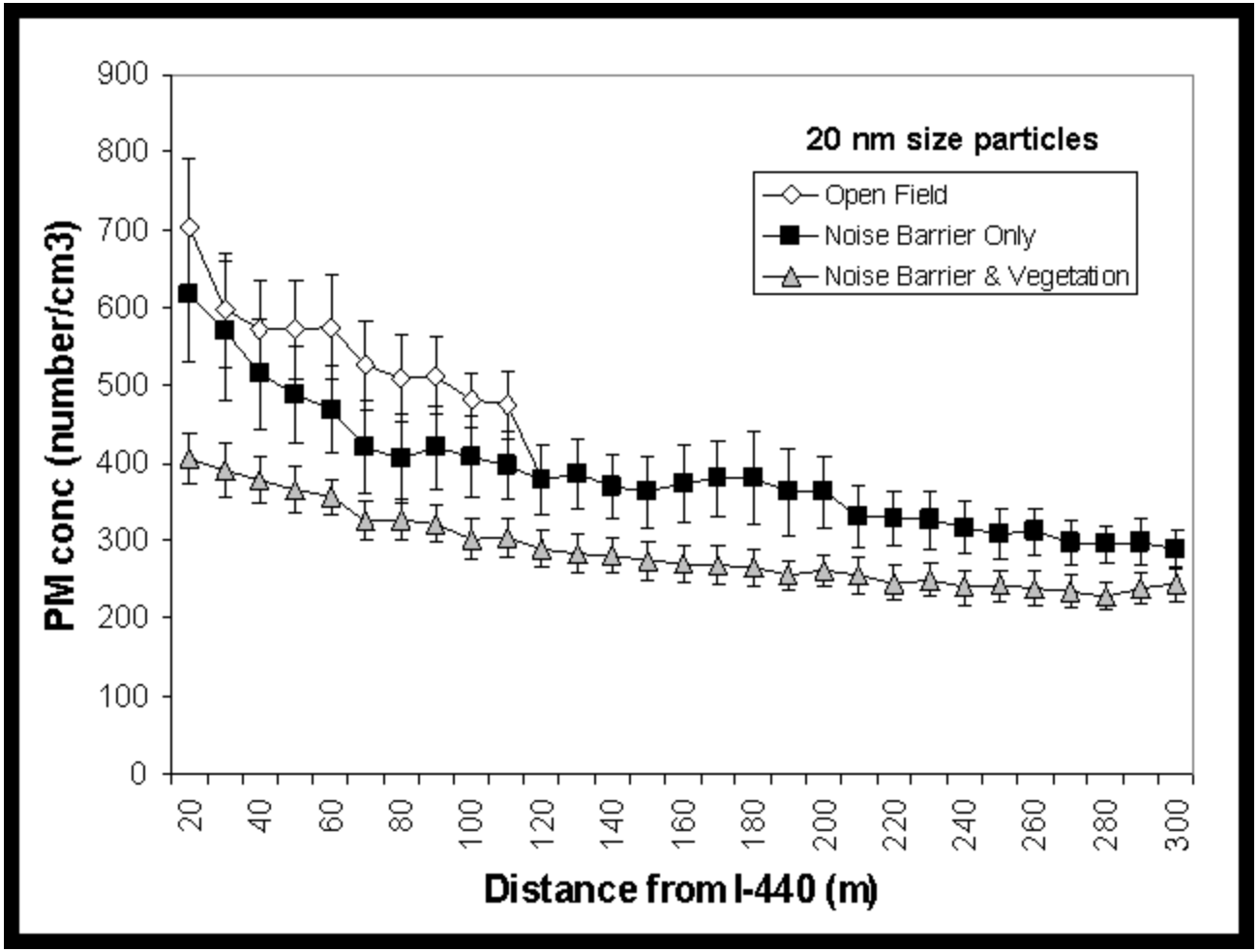
1. Gasoline Regulations (1989)
2. Benzene in Gasoline Regulations (1997)
3. On-Road Vehicle and Engine Emission Regulations (2004)
4. Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations (2010)
5. Sulphur in Diesel Fuel Regulations (2001)
6. Sulphur in Gasoline Regulations (1998)
7. Driveclean (Ontario, 2000)

Mitigation (continued)



Baldauf et al., 2009

Mitigation (continued)



Baldauf et al., 2008

Conclusions

1. Emissions are sensitive to vehicle speed, vehicle mix and horizon year
2. Road transportation in general:
   - Significant regional and local impacts
3. Specific projects:
   - Change in regional/local impact often small
4. Mitigation
   - Federal regulations fuel/engines
   - Barriers/vegetation to reduce local impacts

THANK YOU

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