Mapping the environmental impact of transport: Stormwater Run-off, Road Traffic Noise and Vehicle Emissions

Rob Hannaby
Environment and Urban Design Manager
NZ Transport Agency
Overview

1. Exploring the challenges
2. Case studies

<table>
<thead>
<tr>
<th>Stormwater Run-Off and Roads</th>
<th>![Map of Stormwater Run-Off and Roads]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Traffic Noise</td>
<td>![Map of Road Traffic Noise]</td>
</tr>
<tr>
<td>Vehicle Emissions</td>
<td>![Map of Vehicle Emissions]</td>
</tr>
</tbody>
</table>
Transport Domain Plan

**Figure 8: Theme Overview - Transport Impacts**

Knowledge needs
Better understanding of the size, exposure, valuation, interactions and influences of social, economic, cultural (including transport impacts for Māori as tangata whenua) and environmental impacts as well as the potential effects from mitigations.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Related enduring question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

### Scale

- M: Medium
- H: High

<table>
<thead>
<tr>
<th>High-priority Initiatives</th>
<th>Assessment Result</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quick wins</strong></td>
<td></td>
</tr>
<tr>
<td>R11.9 Improve environmental impact evaluation around run-off of vehicle pollutants on road</td>
<td></td>
</tr>
<tr>
<td>R11.2 Develop environment impact framework for emissions and infrastructure</td>
<td></td>
</tr>
<tr>
<td><strong>Other high-priority initiatives</strong></td>
<td></td>
</tr>
<tr>
<td>R11.1 Research into transport emissions profiles</td>
<td></td>
</tr>
<tr>
<td>R10.1 Develop health and safety risk profiles and exposures that lead to transport-related harm</td>
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</tbody>
</table>
Stormwater Run-off and Roads

Transportation Cost and Benefit Analysis II – Water Pollution
Victoria Transport Policy Institute (www.vtpi.org)

5.15.2 Definitions
Water pollution refers to harmful substances released into surface or ground water, either directly or indirectly. Hydrologic impacts refers to changes in surface (streams and rivers) and groundwater flows.

5.15.3 Discussion
Motor vehicles, roads and parking facilities are a major source of water pollution and hydrologic disruptions.¹ These include:

**Water Pollution**
- Crankcase oil drips and disposal.
- Road de-icing (salt) damage.
- Roadside herbicides.
- Leaking underground storage tanks.
- Air pollution settlement.

**Hydrologic Impacts**
- Increased impervious surfaces.
- Concentrated runoff, increased flooding.
- Loss of wetlands.
- Shoreline modifications.
- Construction activities along shorelines.

These impacts impose various costs including polluted surface and ground water, contaminated drinking water, increased flooding and flood control costs, wildlife habitat damage, reduced fish stocks, loss of unique natural features, and aesthetic losses.

10 December 2015

Urban land use also affects waterways. Run-off from roads and other human-made surfaces can wash heavy metals and other pollutants into drains, streams, and rivers. Untreated wastewater also carries pollutants into streams and rivers. We currently have insufficient data to assess the effect of urban and industrial discharges on the freshwater environment and how these pressures have changed over time. We will include this information in future reports.
Road Traffic Noise

Traffic noise increases risk of heart attack, researchers find

12:44 PM Monday Jul 11, 2016

SHARE: Facebook Twitter Google LinkedIn

People in areas exposed to traffic noise are at a higher risk of heart disease. Photo / iStock

Exposure to traffic noise increases the risk of suffering from a heart attack, researchers have found.

Pollution

Study links blood pressure risk to road noise

Traffic noise is associated with an increase in hypertension cases, according to research from five European countries

Tuesday 25 October 2016 09:05 EDT

Figure 7.1 People affected by transport noise in agglomerations > 250 000 inhabitants (EU-27)

Almost 67 million people (i.e. 55% of the population living in agglomerations with more than 250 000 inhabitants) are exposed to daily road noise levels exceeding 55 dB Ldn (the lower benchmark for the combined noise indicator). Daily exposure to railway noise and airport noise in these agglomerations is lower but still significant, with respectively 5.6 and 3.2 million people exposed to levels above 55 dB Ldn. With almost 45 million people exposed to levels exceeding 50 dB Ldn (the lower benchmark for nighttime noise) road noise is also by far the largest source of exposure to night-time transport noise.

Vehicle Emissions

Road motor vehicle emissions

Road motor vehicles emit a range of air pollutants from their exhausts, and from brake and tyre wear. They are the main human-made source of nitrogen oxides and carbon monoxide emissions. Exposure to these pollutants can damage health, with effects ranging from respiratory irritation to cancer.

We classified Road motor vehicle emissions as a national indicator.

Key findings

- Decreasing trend (improving status)

Estimated emissions of key pollutants from road motor vehicles decreased 26–52 percent between 2001 and 2013.

Figure 2.5 shows trends in the annual average NOx concentrations from 2007 to 2014 for sites contained within the central Auckland monitoring zone.

Figure 3.5 Annual average NOx concentrations 2007-2014. SH = state highway, LR = local road. BK = background.

Updated Health and Air Pollution in New Zealand Study

Table 6.1: Total air pollution health impacts for New Zealand in 2006 by source and effect

<table>
<thead>
<tr>
<th>Health Effect</th>
<th>Domestic Fires</th>
<th>Motor Vehicles</th>
<th>Industry</th>
<th>Open Burning</th>
<th>Natural</th>
<th>Total</th>
<th>Social Costs (Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature Mortality (adults)</td>
<td>65</td>
<td>255</td>
<td>123</td>
<td>139</td>
<td>1,136</td>
<td>2,307</td>
<td>8,211</td>
</tr>
<tr>
<td>Premature Mortality (babies)</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>9</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>Cardiac Admissions (all)</td>
<td>171</td>
<td>51</td>
<td>33</td>
<td>29</td>
<td>217</td>
<td>449</td>
<td>3</td>
</tr>
<tr>
<td>Respiratory Admissions (all)</td>
<td>321</td>
<td>71</td>
<td>24</td>
<td>47</td>
<td>356</td>
<td>731</td>
<td>3</td>
</tr>
<tr>
<td>Restricted Activity Days (all)</td>
<td>217,400</td>
<td>312,300</td>
<td>28,900</td>
<td>187,700</td>
<td>1,440,000</td>
<td>2,926,500</td>
<td>181</td>
</tr>
</tbody>
</table>

Source: NZ Transport Agency (2015)

Note: The social costs can be pre-rated across the table by source.
Challenge and Response

The Challenge

• Transport can create a range of public health, ecological, social and cultural impacts.
• Most impacts are experienced at the local scale but often require a management response at the regional or national level.
• Efficient and effective management requires comprehensive measurement of such impacts in space and time.
• Whilst there are numerous measurement frameworks, there remains the enduring problem of collecting, reporting and analysing such data in a way that enables multiple stakeholders, often working in apparently unrelated disciplines, to understand the relevance of the data to them and any ‘call to action’.

The Response

• Innovative use of Geographical Information Systems (GIS).
5.9 Conclusions from case study

Conclusions from applying the RSS model in the case study area are as follows:

5.9.1.1 Rivers and streams risk assessment

The majority of sub-catchments containing roads are classified in the 'lowest risk' category. In contrast, most sub-catchments containing any urban land use are classified as 'highest risk' reflecting the fact that loads of copper and zinc are high in relation to stream dilution potential. Loads from non-road impervious surfaces make up the majority of the total metal loads in these sub-catchments.
# Stormwater Run-off

## Overview
- ESRI ArcGIS and MS Excel Road Stormwater Screening (RSS) Model
- Considers relative risk of run-off from Road Traffic and Non-road Urban Contaminants
- Run-off for river reach sub-catchments based River Catchment Classification system
- Output Parameters - Road traffic run-off ‘markers’ - copper and zinc

## Stakeholders and Partners
- NZ Transport Agency
- MWH
- NIWA
- Greater Wellington Regional Council

## Current Status
- Basic relative risk model developed
- Case study of run-off risk for Te Awarua-o-Porirua Harbour and Catchment complete

## Next Steps
- Improve efficiency of sourcing and process model input data, including development of national geodatabase.
- Further validation work – additional case studies
- Map national risk

## Further Information
- [https://www.nzta.govt.nz/resources/research/reports/585/](https://www.nzta.govt.nz/resources/research/reports/585/)
Road Traffic Noise

STATE HIGHWAY NOISE MAPPING – AUCKLAND MOTORWAYS CASE STUDY

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Stephen Chiles, NZ Transport Agency, New Zealand
Chris Worts, NZ Transport Agency, New Zealand
James Whitlock, Marshall Day Acoustics, New Zealand
Andy Haigh, Beca, New Zealand

ABSTRACT

The NZ Transport Agency initiated a strategic noise mapping exercise in 2009. The aim was to generate noise maps covering the 220 km motorway network in Auckland, which could then be used to inform and identify priority areas for noise mitigation.

The 2009 exercise was repeated and refined in 2012 to address a number of short-comings, in particular, the limited geographical coverage of the maps due to incomplete input data, as well as output inconsistencies associated with the mapping methodology. Careful project scoping, supplier selection and project management enabled the efficiency of the 2012 mapping process to be enhanced and streamlined. Ultimately, a comprehensive and consistent set of noise maps have been generated for the Auckland motorway network for a base year of 2006 as well as for 2011.

This paper explores the lessons learnt from the noise mapping exercise. It discusses the benefits of optimising the use of specialists in geographical information systems (GIS), acoustics, transport policy and asset management. The paper also discusses how the information provided by the maps is now being used to shape the Transport Agency’s response to road traffic noise issues in Auckland.
## Road Traffic Noise

<table>
<thead>
<tr>
<th>Overview</th>
<th>• ESRI ArcGIS and Soundplan Model</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>• Road traffic noise from Auckland Motorway Network only (220km)</td>
</tr>
<tr>
<td></td>
<td>• Years modelled - 2006 and 2011</td>
</tr>
<tr>
<td></td>
<td>• Output Parameter – $L_{Aeq(24hr)}$</td>
</tr>
<tr>
<td>Stakeholders and Partners</td>
<td>• NZ Transport Agency</td>
</tr>
<tr>
<td></td>
<td>• Beca</td>
</tr>
<tr>
<td></td>
<td>• Marshall Day Acoustics</td>
</tr>
<tr>
<td>Current Status</td>
<td>• No recent updates since original work completed in 2013</td>
</tr>
<tr>
<td></td>
<td>• Used to inform noise mitigation business case development</td>
</tr>
<tr>
<td>Next Steps</td>
<td>• Explore simpler mapping and modelling options at national level</td>
</tr>
<tr>
<td></td>
<td>• Repeat Auckland motorway noise model run for 2016 (next census) and explore options to expand to include significant local roads</td>
</tr>
</tbody>
</table>
Vehicle Emissions

National Vehicle Emissions
GIS Mapping Tool

National

NOx (kg/km/day)
- < 1
- 1 - 2
- 2 - 4
- 4 - 8
- 6 - 10
- 10 - 15
- > 15

Regional

Local
## Vehicle Emissions

### Overview
- ESRI ArcGIS Feature Manipulation Engine (FME) software model
- Emissions factors based on NZ Vehicle Emission Prediction Model
- Year Modelled - 2013
- Output Parameters - Greenhouse Gases (CO2) and Harmful Air Pollutants (CO, NOx, PM, etc)

### Stakeholders and Partners
- NZ Transport Agency
- Jacobs
- Transport Environment Knowledge Hub

### Current Status
- State highway emissions mapped
- Emissions mapped from all ‘significant’ roads Top of South Island + Gisborne

### Next Steps
- Emissions from all ‘significant’ roads in NZ to be mapped by Jun 2017
- Further validation work – to include comparison against regional and national greenhouse gas and harmful air pollutant inventories

### Further Information
Summary

- Smart use of GIS platform(s) informed by robust science to enable cross-sector collaboration in order to minimise the impact of transport-related environmental harms.

- Designed to:
  - support strategic and tactical interventions
  - monitor and report spatial and temporal trends at national, regional and local levels
  - inform scenario testing and economic appraisal
Thank You

QUESTIONS?

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