Health Impact Assessment - Definition

“Health Impact Assessment is both a health protection and health promotion tool. In HIA, health is broadly defined to include assessments of both the health hazards and health benefits of a proposal/project and the potential ways in which health and well being can be protected and promoted within the proposal/project.”

(Harris et al 2007)
Methodology and Guidelines

General guidance from:
- enHealth 2017, *Health Impact Assessment Guidelines*

More detailed approach to assessing health impacts from changes in air quality and noise based on approaches developed for major infrastructure projects in Victoria (West Gate Tunnel) and NSW (NorthConnex, WestConnex, F6 and Moorebank IMT – developed with NSW Health). Methodology developed in consultation with DHHS and EPA

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Health Impact Assessment – Desk-top assessment

- Assess all aspects of the project
- Consider stakeholder and community concerns in relation to health
- Assess health impacts (negative) and benefits (positive) using qualitative or quantitative methods
  - Consider the existing environment, population distribution, health behaviours and existing health – includes information on the existing health of the population
  - Evaluate the severity and likelihood of impacts and benefits
  - Assess the distribution of these impacts on the community - particularly important for transport projects as many of the impacts relate to a redistribution of traffic, vehicle emissions and noise in the community
  - Evaluate equity
- Recommend mitigation measures, where relevant
Objectives and Scope of Work

The overarching objective of the HIA is to evaluate how the project may benefit or impact upon the health and wellbeing of the local community, and to facilitate more health conscious planning and development.

Address the scoping requirements for the EES, that specifically requires health and amenity to be addressed in relation to:

- **Air quality** (changes within the local community from emissions to air from tunnel ventilation, and from key local roads)
- **In-tunnel air quality**
- **Noise and vibration** (changes within the local community)
- **Social aspects** (qualitatively address the social aspects that can affect health and wellbeing)

Changes in Air Quality

- Based on Air Quality assessment
- Assessment of changes in air quality associated with the project and impacts on health of community
- Construction impacts:
  - Qualitative assessment
  - Key issues relate to generation of dust, odours and emissions from diesel vehicles and equipment
  - Impacts require management through EPRs (EMF2, AQ1, CL1 and SC2)
  - Where managed, impacts to community health are minimised
Changes in Air Quality

• Operations: quantitative assessment of key pollutants from vehicle emissions:
  • **Volatile organic compounds and polycyclic aromatic hydrocarbons (PAHs)** – assessed acute and chronic exposures and compared with health based guidelines. Also assessed carcinogenic risks for benzene, 1,3-butadiene, carcinogenic PAHs and diesel particulate matter. **No exceedance of health based guidelines and no unacceptable risks**
  • **Carbon monoxide** – comparison of total predicted concentrations (background plus project) to health based criteria. **No exceedance of health based guidelines**
  • **Nitrogen dioxide and particulates** – No significant risks (as in next slides)

Nitrogen Dioxide and Particulate Matter

• Assessed 2 different vehicle emissions scenarios – **conservative and realistic**
• **Cumulative assessment** (background plus project) – review against NEPM (NEPC 2016)
• **Incremental assessment** – project specific and related to the changes in air quality from the project
• No threshold identified for nitrogen dioxide and particulate exposures. So in theory we can calculate an incremental risk from any change in exposure
• HHRA uses **robust** exposure response relationships for key health effects that have been shown to be **caused** by exposures to nitrogen dioxide or particulates (detailed discussion in Appendix E of HIA report for particulates)
Nitrogen Dioxide and Particulate Matter

<table>
<thead>
<tr>
<th>Nitrogen Dioxide</th>
<th>Health Effects Quantified</th>
<th>Particulates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality all causes (all ages) (ST)</td>
<td><strong>Primary health effects</strong></td>
<td></td>
</tr>
<tr>
<td>Mortality, respiratory (all ages) (ST)</td>
<td>PM$_{2.5}$: mortality all causes (ages 30+) (LT)</td>
<td></td>
</tr>
<tr>
<td>Asthma emergency department admissions (1-14 years) (ST)</td>
<td>PM$_{2.5}$: hospitalisations for respiratory and cardiovascular disease (ages 65+) (ST)</td>
<td></td>
</tr>
<tr>
<td><strong>Secondary health effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PM$_{10}$: mortality all causes (all ages) (ST)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PM$_{2.5}$: mortality, cardio pulmonary (ages 30+) (LT)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PM$_{2.5}$: mortality, respiratory and cardiovascular (all ages) (ST)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PM$_{2.5}$: Asthma emergency department admissions (1-14 years) (ST)</td>
<td></td>
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</tbody>
</table>

**ST** = health effects related to short-term changes in exposure
**LT** = health effects related to long-term changes in exposure

**Primary health effects** – key effects shown to be causal that include the secondary effects as well as a range of others

**Secondary health effects** – effects that relate to other age groups or specific subsets of effects that may be of particular concern to the community

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Nitrogen Dioxide and Particulate Matter

- Calculate a population risk:
  - Addresses exposures from emissions from tunnel ventilation and changes in road traffic within community that include sensitive groups
- Calculate a maximum localised risk:
  - Evaluate the maximum impacts from emissions from tunnel ventilation and changes in road traffic within the population and evaluate the significance
- This calculation is used to identify where risks increase and where they decrease – and if the increase is significant enough to require additional mitigation to lower health impacts
Nitrogen Dioxide and Particulate Matter

- Key assumptions in assessing population and maximum impacts from changes in air quality:
  - Assumes exposure occurs to anyone, including sensitive groups, at all these locations 24 hours per day, every day
  - Indoor air concentrations = outdoor air concentrations
  - Need to consider the acceptability of risk (discussion in Appendix D of HIA report)
    - Carcinogenic risks $\leq 1 \times 10^{-6}$ (1 in 1,000,000)
    - Population risks $\leq 1 \times 10^{-5}$ (1 in 100,000) (NEPC 2011)
    - Maximum localised risk: risk management measures required for risks $\geq 1 \times 10^{-4}$ (1 in 10,000)

Risk Levels

<table>
<thead>
<tr>
<th>Source</th>
<th>Incremental risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in 1,000,000</td>
<td>1 in 100,000</td>
</tr>
<tr>
<td>Air pollution-based guidance</td>
<td></td>
</tr>
<tr>
<td>NEPC (2011) (community/population mortality (HAI))</td>
<td>As low as possible but not lower than upper limit</td>
</tr>
<tr>
<td>NSW Health 2017 (community/population health)</td>
<td>- Negligible</td>
</tr>
<tr>
<td>NSW DEP (2017)</td>
<td>- Negligible</td>
</tr>
<tr>
<td>Other guidance (not specific to pollution levels)</td>
<td></td>
</tr>
<tr>
<td>NSW Planning, 2015</td>
<td>Acceptable</td>
</tr>
<tr>
<td>NEPC (2016)</td>
<td>- Negligible</td>
</tr>
<tr>
<td>NSW Planning, 2015</td>
<td>Unacceptable for assessment of lifetime exposures to</td>
</tr>
<tr>
<td></td>
<td>population cancer risks –</td>
</tr>
<tr>
<td></td>
<td>localised impacts</td>
</tr>
</tbody>
</table>

Maximum localised risks for other infrastructure projects range typically in the range 1 to 4 in 100,000

Some projects have maximum localised risks to 7 in 10,000
Nitrogen Dioxide and Particulates – Population Risks

Changes in nitrogen dioxide concentrations with project (mortality all-causes)

Changes in PM$_{2.5}$ concentrations with project (mortality all-causes)

Nitrogen Dioxide – Localised Risks

Management criteria adapted for localized changes in the order to meet local R&O.
Particulates – Localised Risks

Nitrogen Dioxide and Particulate Matter

- Calculate population incidence:
  - How many additional, or less cases (for the health effects) would occur in the populations evaluated
  - Total change is very small for all health effects considered: 0.00009 to 0.3 cases/year
  - These changes are not measurable
- None of the outcomes for health impacts from changes in air quality change if different (but also robust) published studies are used in the calculations
Impacts to health from changes in air quality - Summary

- Construction: management is required to minimise impacts to protect health
- Operations:
  - None of the impacts to health evaluated are considered to be significant or measurable, particularly where the realistic emissions scenario is considered
  - As there are no significant or measurable health impacts, there are no triggers to evaluate any mitigation measures
  - This includes tunnel filtration – impacts from tunnel ventilation much smaller than from changes in air quality from surface roads
- Where management measures are implemented all health impacts considered low and acceptable

In-tunnel exposures

- Time spent in the tunnel is short (4.5 minutes when travelling at 80 km/hr, and 9 minutes at 40 km/hour [slightly longer for slower speeds])
- In-tunnel guidelines for carbon monoxide – these are lower than the WHO air guidelines: no health effects expected
- Nitrogen dioxide – adopting guidelines from NSW tunnels (as recommended by the NSW Advisory Committee on Tunnel Air Quality) (0.5 ppm 15-minute average) which is considered protective of health for exposures up to an hour
- Tunnel designed to meet guidelines at all travel speeds
- Particulates
  - Tunnel guideline relate to visibility
  - There are no guidelines for very short duration exposures
  - Exposures 80% lower with ventilation on recirculation
  - Should minimise exposures in tunnels
Noise and Vibration

- Based on Noise and Vibration assessment
- Project areas are urbanised environments with many already impacted by existing road noise
- Assessment of health impacts against current published information on health effects from noise, particularly road traffic noise
- Construction: Without mitigation significant noise impacts are predicted that have the potential to result in adverse health effects in the community – these noise sources require mitigation to protect health and wellbeing (EPRs NV3 to NV6 and NV8 to NV12)
- EPRs include construction noise targets for sensitive areas and residential homes

Noise and Vibration

- Operational impacts evaluated changes in noise from roadways as well as the operation of ventilation facilities
- Some areas required noise mitigation/barriers – these have been considered in noise modelling
- Assessed health impacts in community from changes in noise associated with the project: population impacts and maximum localised impacts evaluated using same risk criteria as for changes in nitrogen dioxide and particulate matter

(WHO 2011)
### Noise and Vibration

<table>
<thead>
<tr>
<th>Health effect</th>
<th>Noise measure</th>
<th>Threshold for effects</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension: incidence</td>
<td>Lden</td>
<td>47 dB</td>
<td>Relative risk – calculation of individual risk and change in incidence in population</td>
</tr>
<tr>
<td>Ischaemic heart disease: hospitalisations</td>
<td>Lden</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Stroke: hospital admissions</td>
<td>LAeq,16hour</td>
<td>55-60</td>
<td></td>
</tr>
<tr>
<td>Mortality: all causes</td>
<td>LAeq,16hour</td>
<td>&gt;60</td>
<td></td>
</tr>
<tr>
<td>Annoyance</td>
<td>Lden</td>
<td>42</td>
<td>% population annoyed, or highly annoyed</td>
</tr>
<tr>
<td>Sleep disturbance</td>
<td>Lnight</td>
<td>32 to 60</td>
<td>% population sleep disturbed or highly sleep disturbed</td>
</tr>
</tbody>
</table>

Assessed health effects where road traffic noise has been shown to be causal and robust studies are available to quantify health impacts – used relationships specific to road-traffic noise.

### Noise and Vibration

- Calculated population risks and change in incidence for health effects in the population
- Assessed the maximum localised risks for residents adjacent to roadways specific to the project and also adjacent to key local roads – assuming residents at home all day, every day
- All calculated risks are low and not significant
  - Overall decrease in population risk and incidence, and small health benefit, (only increase relates to population risks in Whitehorse LGA)
Noise and Vibration

• Maximum localised risks
  • Where all mitigation measures considered (including at-property treatments), the maximum localised risk below or equal to $1 \times 10^{-4}$, which is the risk management level
  • Maximum changes in noise is conservative and hence no health impacts of significance expected
  • Detailed design phase needs to further evaluate, model, assess and minimise operational noise impacts

Noise and Vibration

• Calculated change in % population annoyed, highly annoyed, sleep disturbed or highly sleep disturbed
  • Change in % population highly annoyed between -2% and 0.1%, with maximum localised increase of 5%
  • Change in % population highly sleep disturbed between -1% and 0.1% with maximum localised increase of 2%
  • These changes not considered significant in population
  • Overall: there is an overall small benefit to population health from reductions in noise. Maximum localised impacts need to be further evaluated and managed as part of the design phase, to minimise impacts on health
  • There no trigger to implement any additional mitigation measures
Social Aspects

- Qualitative assessment of the general impact of the project on the health and wellbeing of the community
- Evaluates more indirect impacts on health and wellbeing
- Evaluates if the impacts of the project are differentially distributed in relation to socioeconomic status – equity
- Assessment relies on other technical studies including Transport, Contamination, Social and Business
- Focus on aspects where changes have the potential to affect health, both negative and positive impacts considered
- Many of the impacts on health relate to changes in levels of stress and anxiety within the community

Evaluating project impacts on more general health and wellbeing in urban areas is highly complex

### Social Aspects

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Health Impacts</th>
<th>Health Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td>Some impacts to businesses from acquisitions and access during construction</td>
<td>Economic benefits of the project including employment, improved access and opportunity to live closer to employment</td>
</tr>
<tr>
<td>Traffic</td>
<td>Increased congestion during construction</td>
<td>Reduced and less variable travel times once completed</td>
</tr>
<tr>
<td>Safety</td>
<td>Construction impacts on road accidents, more traffic on some roads during operation may decrease safety (road, pedestrian, cycle)</td>
<td>Reduced traffic on some roads may improve safety (road, pedestrian, cycle)</td>
</tr>
<tr>
<td>Public transport</td>
<td>Maintenance of public transport during construction</td>
<td>Upgrades to public transport – decreased travel times and greater patronage of services</td>
</tr>
</tbody>
</table>

### Social Aspects

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<thead>
<tr>
<th>Aspect</th>
<th>Health Impacts</th>
<th>Health Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian and cycle</td>
<td>Alternate routes during construction may discourage use or be less safe</td>
<td>Project will improve pedestrian and cycle access and connectivity – promoting active lifestyles and improved safety</td>
</tr>
<tr>
<td>Contamination</td>
<td>Remediation will require management to ensure no impacts to community</td>
<td>Remediation of contamination to prevent future exposures to contamination</td>
</tr>
<tr>
<td>Green space</td>
<td>Temporary use of some greenspace and some permanent acquisitions – sporting clubs relocated and management required</td>
<td>None identified</td>
</tr>
<tr>
<td>Equity</td>
<td>No impacts that are unfairly distributed within the community</td>
<td>None identified</td>
</tr>
</tbody>
</table>
Expert report and expert meeting

- Expert Report addresses information not included in HIA report, including assessment of 2 additional vehicle emissions scenarios, which do not change the outcome of HIA
- Key issues raise in submissions relate to the assessment of health impacts of noise during construction and operation, impacts of dust generated during construction, impacts of the loss of green space, issues that affect levels of stress and anxiety, and public safety particularly road safety during construction.
- The issues raised in submissions have been addressed in my Expert Report. No issues raised have changed the outcomes of the HIA.
- Expert meeting mainly raised the issue of increased road trauma from higher speed crashes, and broad concerns about impacts of new freeways on community health. No issues raised have changed the outcomes of the HIA.

Overall conclusions

- Where mitigation and management measures identified in the project are implemented, the health impacts of the project are low and acceptable
- No EPRs identified that are specific to health
- No issues raised in submissions or during the expert meeting that change the outcomes of the HIA.