Comfort and Safety

comfortable

Overview

Indicator name	**Air quality and noise**		
Indicator number	27	**Indicator type**	Core
Objective	To estimate air quality, noise and greenhouse gas emissions impacts from road traffic		
Application guidance	Movement infrastructure needs to be assessed for impacts at a local scale. Activities associated with high traffic volumes can affect places, just as places can impact on the movement of vehicles. Air pollution from motor vehicles, particularly fine particles (PM2.5) and nitrogen dioxide (NO2), has health impacts on exposed communities. This indicator will support practitioners to understand air quality and road traffic noise levels and their health impacts for non-complex scenarios. Based on the outcome of the assessment, practitioners can determine suitable land-uses for the environment adjacent to road corridors. Practitioners can use the *risk of land-use conflicts* metric to assess the level of risk of exposure to air pollution from road traffic for both residential and sensitive locations. Practitioners can use the *monetary environmental cost of traffic* metric to assess the economic impact of air pollution, greenhouse gas emissions and noise from road traffic to society. Practitioners can use the *noise impacts* metric to assess the noise decibels resulting from road traffic.		

Metric

- Risk of land-use conflicts
- Monetary environmental cost of traffic
- Noise impacts

Related indicators

Access and Connection
1 Mode share
5 Freight network accessibility
8 Steepness

Amenity and Use
10 Local living

Green and Blue
19 Tree canopy
20 Biodiversity

Comfort and Safety
25 Safe speed for environment
28 Urban heat

Comfort and Safety

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Recommendation

Air quality

- Analysis of air quality in the metrics provided incorporates a preliminary and semi-qualitative assessment of road traffic air quality impacts
- An air quality health impact metric with a methodology based on PM2.5 is under development and will be included on future iterations of this factsheet
- To enrich the analysis, population density could be considered, particularly in relation to the sensitive land-uses

Noise

- This process could ultimately lead to the development of an interactive tool to estimate and predict noise impacts related to traffic volumes
- For existing conditions, baseline information could be collated to calibrate the tool to produce more precise noise impacts outputs, based on the land use design and development
- For new infrastructure developments or road corridors upgrades, the tool could be calibrated based on a mix of baseline information and forecasted traffic volume data to produce reliable noise impact outputs
- In the case of major road corridor developments, the interactive tool could also be used to evaluate noise impacts for different options (alignments, number of lanes, central reservation or kerb size) to support computational noise propagation software (ie. SoundPLAN, CadnaA) and environmental noise studies (ie. REF, EIS)

Reference

Air quality

- Australian Bureau of Statistics, Survey of Motor Vehicle Use (2020): abs.gov.au/statistics/industry/tourism-and-transport/survey-motor-vehicle-use-australia/12-months-ended-30-june-2020
- Institute for Sensible Transport, Transport Strategy Refresh: Transport, Greenhouse Gas Emissions and Air Quality (2018): s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.com-participate.files/6615/2948/1938/Transport_Strategy_Refresh__Zero_Net_Emissions_Strategy_-_Greenhouse_Gas_Emissions_and_Air_Quality.pdf
- Infrastructure and Transport Ministers, Australian Transport Assessment and Planning Guidelines Environmental Parameter Values (August 2021): atap.gov.au/sites/default/files/documents/pv5-environmental-parameter-values.pdf
- World Resources Institute, Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) (2014): ghgprotocol.org/sites/default/files/standards/GHGP_GPC_0.pdf

Noise

- New Zealand Transport Agency, Road traffic noise calculator (CoRTN): nzta.govt.nz/roads-and-rail/highways-information-portal/tools/road-traffic-noise-calculator/ (note: it is unclear what "single segment" in this calculation represents but most likely is a single lane carriage way, in each direction)
- Department of Environment, Climate Change and Water, NSW Road Noise Policy (2011): epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/noise/2011236nswroadnoisepolicy.ashx
- Department of Planning, Development Near Rail Corridors and Busy Roads - Interim Guideline (2008): roads-waterways.transport.nsw.gov.au/business-industry/partners-suppliers/documents/planning-principles/guideto-infrastructure-development-near-rail-corridors-busy-roads.pdf
- NSW Government, State Environmental Planning Policy (Infrastructure 2007): legislation.nsw.gov.au/view/html/inforce/current/epi-2007-0641

Metric – Risk of land-use conflicts

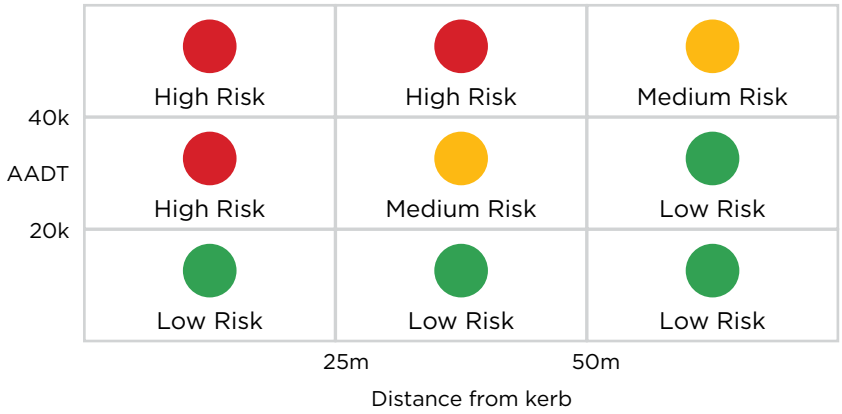
Metric unit	Level of risk
Description	To assess the associated risk of exposure to air pollution from road traffic for both residential and sensitive locations
Spatial coverage	Applicable to all NSW
Spatial application	This metric is most suitable for area-based analysis based on mesh block level

Calculation methodology

Assess risk level of sensitive locations

1. Obtain location of discrete sensitive locations
   a. Extract Points of Interest dataset from NSW Spatial Services
   b. Identify sensitive locations where POITYPE = nursing homes, retirement villages, community home, combined primary-high schools, high schools, preschools, primary schools, education facility, special school, general hospitals, psychiatric hospitals, children's hospitals, integrated health services, community medical centres, childcare centre
2. Using the Geoscape Buildings dataset, snap each building footprint to the nearest road segment using the TfNSW Road Track Path Network dataset
3. Measure the distance from the centroid of each building within the POI property boundary to its nearest road segment centreline
4. Using the Transport for NSW Traffic Volume Viewer, find Average Annual Daily Traffic (AADT) counts for that road (where available). If counts are not available for the selected road, manual counts should be undertaken to determine AADT.
5. Using the matrix below, find risk level based on AADT and distance from centreline and fill the POI boundary with the relevant colour

Risk of Land Use Conflict – Air Pollution from traffic
Land use – Sensitive (child and aged care, schools, hospitals)



Assess risk level of residential locations

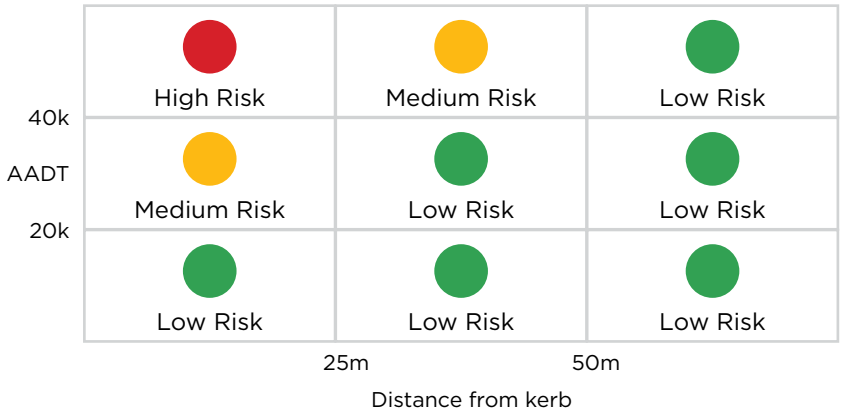
6. Display all residential land zones types within the land zoning layer:
   - R1: General Residential
   - R2: Low Density Residential
   - R3: Medium Density Residential
   - R4: High Density Residential
   - R5: Large Lot Residential
   - B4: Mixed Use

Metric – Risk of land-use conflicts (Cont.)

Calculation methodology

7. Using the Geoscape Buildings dataset, snap each building footprint to the nearest road segment using the TfNSW Road Track Path Network dataset
8. Measure the distance from the centroid of each building within the designated land-use to its nearest road segment centreline
9. Using the TfNSW Traffic Volume Viewer, find Average Annual Daily Traffic (AADT) counts for that road (where available). If counts are not available for the selected road, manual counts should be undertaken to determine AADT.
10. Using the matrix below, find risk level based on AADT and distance from centreline for each building within the relevant residential zones
11. Aggregate the risk levels ratings at the ABS mesh block level and assign the dominant risk rating value of all the buildings within that mesh block with the corresponding colour

Risk of Land Use Conflict – Air Pollution from traffic
Land use – Residential



Assumption

- Some land uses are less suitable in areas of relatively higher pollution levels. As the young, elderly and sick are more susceptible to air pollution, land-uses such as childcare, schools, aged care and hospitals should be not be located next to busy roads, where feasible. While not generally considered as sensitive a land-use, it is also desirable to avoid locating residential land-use next to busy roads where feasible.
- AADT counts, where available, are assumed to be consistent across the entire length of the road

Limitation

- Using kerb to building centroid measurements would provide more accurate calculation methodology. Centreline data has been included in this methodology due to data availability.
- Further analysis should be done to support/develop the above matrices to ensure they provide meaningful outputs

Data source

- NSW Spatial Services Points of Interest: maps.six.nsw.gov.au/clipnship.html
- TfNSW, Traffic Volume Viewer: rms.nsw.gov.au/about/corporate-publications/statistics/traffic-volumes/aadt-map/index.html#/?z=11
- TfNSW, Traffic volume maps for Infrastructure SEPP: rms.nsw.gov.au/about/environment/reducing-noise/traffic-volume-maps-for-infrastructure-sepp.html
- TfNSW Road Track Path Network
- Geoscape® Buildings: geoscape.com.au/
- ABS Mesh Block 2016: abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/1270.0.55.001July%202016?OpenDocument

Metric – Monetary environmental cost of traffic

Metric unit	Percentile of dollars per 1000 VKT ($)
Description	To assess the monetary environmental cost of air pollution caused by light and heavy vehicle traffic
Spatial coverage	Applicable to all NSW
Spatial application	This metric is most suitable for link-based analysis based on the road network
Calculation methodology	**Calculate Vehicle Kilometres Travelled (VKT)** 1. Using the TfNSW Traffic Volume Viewer, find Average Annual Daily Traffic (AADT) counts for that road (where available). If counts are not available for the selected road, manual counts should be undertaken to determine AADT. 2. Determine road length using the TfNSW Road Track Path Network dataset by combining road segments of the same ID and calculating the length of the road 3. Determine fleet composition of light versus heavy vehicles 4. Calculate Vehicle Kilometres Travelled (VKT) for the time period that is being assessed (peak hour, day, week, month, year), distinguishing between light vehicles and freight *VKT = (AADT x Length) x 365* **Calculate monetary environmental costs of transport** 5. Using the VKT calculated above, use the lookup table below (extracted from ATAP Guidelines Environmental Parameter Values) to determine the monetary environmental cost of passenger and freight vehicle transport

Externality		Car $/1000vkm	Heavy commercial vehicle $/1000vkm
Air pollution	Urban	8.48	69.92
	Rural	0.08	6.99
Greenhouse gas	Urban	12.74	43.56
	Rural	12.74	43.56
Noise	Urban	6.65	43.72
	Rural	0.07	0.44

Note: Costs calculated in June 2020 dollars

6. Based on the risk category determined in the risk of land-use conflicts metric above, weighted adjustments should be made to the ATAP figures provided in the table:
   - Low risk of land-use conflicts = use ATAP figures as provided
   - Medium risk of land-use conflicts = apply 50% weighting
   - High risk of land-use conflicts = double the numbers provided

Metric – Monetary environmental cost of traffic (Cont.)

Assumption	• Analysis of air damage cost is a simplified measure of population exposure impacts to particulate matter ($PM_{2.5}$) emissions from transport
Limitation	• The reported environmental unit costs should be used with a significant degree of caution. They should be interpreted as indicative rather than definitive. The use of sensitivity testing to assess the robustness of transport system decisions to the environmental unit costs, especially those that are related to greenhouse gas emissions, is strongly encouraged. • Environmental impacts in NSW and/or at the metropolitan level are likely to be higher than the national averages monetised by ATAP, which could dilute the analysis. Weightings provided in Step 2 of the methodology should be applied to the ATAP figures to account for this difference.
Data source	• TfNSW, Traffic Volume Viewer: rms.nsw.gov.au/about/corporate-publications/statistics/traffic-volumes/aadt-map/index.html#/?z=11 • TfNSW, Traffic volume maps for Infrastructure SEPP: rms.nsw.gov.au/about/environment/reducing-noise/traffic-volume-maps-for-infrastructure-sepp.html • TfNSW Road Track Path Network • ITM, Australian Transport Assessment and Planning Guidelines Environmental Parameter Values (2020): atap.gov.au/sites/default/files/documents/atap-pv5-environmental-parameter-values-080221.pdf • Infrastructure and Transport Ministers, Australian Transport Assessment and Planning Guidelines Environmental Parameter Values (August 2021): atap.gov.au/sites/default/files/documents/pv5-environmental-parameter-values.pdf

Metric – Noise impacts

Metric unit	dB(A)$L_{eq(period)}$
Description	To assess traffic noise levels associated with a road considering Annual Average Daily Traffic (AADT), vehicle speed, percentage of heavy vehicles, road configuration, distance attenuation, angle of view and attenuation resulting from barriers/screens
Spatial coverage	Applicable to all NSW
Spatial application	This metric is most suitable for link-based analysis based on the road network
Calculation methodology	This methodology is based on the CoRTN algorithm: 1. Typically, the following information must be sourced to accurately predict road traffic noise impacts: • Traffic volumes on specific sections of the road(s) within the study area, divided into day and night-time periods (as defined by the NSW EPA Road Nosie Policy (RNP)) • Heavy vehicles volume percentage for the day and night-time periods • Vehicle speed – posted speed • Relative height and location (distance) of receiver from road • Relative height and location (distance) of barrier between road and receiver • Angle of view • Road configuration (number of lanes and lane sizes) • Type of road surface • Gradient of road • Ground absorption For a preliminary desktop review, to gauge the level (quantitative) of road traffic noise impacts, the following minimum inputs are required: • Traffic volumes (as AADT) and heavy vehicle volume percentage, for the day and night-time periods – for existing roads, this information can be sourced from the TfNSW Traffic Volume Viewer platform, (see data source section) – for upgrades/improvements and/or new roads, this information should be sourced from project traffic consultant documentation – future growth conditions must be considered for greenfield sites/rural areas or early master planning assessments, where existing traffic volumes are expected to increase when the proposed project will be delivered • Vehicle speed (NSW Government Speed Advisor smartphone app, google street view, or posted speed limit data could be used if accompanied by assumptions on behaviour) • Road gradient (sourced from steepness indicator) • Road surface – two layered sealed road surface must be selected (typical for sealed Australian roads) if information is not available • Assume no barrier between road and receiver and a 180° angel of view (with no reflecting surfaces opposite) • Generally assume a relatively flat terrain, with source height (height of car engine) at 0.5, ground absorption between source and receiver (if this information is not easily available, 40-60% can be assumed as typical), average propagation of 1.5m and distance to receiver adjusted as required from the edge of the road to façade of receiver 2. The resultant road traffic noise level is then calculated using CoRTN algorithms. An example of this calculation methodology is provided in the data source section. Noise levels are represented as dB(A)Leq (average noise level for a measurement period expressed as an A-weighted decibel level) for a time period, either applying to the entire duration of a reference period (15-hour for day ie. 7am to 10pm and 9-hour for night ie. 10pm to 7am) or a worst 1-hour period during the day and night periods.

Metric – Noise impacts (Cont.)

Calculation methodology

3. Guidance is sourced from the NSW EPA RNP as to what assessment criteria (external, typically 1m from worst affected façade of the receiver – see Table 7 of RNP for more information) applies to different road categories, in addition to the relevant noise and time descriptors:

Road category		Assessment criteria	Qualitative impact and next steps
Freeway/arterial/ sub-arterial roads	New or existing	Day – 55 dB(A)$_{Leq(15hour)}$ Night – 50 dB(A)$_{Leq(9hour)}$	**LOW RISK:** minimum impacts are expected for residential land uses and standard building constructions will be sufficient to ensure compliance with internal noise goals of Infrastructure SEPP, Development Near Rail Corridors and Busy Roads – Interim Guideline and Australian Standards: • Day – calculated level < 50 dB(A)$_{Leq(15hour)}$ • Night – calculated level < 45 dB(A)$_{Leq(9hour)}$ **MEDIUM RISK:** moderate level of impact is expected for residential land uses, typical to suburban areas i.e. land adjacent to local and/or sub-arterial/collector roads (< 20k AADT). Calculated levels must be verified against noise monitoring results of the validation/calibration process detailed in Step 4. Standard building constructions will generally be sufficient to ensure compliance with internal noise goals of Infrastructure SEPP, Development Near Rail Corridors and Busy Roads – Interim Guideline and Australian Standards: • Day – calculated level > 50 < 65 dB(A)$_{Leq(15hour)}$ • Night – calculated level > 45 < 60 dB(A)$_{Leq(9hour)}$ **HIGH RISK:** intrusive impacts are expected for residential land uses and a detailed acoustic assessment is required, as outlined in Step 4. Consideration must also be given to zoning/land use type proposals by planning less sensitive land uses (commercial, light-industrial, industrial, open spaces etc.) adjacent to road corridors and architectural design of land use developments (orientation of sleeping areas, location of balconies and open spaces, size of façade glazing and other light-weight elements): • Day – calculated level > 65 dB(A)$_{Leq(15hour)}$ • Night – calculated level > 60 dB(A)$_{Leq(9hour)}$
	Redevelopment or increased traffic due to new land use developments	Day – 60 dB(A)$_{Leq(15hour)}$ Night – 55 dB(A)$_{Leq(9hour)}$	
Local roads		Day – 55 dB(A)$_{Leq(1hour)}$ Night – 50 dB(A)$_{Leq(1hour)}$	
Any road category – School classrooms		$L_{eq(1hour)}$ 50 (when in use)	**LOW RISK:** where noise levels are calculated below this level, minimal impacts are expected for the proposed land uses and standard site/building constructions will be sufficient to ensure compliance with internal noise goals, where applicable. **MEDIUM RISK:** moderate levels of impacts are expected for the proposed land uses, when calculated levels are within 10dB(A) of the assessment criteria. Calculated levels must be verified against noise monitoring results of the validation/ calibration process detailed in Step 4. Standard site/ building constructions will generally be sufficient to ensure compliance with internal noise goals, where applicable. **HIGH RISK:** intrusive impacts are expected for the proposed land uses, when calculated levels are > 10dB(A) of the assessment criteria. A detailed acoustic assessment is required, as outlined in Step 4.
Any road category – Childcare facilities		Sleeping rooms – 45 dB(A)$_{Leq(1hour)}$ (when in use) Indoor play areas – 50 dB(A)$_{Leq(1hour)}$ (when in use) Outdoor play areas – 55 dB(A)$_{Leq(1hour)}$ (when in use)	
Any road category – Hospital		45 dB(A)$_{Leq(1hour)}$ (when in use)	
Any road category – Places of worship		50 dB(A)$_{Leq(1hour)}$ (when in use)	
Any road category – Open space (active)		60 dB(A) $_{Leq(15hour)}$ (when in use)	
Any road category – Open space (passive)		55 dB(A)$_{Leq(15hour)}$ (when in use)	

Metric – Noise impacts (Cont.)

Calculation methodology	4. Detailed acoustic assessments should include a validation/calibration process (in accordance with the requirements of TfNSW Model Validation Guideline) and computational noise modelling (empirical calculations or noise prediction software like SoundPLAN or CADNA), to forecast the level of noise impacts and formulate relevant mitigation measures. At a minimum this should include: • Long term noise surveys to determine average noise levels data (Leq) at different time periods (ie. worst 1-hour, 15-hour daytime period, 9-hour night-time period etc.) • Attended short term (15-min) peak period noise measurements, to understand the prevailing noise environment and to ensure the unattended noise survey results are governed by road traffic noise and not extraneous sources • Concurrent traffic counts • Verification of preliminary calculated noise levels with results of validation/ calibration process • Development of computational model using CoRTN algorithms • Noise intrusion assessment to determine mitigation measures (based on type of proposed land use type, external traffic noise level predicted from the computational modelling and proposed architectural design) 5. Map results displaying noise level at different distances from the road (either as noise contour maps for the two time periods or even a distance-based markup on aerial image based on empirical calculation predictions)
Assumption	• Estimated traffic noise levels will be based on the UK Calculation of Road Traffic Noise (CoRTN) algorithm, which is accepted by TfNSW for the assessment of road traffic noise • Specialist studies are conducted to determine detailed information of all necessary parameters, when appropriate
Limitation	• Results reliant on the accuracy of available data • Analysis is based on a specific location at a particular point in time • Limitations of the CoRTN algorithm, which includes assessment of a specified segment of road, standard terrain conditions, predominantly straight road and regular traffic volumes • The aim of this indicator is to support practitioners in estimating (preliminary screening assessment only) road traffic noise levels to inform zoning and master-planning studies and also evaluate land use development proposals adjacent to road corridors. • This indicator is not suitable for the assessment of noise impacts from road/carriageway associated projects (new roads, upgrades or extension of existing roads, new bridges/ tunnels, upgrades to existing bridges/tunnels etc.)
Data Source	• Manual data collection (traffic surveys, noise surveys, field surveys) • TfNSW, Traffic Volume Viewer: rms.nsw.gov.au/about/corporate-publications/statistics/traffic-volumes/aadt-map/index.html#/?z=11 • TfNSW, Traffic volume maps for Infrastructure SEPP: rms.nsw.gov.au/about/environment/reducing-noise/traffic-volume-maps-for-infrastructure-sepp.html