

Acoustics, amenity and the vicissitudes of impact

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ABSTRACT

Land-use planning and assessment is envisaged by many to involve orderly and uncontentious procedures contributing constructively to how we protect community assets and the environment more generally. However many decisions are made in a local or parochial context with an underlying assumption that impacts and outcomes are close proximity effects in both distance and in time. These local decisions can lead to cumulative outcomes that, sometimes instantly but more commonly progressively, entirely change the nature of nearby lands. This insular perspective is allowed perpetuate by the absence of legislative definitions for fundamentally important terms – impact, amenity and reasonableness – leading to assessment reports that do not consider the potential impact from a proposed land use in an appropriate way. This has aggravated public misunderstanding of the assessment process such that expectations and outcomes are commonly disarticulated. Acoustical assessment reports frequently refer to amenity loosely and encourage an emphasis on sound level criteria referencing sometimes inappropriate regulatory authorities. This paper examines the issues involved in these circumstances and attempts to establish more rigorous procedural foundations that may help ameliorate the risk of unsatisfactory unforeseen outcomes.

1 INTRODUCTION

Land-use planning laws pre-condition approval to implement a proposed land-use on, generally, a predicted outcome that the subject land-use will not impact adversely on the amenity of surrounding areas. Functionally, conforming with this pre-condition requires that the way in which a proposed land-use will function can be understood, that the effects from those functions can be quantified, that the method of prediction of the impact will be confidently understood and that the operating conditions and the outcomes can be retrospectively validated. Regardless of these uncertainties, the two key words relevant to such a review and decision are impact and amenity. Neither are legislatively defined. This has allowed acoustics to be incorrectly perceived as a synonym for amenity and for professional reporting referencing many regulatory procedures to be interpreted, incorrectly, as the assessment of amenity impact.

The following definition for environmental impact was adopted by the Commonwealth Government Senate Select Committee on Aircraft Noise (Commonwealth of Australia, 1995):

"The environmental impact of an action is the difference between the state or condition of the environment which occurs as a result of that action being taken or withheld, and the state or condition which would otherwise occur." (Hede, 1993)

This definition can be easily adapted from environmental impact to amenity impact predicted for a proposed land use, thus:

The impact of a land use on the amenity at a location is the difference between the ambient state or condition of the amenity at that location and the state or condition of the amenity at that location including the effects due to the land use.

That is, the impacts on amenity arising from a proposed land use can only be considered by examining, carefully, the factors affecting the amenity of the surrounding land and then examining how these factors may change should the proposed land use be allowed occur. Amenity, however, is complex.

The following is an aggregate definition for amenity, consequential to decisions of the High Court of Australia (High Court of Australia, 1970) and the NSW Land and Environment Court (Lloyd, 2003), and to guidelines of the Victoria Government Solicitor's Office (Victorian Government Solicitor's Office, 2008):

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"The pleasantness of a place, being influenced by the environmental parameters – sound, air quality, odour, climate - describing the place. All the features, benefits and advantages inherent in the environment of the place, its social framework and its conveniences. Amenity describes the intrinsic values able to be experienced by an occupant of the place." (Fitzell, 2021)

Amenity could constitute any or all of the following, one of which - environmental conditions -relates to acoustics:

- Social and physical accessibility
- Availability of public transport
- Proximity to "amenities" such as shops, entertainment, parkland or relaxation areas, sporting areas.
- The range and pleasantness of available environmental conditions
- Unspoiled environmental conditions in the case of pristine lands and wilderness areas
- Proximity and access to pristine lands and wilderness areas

The NSW Land and Environment Court clearly deems amenity and noise to be different considerations, in s 12 (b3) of the Trees Act (NSW Land and Environment Court, 2006) and the broad scope of amenity is noted in s 79C(1)(b) of the EP&A Act of NSW.

There is a further overlay in the application of these laws for a land-use planning assessment, being assumptions regarding the concept of "reasonableness". Acting reasonably is a statement that can bring a warm and comfortably fuzzy feeling when used in a context describing land uses in an inquisitive report, however the use of the term conveys more responsibility to all parties, particularly advisors, than many may be aware.

2 ACOUSTICAL AMENITY

Among other outcomes, the broad definition of amenity outlined above explains why residents choose to live in diverse locations - CBD, urban and suburban areas - with widespread satisfaction. It also explains why residents may choose to live in multiple-occupancy apartment buildings and in free-standing dwellings, accepting the fundamental acoustical differences that exist between those dwelling types, again with widespread satisfaction.

Table 1: Conflicting Terminology

Confusing beliefs and terminology	
Noise can be used interchangeably with Acoustics	Acoustics encompasses all sound, a sub-category of which is noise
Noise is quantified by a sound pressure level	Context, appropriateness and character are the parameters that identify a sound as noise. Sometimes the sound pressure level is a determinant.
"Noise" implies a loud intrusive event	A low level constant drone may be equally or more offensive than audible events.
Amenity can be related to a sound level	Sound level alone is (almost) unrelated to amenity. This misunder-standing is aggravated by the use of levels described as amenity criteria by the NSW EPA in the Industrial Noise Policy, without explanation that the context of criteria stated in that document was derivation for industrially zoned lands. These apply, therefore, to controls on impact on lands characterised in their ambient condition by sound from industry.
Control of offensive noise provides environmental protection	Offence due to noise is a subjective anthropogenic response. Amenity is a composite property relating to anthropogenic comfort and is not a measure of biodiversity or environmental health.

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Ambient sound level conditions alone cannot and do not describe amenity although their magnitude may contribute to an overall acoustic amenity. A range or limit defined by sound pressure levels may be consistent with aspects fundamental to amenity – e.g. very low threshold sound levels are experienced in pristine and wilderness areas – however experience suggests that amenity is more likely associated with the appropriateness of the sounds that contribute to the acoustical environment and their audible information content. Amenity therefore involves value judgements, particularly regarding what is appropriate in any given area soundscape. It would not be surprising if a resident who makes regular use of rail transport is less likely to object to the sound of the railway than one who has chosen to live in a quiet or remote area and who views sound from a new railway as incompatible. Community misunderstanding of acoustic assessment procedures can be aggravated by poorly considered terminology and argument implied by land-use application reporting.

3 REASONABLENESS

Legal decisions are made through a combination of applied legal principles within a framework of case-dependent facts. However what is and is not reasonable is tied to the notion of risk, being the product of the probability of occurrence and severity of outcome (Kneer, 2021).

It is important to recognise the importance of the term "reasonable" applying to either or both sound pressure level measurement and land-use impact assessment. The term "reasonable" is a legal construct in a similar way to "the common man". When considering a legal land-use planning decision, the common man - a legal invention – personifies the actions of the assumed participants and seeks to avoid decision being based on behaviours and reactions that are unique, remarkable, special or atypical. A legal decision is based on legal standards embodying social values. These values are somewhat localised to the particular standard, whereas reasonable people take account of foreseeable risks having regard to serious possibilities and probabilities (MacCormick,1999). The term "reasonable" clearly attaches to the giving of advice and describes the context and diligence adopted by an assessor. The legal intent of this term is described by MacCormick by example of reasonable care in a manufacturing process (MacCormick, 1999) as:

"I am comparing what was done with what could have been done, and assessing whether a reasonable evaluation of the risks would have left an actor in that situation satisfied with the degree of care that was taken, or not so satisfied."

MacCormick proposes that the use of the term reasonable lies in the style of deliberation a person would normally engage in, that these deliberations are context dependent, and that reasonable behaviour as an advisor is more strongly identified by the consideration of risk undertaken in advance, than of the actual outcome.

A constructive way to consider the risk attached to each element in an advisory study is to pose the question:

How likely is it that the value/s attached to this element will differ from the value/s used in the assessment, and how serious is the difference in the outcome that would arise if that value were to be different?

This is a more searching consideration and is as much, or more, dependent on being able to explain the inevitable variance that will apply to most elements of a technical assessment than it is to being able to state what sound level has been adopted for the source levels in an assessment review. Preston (2018) notes the scope of allegations of negligence to include failure to "use due care…to…prevent reasonably foreseeable harm…from…ordinary use or reasonably foreseeable misuse".

Reasonable care in the giving of information or advice refers to the consideration of risk recognisable to the assessor and is not a value judgement referring to the intended behaviour of the proposed land-user or of the actual attitudes of the affected neighbourhood. The onus of responsibility to consider impact reasonably lies with the actions of the assessor, not the assumptions made about how the stakeholders will behave. A qualification attaching to the use of the term "reasonable" in an advisory report when referring to input risks – e.g. land user behaviour and affected neighbourhood reaction – is that the advisor must be able to describe the risks and how they have been accounted in relying on that term.

Evaluating an ambient acoustical environment reasonably, again in the context above, also involves consideration of the ambient environment, for which an impact assessment based on an L_{A90} ambient sound level is entirely and almost irrelevantly inadequate (Fitzell, 2019a).

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In describing acoustical amenity for any given location, an assessor should recognise that there will normally exist a continuum from non- and interpretively bland ambient sound elements through to associated sound, the latter being characteristics that often represent the desirable features representing value in the acoustical environment. Technically, the non-associated sound content probably describes the content of the L_{A90}. Both non-associated and associated sounds are, by their existence, appropriate and both warrant description. Existing or predicted sound that is recognised as contra-associated is the component that should be described as noise. Noise is a composite function definable in both sound pressure level and subjective content. This is the means to identify, and therefore potentially quantify, the impact of loud noise events in an area that is already characterised by sound from road traffic and to distinguish those loud events from, for example, the loud events generated by wildlife.

4 LEVEL ERROR RISK

The most common basis used to assess risk in assumptions regarding the levels of sound defining a source is to examine the expected mean value of a source output and of its expected variance. Describing a level as being the "worst case" is both undesirable and concealing, as there can is no way that an independent reviewer can judge the validity of the claim, nor can the claim ever be proven. It can be misunderstood that a confidence interval calculated from the mean and the standard deviation of a relatively small set of sampled values defines the range within which the mean value of a subsequent similar sample would be expected to lie, were that same survey to be repeated. In this case the value of the upper bound of the confidence interval represents a "safe" estimate for a value, determined by survey, that could still be exceeded 50 percent of the time. If the survey data sample size is very large then the upper bound of the 90th percentile confidence interval based on data mean and standard deviation trends to the 90th percentile value of the expected range of instantaneous sound levels emitted by that source, however even the use of the mean value from that very large sample remains a value that is confidently exceeded with a probability of 50 percent. Given the difficulty entailed in obtaining large numbers of reliable source level assessments for most stochastically varying sources, any assessment determined using simply a mean value survey finding could not be considered reasonable.

More commonly, a linear regression model may be used to determine, for example, vehicle sound power emission level as a function of vehicle speed. However, in this instance the collection of sampled values from which the linear model was derived almost certainly involved a scatter of data both higher and lower than the predictive model. These scattered data values are known as residuals and convey important information regarding the expected error-risk contained in a level prediction compared with simply an R-squared model regression coefficient. An expected value derived from a linear model should be recognised as a mean value for the modelled condition, to which an appropriate and reasonable provision for variance should be added.

Consideration of risk must include consideration of how the expected level allocated to sources used in an assessment will vary – including those levels defined as ambient values – and how those levels may be influenced by aspects of the proposed land use activity.

5 CUMULATIVE IMPACTS

The importance of cumulative impact is inadequately considered and is rarely mentioned in land-use applications. Recent decisions in the NSW Land and Environment Court (Preston, 2019) signal that ignoring the importance of cumulative impact may become a more significant risk to applicants than in the past. An attempt is made in EPA regulations to recognise cumulative acoustical impact, however not only are the EPA procedures unable to examine impact effectively, the planning laws do not generally respond adequately to cumulative consequences nor expect a procedural review to include focus on cumulative impacts. This is an almost inevitable consequence of the absence of a statutory definition for impact and to the absence of zoned land use objectives. Planning laws frequently identify preferred or approved uses as a project type [NSW Government,2006] but not in any manner that can be related to either impact or amenity. Contrary to procedures that recognise the relevance of cumulative impacts on amenity and environmental degradation, approval of a small commercial precinct, for example, in a quiet rural town under current planning principles, justified by expectation that the availability of facilities will balance or outweigh any negative environmental impacts, establishes consequent acoustical conditions that then ensure a subsequent, potentially larger, precinct is made more readily approved.

Current acoustical impact management tends to be limited to considering the equivalent energy level generated by a land use and comparing it with the 10^{th} percentile level of the ambient, the L_{A90} , and to represent those limit conditions as being both acceptable and evidencing little or no environmental compromise. Considering larger data sets of environmental acoustic sound levels, the L_{Aeq} level tends to be innately higher than the L_{A90} level by about 6.5 dB(A) daytime and evening, and about 9 dB(A) at night (Fitzell, 2019b). The average difference between

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what is currently termed the background noise level (the ambient L_{A90} sound level) for one land classification and that of the adjacent land classification is about 6.5 dB(A). That is, the L_{A90} level for what was, say, a quiet residential living environment will be about 6.5 dB quieter than that of an urban living environment. The mathematics of these relationships is such that as few as three acoustically comparable land use changes will result in unambiguous change to the fundamental acoustical environment that had originally existed.

6 MAGNITUDE OF IMPACT

In NSW, development is controlled by Local Environmental Plans (LEPs) and associated Development Control Plans (DCPs). Whilst LEPs have legislative authority within a specific local government area they have been prepared in compliance with a standard planning instrument (NSW Government, 2006). Consequently many LEPs invoke substantially similar regulatory controls and define approved and prohibited land uses on a land-zoning basis. Two clauses have received widespread attention in the application for consent to carry out activities that are, under the subject land zoning, a prohibited use - a temporary use clause 2.8 and a Heritage considerations Clause 5.10.

The clauses having relevance to acoustic assessment are 2.8 (1), 2.8(3), and 5.10 (10). These relate to impact on amenity and environmental attributes. The pre-condition requirements of 2.8 (3) subclauses (a) through (d) and in 5.10.10 subclauses (a) through (e) are clearly conjunctive and require, in each circumstance, that the relevant subclause conditions are wholly satisfied. These clauses are exampled below in Table 1 and a review shows that the obligation of an applicant is to satisfy conditions under one clause that are described as having no adverse impact, and under the second of resulting in no significant adverse impact.

Impact and amenity have been discussed above. An adverse impact and a significant adverse impact are clearly legal judgements required to be made on the legal facts of each circumstance. These clauses therefore involve fundamental considerations on how one defines impact, amenity, reasonableness and, for the consideration of Schedule 5 concession pre-conditions, the meaning of the term significant.

An important Land and Environment Court of NSW decision (Moore, 2015) - Marshall Rural Pty Limited v Hawkesbury City Council (2015) NSWLEC 197 – has particular relevance to the consideration of impact. For simplicity this case is referenced hereafter as Marshall. In Marshall the commissioner, in upholding an appeal against a development consent decision made under an equivalent clause to the Model LEP 2.8, stated that the error in granting approval was that "this was done in terms that do not reflect what is required by this element of the clause" and that "the commencement path leading to error commences assuming that the appropriate technical lens through which application should be viewed is whether or not an approved development could be rendered compliant with technical standards derived from those applied by an external regulator" (in that particular case the OLGR). "Those standards envisage merely an acceptable impact rather than absence of adverse impact". The commissioner also noted that "Nowhere in the analysis ... is there set out any cautionary warning nor that draws attention ... that the test differs from that which would be conventionally applicable to an ordinary development application".

Marshall describes important fundamental obligations of the approval authority and of professionals preparing reports on matters relevant to Clause 2.8 of the LEP, providing a clear basis for the interpretation of the impact magnitude implied by the condition "not adversely impact".

Marshall also gives guidance relevant to Clause 5.10 (10) in so far as the Marshall decision notes the distinction between "an acceptable impact rather than absence of adverse impact". The terms used in the Marshall judgement would suggest that a significant adverse impact would describe an impact that is beyond that which represents an acceptable impact. In this context satisfaction of 5.10(10) could require standards that could be related, for each specific proposed use, to those that would be required by an external regulator. The policy standards adopted by the EPA do not enable assessment of impact as the considerations of these policies are unable to consider the above impact definition, instead being focussed on measures of pollution. In an example of a function centre or dining facility, where alcohol would be made available, limits for noise emission could contemplate criteria such as those historically required by the Office of Liquor, Gaming and Racing, because those standards relate to a relatively rigorous evaluation of existing or ambient conditions and impose a limit to the magnitude of change permitted to those ambient conditions. It is relevant, however, that the OLGR is an Authority able to rescind a license in the event of continued transgression, an authority encouraging compliance that an approval condition by a local council would lack.

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Table 2: Example Local Environment Plan Clauses

2.8 Temporary use of land

- (1) The objective of this clause is to provide for the temporary use of land if the use does not compromise future development of the land, or have detrimental economic, social, amenity or environmental effects on the land.
- (2) Despite any other provision of this Plan, development consent may be granted for development on land in any zone for a temporary use for a maximum period of 52 days (whether or not consecutive days) in any period of 12 months.
- (3) Development consent must not be granted unless the consent authority is satisfied that:
- (a) the temporary use will not prejudice the subsequent carrying out of development on the land in accordance with this Plan and any other applicable environmental planning instrument, and
- (b) the temporary use will not adversely impact on any adjoining land or the amenity of the neighbourhood, and
- (c) the temporary use and location of any structures related to the use will not adversely impact on environmental attributes or features of the land, or increase the risk of natural hazards that may affect the land, and
- (d) at the end of the temporary use period the land will, as far as is practicable, be restored to the condition in which it was before the commencement of the use.
- (4) Despite subclause (2), the temporary use of a dwelling as a sales office for a new release area or a new housing estate may exceed the maximum number of days specified in that subclause.
- (5) Subclause (3) (d) does not apply to the temporary use of a dwelling as a sales office mentioned in subclause (4).

5.10 Heritage conservation

- (10) **Conservation incentives** The consent authority may grant consent to development for any purpose of a building that is a heritage item or of the land on which such a building is erected, or for any purpose on an Aboriginal place of heritage significance, even though development for that purpose would otherwise not be allowed by this Plan, if the consent authority is satisfied that—
- (a) the conservation of the heritage item or Aboriginal place of heritage significance is facilitated by the granting of consent, and
- (b) the proposed development is in accordance with a heritage management document that has been approved by the consent authority, and
- (c) the consent to the proposed development would require that all necessary conservation work identified in the heritage management document is carried out, and
- (d) the proposed development would not adversely affect the heritage significance of the heritage item, including its setting, or the heritage significance of the Aboriginal place of heritage significance, and
- (e) the proposed development would not have any significant adverse effect on the amenity of the surrounding area.

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Magnitude of acoustical impact can be quantified using statistical simulation and summation, however the magnitudes that correspond to these subjective considerations have yet to be determined. An acceptable magnitude of impact is, however, one that considers and deals appropriately with foreseeable cumulative impacts. The magnitude of an acoustical impact determined by these techniques, in parallel with an appropriate land-use development policy, can be defined (Fitzell, 2019a).

7 ROLES AND RESPONSIBILITIES

7.1 The acoustic advisor

In land-use planning the role of the acoustic advisor is not to state what is acceptable, but to describe how the acoustical aspects of a proposed land use may relate to or may affect the amenity of the existing acoustical environment. This cannot be achieved by the current assessment paradigm, primarily because the current paradigm has evolved from a pollution-management perspective focusing on the concept of absolute sound pressure levels and is unable to describe impact-management. It also places little emphasis on the soundscape describing a potentially affected area from which the acoustical amenity is likely to be perceived.

If a relevant risk for a particular project in NSW is that the development may not comply with the conditions required by the Industrial Noise Policy, then an assessment against the criteria of that document is clearly an appropriate procedure. For most land use assessments, however, not only does the Industrial Noise Policy not apply, but the Policy does not consider or examine amenity.

An assessment of risk that a development proposal will have impact on existing ambient sound levels, or of audible and undesirable noise being resultant, cannot be made without reference to an appropriate description of ambient sound levels and conditions. It is certainly not possible to make a prediction based on comparison of a predicted outcome level with an ambient sound level L_{A90} limited to a threshold of 30dB, as is often presented in assessments made in NSW.

As regards assessment sound pressure levels generally, relying on the use of a mean value predicted source level for an impact prediction gives an unsatisfactory answer to the question of risk posed earlier. The probability that both level and impact will be higher than the stated outcome of the assessment has to be acknowledged as 50%. The responsibilities of the acoustic advisor to consider risk require that advisor to be able to inform a reader far more than simply an adopted design or assessment level.

7.2 The Regulator

The role of the regulator is to require and ensure that an applicant describes the impact associated with a land-use proposal application on an existing amenity, in the broad sense described above. This requires a description and commitment to the operational demeanour of a proposal, involving specification of both times of operations and the nature of those operations. An acoustical impact assessment that is unable to provide an examination in the same context is unlikely to be of any use.

7.3 The Planner

The role of the Planner is to amalgamate these, often contrasting, impacts on amenity into an overall outcome. Where a development proposal can claim a justified improvement to community conveniences, contributing positively to amenity so far as it relates to functional locality facilities, there may be opportunity to balance with other consequential effects on the existing amenity. This is a critical role as the reasonableness of an outcome impact on amenity is a multi-disciplinary equation that requires the illumination of amenity gains if there are perceived amenity losses. Indeed, the NSW Land and Environment Court (Pepper, 2016) has held that cumulative impact is a relevant consideration under the Planning Act. Adopting a commonly observable strategy of denial that any adverse impact will occur for each and any aspect likely to be associated with an application, instead of constructively identifying the aggregate of both positive and negative amenity outcomes including cumulative impacts, is simply poor planning.

7.4 Researchers

The role of researchers is to seek better understanding of the mechanisms interfacing between each of the parameters contributing to amenity. In relation to acoustical amenity, an obvious focus is on how the extensive body of knowledge on soundscapes can be amalgamated with more rigorous sound level modelling. The current environmental sound modelling paradigm is too simplistic to provide a searching basis supporting objective sound-scape interpretation.

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8 CONCLUSIONS

When compared with acoustic design work for the built environment, environmental acoustic design and assessment involves far more complex considerations to give meaning to the term "fitness for purpose". In contrast to design and assessment concerning environmental acoustics, the built environment implementation period is short, the utilisation period relatively short, with functional design objectives usually being able to reference requirements of either an owner or an end user. Cumulative effects are almost inconsequential.

Uncertainty in defining environmental acoustic design objectives is aggravated by the fact that neither impact nor amenity are legally defined terms, yet both are primary pre-requisites that land-use legislation requires an applicant to consider. This places inappropriate pressure on professional advisors engaged to assist an applicant in the preparation of application design and documentation. One outcome is a community perspective that advisors are advocates for the applicant instead of advisors to the applicant and to the authority approval process.

The importance of cumulative impact is insufficiently considered in land-use planning assessment. In NSW the relevance of cumulatively acoustical impacting effects is aggravated by inappropriate use of the term "amenity" in NSW EPA policy documents and by the promulgation of policy permitting the use of a background sound level threshold limit. The same concern may well apply to other, more environmentally critical, policy areas. Cumulative effects relate to long-term values, long-term outcomes and inter-generational equity. The mathematics of typical acoustical assessment conditions show that cumulative impact effects are more significant than are those of immediate or short-term impacts, yet they are almost ignored at local and state government policy level.

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