March 29th, 2016

Secretary
Department of Planning & Environment
GPO Box 39
Sydney NSW 2001

Secretary McNally

I understand the Department has embarked on creating a scale to quantify the visual impact (VI) of wind farms on neighbours. If done professionally, this could be of some value. Unfortunately the evidence currently available indicates it is being done in a very amateurish way, such that the scale will have no scientific or practical validity. In that case any internal decisions or recommendations to the PAC purporting to present the scale as valid information would be fraudulent.

The scale, termed a "Refined Assessment Matrix" (RAM), is cited in the VI submission by Green Bean Design (GBD) in support of Mod1 to the Sapphire Wind Farm. GBD has used it in that submission and claims it has been developed by the Department. Since their submission was being lodged with the Department, it seems unlikely they would make such a claim were it not true.

Scale development in this context is actually a scientific task which requires scientific research and statistical analysis skills to validate the constructed scale and its components. There is nothing cited in GBD's submission to demonstrate any validation by either GBD or the Department.

Typically, being a landscape designer, or even a public servant familiar with spreadsheets, does not in itself provide the expertise necessary to create and validate scales whose purpose is to predict outcomes.

As it happens, a substantial part of my PhD research was on scale construction and validation, and techniques for doing so[1]. Consequently, I have professional skills relevant to the matter and am able to identify a number of profound defects from a scientific perspective on scale construction.

If the description of the Department's RAM in GBD's Sapphire Mod 1 VI submission is accurate, then not only has the scale no demonstrated validity but it is clear that its constructors have no knowledge of the legitimate treatment of different types of numbers. In addition, they appear to be attempting to cast a cloak of fake scientific legitimacy over the subjective process of assessing visual impact.

In summary, the scale as described by GBD suffers from the following defects, which are described in some detail in the attached paper. It:

- ignores the numeric character of the RAM subscales, engaging in inappropriate mathematical aggregation;
- aggregates incommensurable subscales;

[1] *The Character, Determinants and Performance Effects of Inter-Unit Interactions within Organisations: A Disaggregated Systems Approach*, PhD Thesis, Australian Graduate School of Management, University of New South Wales, 1983, in particular see chapters 2 and 3 (pp. 73 – 200).

- includes subjective subscales in what purports to be an "objective" scale;
- provides no apparent testing of either the reliability of the scale or its predictive validity;
- ignores the extensive scientific research findings of the low reliability of individual raters, including VI professionals, on landscape character and VI;
- ignores the established position that there are profound differences between what is valued by landscape professionals and the public;
- ignores the well established research position that visual value depends heavily on the viewer and thus there can be no wholly "objective" measure of either visual value of a landscape or of visual impact of intrusions.
- ignores the effect of constructor bias in determining the scale components and category definitions and cutpoints;
- involves selective scale attenuation which, together with the way the Department applies the term "Moderate" in determining protection rights for landowners, pre-ordains outcomes prejudicial to uninvolved landowners;
- applies a wholly inappropriate mathematical treatment to cumulative visual impact of multiple wind farms, whose effect is to dramatically water down the magnitude of any such effect that will be reported with RAM.

In short, it is a scientific and administrative travesty.

Since the purpose is to predict outcomes (magnitude of visual impact experienced by landowners affected by a wind farm) based on a range of hypothesized factors, creation of RAM is essentially engaging in a comparable research task to the NHMRC's study of the health effects of infrasound, to which the NHMRC has committed $5 million and now awarded research grants to two well established scientific research teams. The Department apparently believes it can create valid indicators of complex human experience outcomes without any significant scientific research while ignoring relevant scientific literature.

Most troubling is the fact that Department officers who, in the process of constructing RAM have displayed such weak scientific knowledge and lack of awareness of relevant research and of thorough papers on visual impact assessment, are actually engaged in making judgements about VI from wind farms and presenting them to the PAC as though they have some well founded expertise.

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Manifest Scientific Faults and Policy Distortions in the Department's "Refined Assessment Matrix" (RAM)

The Purpose of Visual Impact Assessment

Visual impact (VI) assessment is an attempt to determine the adverse perceptual and psychological impact, on people living in and/or using a locality, caused by changes to the related viewscape, in this instance due to construction of a wind farm.

The very fact that the draft NSW Wind Farm Guidelines (2011), EARS and other official documents use the words "visual impact" shows consistent recognition that the sight of wind turbines, in situ, detracts from the mental state residents have when they look at their surrounding landscape and that landscape contains wind turbines. This is consistent with peer-reviewed, published research which shows that even people favourable to renewable energy typically consider wind turbines to have an adverse visual impact on landscape[1].

The process of VI assessment conducted by the Department is an attempt to estimate what the impact will be both in relation to individual properties and to people in public spaces near the wind farm. The estimate is made in order to determine whether under its planning responsibilities the Department should reject the wind farm in whole or in part, or recommend consent conditions that in some way mitigate the impact on people, or that offer alternatives such as compensation or buyout rights.

Subjectivity of VI Assessments

The validity of the predictions made by the VI assessment process is important because the results affect determinations about how the contending interests of the wind farm developer and of impacted neighbours will be treated. If the VI assessment process underestimates the actual VI on individual neighbours, those neighbours will be deprived of their legitimate rights.

The process to date has depended on a landscape consultant hired by the developer producing a VI assessment that says there will be little impact on neighbours. Department officials, review the photomontages, etc provided by the consultant and the consultant's arguments, and perhaps visit some parts of the location that may be affected. Then, with an unspecified set of individual expertise and subjectivity, they make a judgement as to the extent of the visual impact on each property and on the broader community.

The Department has apparently now recognised that this whole process is entirely subjective and unsupportable, with the subjectivity left in the hands of people paid to not see a problem (the wind farm's consultant) and who have chosen to not live in the type of area affected, to which they are at best very infrequent visitors (the consultant and the Department and PAC officers).

The bias inherent in this arrangement is so evident that it is indefensible. That may underlie the Department's foray into attempting to construct an "objective" scale for VI. Unfortunately, all that the Department appears to have done is to embed a combination of subjectivity and arbitrariness into a formalised tool.

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[1] Molnarova K., Sklenicka P., Stiborek J., Svobodova K., Salek M., and E. Brabec, "Visual Preferences for Wind Turbines: location, numbers and respondent characteristics", *Applied Energy* 92 (2012): 269-278, p. 19.

Scale Validation

When a scale purports to provide a measure of the magnitude of a particular outcome, it needs to be validated by testing scores achieved on the scale with actual indicators of the outcome of interest, in this case the adverse mental impact on relevant residents exposed to wind turbines. That needs to be done with a sufficiently large number of cases and variety of situations such that statistical analysis demonstrates a high correlation between the scores on the scale and the mental outcomes experienced, with a low probability of a spurious relationship between the two.

Obviously that is not a simple thing to do. Aside from requiring large numbers of test cases, there are no direct, objective indicators of the mental impact experienced by residents subject to wind turbines in their landscape. There may be research strategies to overcome this problem.

But in any case, saying it is very hard to validate a scale you have decided to create does not then offer any legitimacy for assuming the scale is valid. In fact, the reverse tends to be true. If you can't validate, because you can't otherwise measure the outcome of interest, it means any claim you make about knowing the magnitude of that outcome in particular situations is nothing more than a guess.

This demonstrates even more the subjectivity of claims about visual impact currently made by VI consultants and the Department, and the lack of validity in treating them as an indicator of the visual impact that will be experienced by residents.

Scientific Parallel

The research situation is similar to that now being funded by the NHMRC into the effects of infrasound on health. The NHMRC and its researchers are investigating the impact that various aspects of infrasound (frequency, amplitude, duration of exposure, etc) have on sensations reported by subjects as well as on measurable physiological indicators (such as blood pressure and pulse rate). The NHMRC is interested not just in whether there are effects but in the strengths of the effects related to the measurable characteristics of infrasound.

In attempting to create an "objective" scale for visual impact of wind turbines, the Department is hypothesizing a relationship between the visual impact experienced by residents and wind farm attributes such as turbine distance from the resident, elevation and field of view. And the Department is hypothesizing that the size of impact will vary linearly with the way it has grouped magnitudes on the various constituent variables comprising its RAM scale.

The NHMRC has just awarded the first two contracts for research on infrasound and health. They have gone to established university research groups and the amounts awarded total $3.3 million, out of $5 million the NHMRC has currently budgeted for this purpose. This is additional to the much larger amounts being spent around the world on related research. The research commissioned by the NHMRC will involve large numbers of subjects, not the opinions of the researchers.

In attempting a conceptually similar research task on the predictive validity of its RAM scale, it is doubtful that the Department has committed either anything like these sums or involved experienced research teams. Getting the views of some landscape designers, and some

Departmental staff, irrespective of whether they are disposed to support wind farms, is not in any way a legitimate means of determining the predictive validity of the RAM scale – or indeed of any other scale that purports to predict the magnitude of some outcome.

Assessment Matrices and Assessment Scales

With the exception of nominal scales (e.g. gender) a scale is a set of ordered scores on a dimension of interest. Frequently the scores are expressed as numbers, but often as ordered categories (e.g. low, medium, high). Where numbers are used, they may be *ordinal*, *interval* or *ratio* numbers. The type of numbers associated with a scale determines what mathematical and statistical operations can legitimately be applied to scores obtained with the scale.

The fact that someone presents one or more scales in a matrix layout (e.g. with dimension or variable names on one axis and score values on the other axis) does not mean they cease to be scales, and it does not alter what are legitimate mathematical and statistical treatments for scales so presented.

Number Types

Temperature is an interval number when measured in either Centigrade or Fahrenheit, since neither of those measurement scales has a true zero. They actually do include zero in their scales but in each case the position of zero is arbitrary. However temperature measured on the Kelvin scale has a genuine zero (i.e. the lowest possible temperature in the universe is 0° Kelvin).

It is entirely legitimate to average scores on an *interval* scale, but not to use them in multiplication, whereas scores on a *ratio* scale can be legitimately used in multiplication. Thus, physics gives us *Charles' Law* for the relationship between temperature and the volume of an enclosed gas [V = kT, where V is volume of the gas, k is a constant, and T is temperature, which must be measured on the Kelvin scale, not in Centigrade or Fahrenheit], assuming constant pressure.

One of the dimensions in RAM nicely illustrates the difference in number types when expressed on a scale. That dimension is called "Distance". When distance is expressed in metric units (metres) it is a ratio number, which is why we can multiply distance or length to calculate an area.

However, the RAM scale does not include distance in its metric form. Instead it represents distance as four, ordered categories:

Over 3 km	Very low	Score = 1
Between 2 km and 3 km	Low	Score = 2
Between 1 km and 2 km	Medium	Score = 3
Up to 1 km	High	Score = 4

What the RAM's authors are trying to claim is that they have a scale of the effect distance from a turbine has on the visual impact experienced by residents living in the area. Most people would accept that, *ceteris paribus*, the closer the turbines the greater the impact. So the scale has what is termed face validity when its numbers are treated as ordinal ones.

However, no evidence is offered to demonstrate it is an interval scale, i.e. that the actual difference between having a score of 1 and score of 2 is the same as the difference between

having a score of 2 and a score of 3, or the difference between having a score of 3 and a score of 4. Because these numbers are only ordinal ones and not interval ones, it is mathematically illegitimate to average such scores either together or with scores from other ordinal scales, such as the remaining dimensions of RAM.

Arbitrariness of Number Assignment in RAM

The arbitrariness of the scores used for "Distance" in RAM is easily demonstrated. Consider the alternative scoring below.

Over 10 km	Very low	Score = 1
Between 8 km and 10 km	Low	Score = 2
Between 6 km and 8 km	Medium	Score = 3
Between 4 km and 6 km	High	Score = 4
Between 2 km and 4 km	Very high	Score = 5
Between 1 km and 2 km	Extreme	Score = 6
Up to 1 km	Very extreme	Score = 7

or

Over 7 km	Low	Score = 1
Between 5 km and 7 km	Medium	Score = 2
Between 2 km and 5 km	High	Score = 3
Up to 2 km	Very high	Score = 4

Each of these assignments of magnitude label (e.g. "Low", "Medium", "High") and score is arbitrary. Yet the Department's whole purpose is to treat them as though scores on its scales have real meaning in terms of the *relative* visual impact experienced by different residents.

The Department wants to say that someone getting a score of 4 should be treated materially different from someone getting a score of 3. In the first case the Department might be willing to recommend voluntary acquisition rights whereas in the second case it won't. Under this arbitrary assignment of categories and numbers, someone whose residence is 950 metres from the nearest wind turbine is treated totally different from someone 1,050 metres from a turbine.

The relative difference in visual impact related to distance from the nearest turbine can only be determined empirically through proper scientific research, not by someone in the Department or a hired landscape consultant plugging in some numbers for different distances that suit their purpose.

Subjective Subscales in an "Objective" Scale

But the problems with the RAM do not end there. Each of the dimensions is at best an ordinal scale and has arbitary assignments to magnitude categories and scores. In addition, a number have real operational problems in practice. At least with the distance scale, it is easy to measure the distance between the nearest turbine and the dwelling and then determine which of the distance categories that residence falls into. But consider categories such as "Orientation" (which has category definitions "Opposite", "Indirect", "Partial indirect", "Direct") or "Depth perception" (category definitions "Foreground up to 1km", "Middle ground 1km to 5km", "Background 1km to 10km", "Distant 1km to 30km") or Complexity (category definitions "No overlap", "Up to 30% overlap", "30 to 50% overlap", "50%+ overlap").

Unlike distance, there is no easy underlying measure to translate into scores on the various dimensions. Instead each depends on either a subjective judgement by the VI assessor or interpretations of proprietary software not available to the affected community but upon which the Department will purport to rely.

There is also the matter of what dimensions are missing from RAM. Where, for instance, are turbine height, blade length (which generates the swept area which increases with the square of blade length) and the number of visible turbines?

Incommensurable Dimensions

There is one other massive mathematical and scientific problem with RAM. It attempts to consolidate the scores on its various dimensions into a single number which purports to be the overall visual impact. In so doing it treats what are at best ordinal numbers as though they are interval numbers. It also assumes that the various constituent dimensions are equally important, that there is not significant duplication among some of those dimensions, and that it has not excluded some important dimensions (mentioned above).

So, by treating its subscores as interval numbers (when they are not) and all dimensions are equally important, it assumes, for instance, that the difference in visual impact is the same from:

- being 2km from a turbine compared to 3km;
- having a direct orientation to the wind farm compared to a partial indirect orientation;
- having a field of view of 110 degrees compared to one of 40 degrees;
- having 25% turbine overlap compared to no overlap; etc.

In the absence of empirical research, no one can know whether these assumptions are valid.

This approach also assumes that the contribution of the various dimensions comprising RAM is additive rather than, say, multiplicative.

The contribution of each of these dimensions to visual impact, and the relations between them, are empirical matters to be determined through professional research, not something to be assumed by someone sitting at a desk.

Reliability Testing and Predictive Validity

In social science there are occasions when researchers aggregate scores on multiple ordinal items to constitute an overall score. These are commonly known as Likert scales and there are important characteristics that differ from what has apparently been done with RAM:

- the constituent items that are averaged are typically meant to be indicators of the same subjective thing, e.g. personal happiness, depression, or perceptions of the fitness of applicants for a role;
- there are tests done to determine the consistency of scores from individuals (e.g. test/retest) and the ability of scores to differentiate between subject instances;
- when the scales are of something external to raters, there are tests to measure the consistency of ratings given by different raters about the same test subject, i.e. the reliability of scores obtained with the scale (generalisability coefficient); and

- critically the predictive validity of the scales are statistically evaluated, either directly in relation to the matter a scale is meant to express or in relation to other outcome variables which have an hypothesized dependence on the conceptual content of the scale.

It is quite clear that while the constituent dimensions of RAM might each hypothetically contribute to the magnitude of visual impact experienced by residents, they are not simply interchangeable or even correlated (e.g. there seems no reason to expect a correlation between distance from turbines and orientation or field of view).

The scientifically appropriate way to determine the magnitude of contribution to visual impact of each dimension, and any relationships between them in so doing, is via regression analysis, which allows the testing of more complex equations than simple linear ones (which are assumed in the RAM scale). It also allows testing of:

- relative importance of the constituent dimensions;
- redundancy between constituent dimensions.

It also allows the use of genuine ratio scales rather than ordinal ones. For instance, distance can then be entered as actual physical distance (metres) rather than someone's arbitrary chunking into ordinal scores (as currently in RAM); and field of view can be expressed as zero to 360 degrees rather than the RAM categories (which incidentally don't go beyond 180 degrees).

Scale Attenuation – Manufacturing a Desired Result

Scientifically valid scales need sufficient granularity to adequately express significant diversity within the population of interest. It is therefore important to avoid scale attenuation, i.e. compressing the scale into too few categories or truncating it at one end. RAM has the latter flaw.

The defect is particularly egregious because of the way the Department and industry-paid VI consultants interpret the label "Moderate" on these scales. The interpretation is generally that only landowners experiencing a "High" VI warrant significant compensation. Under that view, anyone rated "Moderate" VI or less warrants no significant protection.

Since 75% of the RAM scale is specified as moderate or below, and the scale is constructed so few properties will fall into the top category, the Department has pre-ordained an outcome (without any empirical substantiation) which precludes significant protection for most wind farm neighbours.

It is instructive to compare the Department's four point scale with one for the retention of landscape scenic integrity cited in a recent, in depth review of VI assessment methodology[2]. That scale had six categories, ranging from "Very High" to "Unacceptably Low". Since high on that scale referred to the retention of the pre-existing landscape, if expressed in terms of adverse impact on the landscape, the scale direction would be reversed and would consist of "Very Low", "Low", "Moderate", "High", "Very High", and "Extreme". While that scale

[2] *Evaluation of Methodologies for Visual Impact Assessments, NCHRP Report 741*, Transportation Research Board of the National Academies, Washington DC, 2013, p.23.

corresponds to RAM at the lower end of impact, it includes two scale categories above "High", i.e. "Very High" and "Extreme".

If the Department had categorised the various RAM subscales using these six points, instead of the four chosen, and then used defensible cutpoints for those categories, it would inevitably have shifted some properties in the vicinity of wind farms up the scale. So some properties currently categorised as "High" VI on RAM would move into the "Very High" or "Extreme" categories and some categorised as "Moderate" would move to "High" or "Very High".

That would, of course, mean that under the Department's interpretation of "Moderate" as being the level not warranting significant protection, many more properties would be recognised as warranting protection – which would be a serious problem for wind farm developers.

This scale attenuation, and its practical consequences, indicates at best gross carelessness if not culpable bias in attempting to manufacture an outcome helpful to wind farm developers and prejudicial to the interests of landowners in the vicinity of proposed wind farms.

Inherent Unreliability in the Concept and Construction of RAM

The *Evaluation of Methodologies for Visual Impact Assessments* review draws on peer-reviewed research which demonstrates that professional ratings of VI have low validity in predicting the VI actually experienced by people who live near a development. There are two reasons discussed in the review:

- Research studies show that the inter-rater reliability of professionals (i.e. the consistency between different individuals) when assessing the various factors commonly used to rate visual character is low, and the reliability of assessments about the difference between before and after a development are even lower[3]; and
- "The difference between what professionals value and what the public values is profound." [4]

Given the combination of low reliability for VI assessments by individual professionals, plus the fact there is a "profound" difference between "what professionals value and what the public values", the dimensions in RAM and the selected category cutpoints (and their associated magnitude of claimed VI) for each dimension have very low reliability as part of a tool for estimating VI as it would be experienced by people living in an affected area. This comment assumes those dimensions and category definitions were provided by someone who would be regarded as a "professional" in doing VI assessments. If they were done by a non-professional working in the Department, the likely validity would be even lower.

Additional Effect of Any Constructor Bias

There is a further damaging factor which is the potential bias of those creating the scale. In a peer-reviewed article, Molnarova and colleagues showed that ***people who are pro wind energy consider the impact of wind turbines on a landscape as less negative than do people who are tolerant of wind power or simply indifferent to it***, and that these differences in perception are substantial and highly statistically significant. They also found ***this is the case***

[3] *Evaluation of Methodologies for Visual Impact Assessments, NCHRP Report 741*, Transportation Research Board of the National Academies, Washington DC, 2013, pp. 34-37 and 39-40.
[4] *Op cit*, p. 139.

irrespective of whether the rater is what might be called a landscape expert or anyone else, and irrespective of whether they live with wind turbines in their locality or not[5].

Thus while someone who is pro wind power is still likely to see some negative effect from wind turbines on a rural landscape, they will tend to rate that impact as being a lot weaker than the rest of the community, including the large part of the community that has no firm views one way or the other about wind power.

So, if deciding the level of a subscale (e.g. "Distance") in RAM at which the "High" VI contribution ends, a person who is pro wind energy is likely to take a less expansive view (e.g. a closer distance) than would individuals who are indifferent or negative to wind energy. Given the Government's commitment to erecting wind farms in NSW and the Department's zeal to apply that policy, it is a reasonable presumption that the Department's officers involved in this activity are pro wind energy.

If the Department has obtained input in the process from VI consultants who work for the wind industry, it is an entirely reasonable presumption that they also are pro wind energy. To take one example, given that "GBD has been commissioned for over 20 wind energy projects across New South Wales, Victoria, South Australia, Queensland and Tasmania"[6], it is reasonable to assume it is pro wind power, which has given it so much employment. If it is claimed otherwise, then it is incumbent on the Department to actually demonstrate that not to be the case.

Inappropriate Mathematical Treatment of Cumulative Visual Impact

It is standard practice to require an assessment of the cumulative impact of any wind farm with pre-existing or approved wind farms. The RAM scale includes a dimension for cumulative impact which is logically nonsense.

The dimension is itself entirely subjective, with its ratings:

- Visible minor contributory (1)
- Visible partial contributory (2)
- Visible contributory (3)
- Visible significant contributory (4)

So there is nothing objective about the dimension, though it purports to be part of an objective scale (RAM).

But that is actually the least of the problems. Even were the dimension somehow wholly objective, it is an intellectual travesty to combine it into RAM in this way, which is easily demonstrated.

Suppose RAM used only 3 other dimensions, then including "Cumulative" as a fourth dimension would mean that whatever rating was given on the "Cumulative" dimension would provide one quarter of the overall score. If, however, there were 5 other dimensions then

[5] Molnarova K., Sklenicka P., Stiborek J., Svobodova K., Salek M., and E. Brabec, "Visual Preferences for Wind Turbines: location, numbers and respondent characteristics", *Applied Energy* 92 (2012): 269-278, Figure 6, p. 15.

[6] *Liverpool Range Wind Farm: Landscape & Visual Impact Assessment*, Green Bean Design, March 2014, p. 2.

"Cumulative" would account for only one sixth of the overall score. Or in the current incarnation of RAM there are 8 other dimensions, so "Cumulative" accounts for only one ninth of the overall score.

The number of dimensions used mathematically to create a direct measure of the visual impact of a wind farm in isolation has no effect on the real combined visual impact that a new wind farm has in conjunction with any existing wind farms. Yet the way RAM is constructed, the more items used in calculating a score, the less the calculated impact of the new wind farm in conjunction with the existing one(s).

The fact that those who constructed RAM failed to take account of these obvious factors indicates either gross carelessness, an inability to think logically, or a preference for an arrangement that dramatically waters down the cumulative impact of a new wind farm in conjunction with existing ones.

It can be useful to consider this in concrete terms. Consider a property near which a wind farm (WF A) has already been built on one side of the property. A second wind farm (WF B) is proposed for the other side of the property. The second wind farm will have the same number of turbines, identical to those in WF A, located at the same distance from the property, with the same visibility. Considered in isolation, WF B would have the same visual impact as WF A.

Many people would reasonably take the view that in such a case adding WF B would give a cumulative impact at least double that of either wind farm on its own. It may well be more than double because previously the resident had one outlook from the property with no wind turbines, whereas with WF B there would be no outlook without wind turbines.

But the RAM scale would actually water down that impact to at most only one ninth of its actual size.

In fact the way the scale seems to be being used, the situation is worse than that. To take a simple example, suppose that the ratings for a property are 4 on all the other 8 dimensions in RAM, so the average is also 4. Now consider the situation if there is another wind farm, though perhaps not close, whose contribution is what can be called, in keeping with the RAM "Cumulative" subscale, "visible minor contributory" visual impact. While the contribution may not be large, the cumulative impact of the two wind farms must be worse than that of the new wind farm on its own. But under the RAM scale, that other wind farm gets a score of 1 for "Cumulative", which averaged with 4 on all the other dimensions gives an overall RAM score of 3.67. It is clearly nonsense that when you enter some visual impact from a existing wind farm the overall score is reduced.

The Limits of "Objective" Visual Impact Assessment

Leaving aside, for the moment, all the defects already noted with RAM, there are ultimately limits to how comprehensively and accurately any "objective" indicator can specify VI. This is true no matter how scientifically the indicator is developed – unless it includes relevant attributes of each person who views the landscape.
There is no visual quality independent of the people who view the landscape, as is well established in related research.

> "Without exception, peer-reviewed literature reviews characterize visual quality as an interaction between viewer and landscape. This characterization contrasts

with artistic characterizations of landscape based on assumptions of intrinsic landscape qualities."[7]

A very thorough review of VI assessment methodologies explicitly states:

> "The scientific literature on landscape perception repeatedly concludes that human perception of the landscape, including visual quality and visual impacts, is a transactional process. That is, perceived visual quality is the result of interaction between the landscape and people. Visual quality is the product of a relationship between the environment and viewers. Understanding both the affected landscape and the affected population of viewers is necessary for determining visual quality and visual impacts. . . . Aesthetic qualities are not intrinsic in the landscape, and beauty is not merely in the eye of the beholder; rather, the landscape and viewers operate within a system to generate perceptions of visual quality. The landscape is but one component of that visual system that also includes people."[8]

Not only is visual quality dependent on the viewers as well as the landscape, but viewers differ in how each responds to a particular landscape. There are also differences between groups of people and importantly:

> "The differences between what professionals value and what the public values is profound."[9]

Individual perceptions of visual quality are not simply abstract perceptions. They depend on the extent and way in which individuals interact with a particular landscape and, by definition, residents in a locality interact with its landscape, over long periods, in ways that transients do not. Thus, for the purpose of visual impact assessment:

> "Existing visual quality is the value placed on the existing landscape by those people who currently have views of the environment."[10]

It is worth paraphrasing those quotes. While there are some features that people commonly find attractive in landscapes (e.g. land-form relief; vegetation, particularly woodland presence; water bodies; apparent naturalism of land use; length or area of view[11]) in any particular situation there is not some objectively definable level of visual quality in the landscape. The actual value comes from the combination of what physically exists and the way individual viewers relate to it.

Thus the only visual values relevant to determining VI are those of residents in the potentially affected area – not those of professionals hired to perform a process, or officials living in totally different environments.

This does not mean there are no identifiable factors that contribute, in consistent ways, to the value people commonly see in a particular landscape, or that there are no identifiable factors which indicate *something* about the magnitude of adverse impact of a certain wind farm configuration on residents. However, those factors can only ever provide a partial indication of the VI on each individual or group.

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[7] *Evaluation of Methodologies for Visual Impact Assessments, NCHRP Report 741*, p. 44.
[8] *Evaluation of Methodologies for Visual Impact Assessments, NCHRP Report 741*, p. 139.
[9] *Evaluation of Methodologies for Visual Impact Assessments, NCHRP Report 741*, p. 139.
[10] *Evaluation of Methodologies for Visual Impact Assessments, NCHRP Report 741*, p. 142.
[11] *Evaluation of Methodologies for Visual Impact Assessments, NCHRP Report 741*, p. 140.

This is similar to the research situation of the NHMRC in relation to infrasound. As with any toxic thing affecting people, exposure to defined levels will lead to a determinable ***average*** magnitude of impact on a population. But there will be variation in the magnitude of impact around that average. Some people will be affected less than the average, others more, and the experience of the latter requires attention and care.

So it necessarily will be with "objective" VI assessment. Provided such instruments are developed with the same scientific rigour as is now going into NHMRC research on infrasound and health, they may provide a mechanism for broad estimates of VI in specific situations but they will not be an accurate estimator of the actual VI experienced by individual residents.

However, for the reasons described in the preceding pages, RAM is lightyears away from being a reliable and valid estimator of average levels of VI, let alone individual experience.