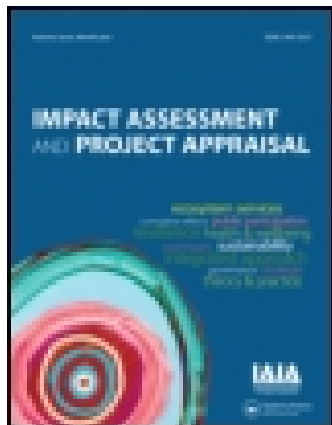


This article was downloaded by: [Gov't of the Nwt], [Alan Ehrlich]

On: 26 January 2015, At: 14:22

Publisher: Taylor & Francis

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Impact Assessment and Project Appraisal

Publication details, including instructions for authors and subscription information:
<http://www.tandfonline.com/loi/tiap20>

The significance spectrum and EIA significance determinations

Alan Ehrlich^a & William Ross^b

^a Mackenzie Valley Environmental Impact Review Board, Box 938, #200 Scotia Centre, 5102-50th Ave, Yellowknife, NT X1A 2N7, Canada

^b Emeritus Professor of Environmental Design, University of Calgary, Calgary, AB T2N 1N4, Canada

Published online: 23 Jan 2015.



CrossMark

[Click for updates](#)

To cite this article: Alan Ehrlich & William Ross (2015): The significance spectrum and EIA significance determinations, Impact Assessment and Project Appraisal, DOI: [10.1080/14615517.2014.981023](https://doi.org/10.1080/14615517.2014.981023)

To link to this article: <http://dx.doi.org/10.1080/14615517.2014.981023>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

The significance spectrum and EIA significance determinations

Alan Ehrlich^{a*} and William Ross^b

^aMackenzie Valley Environmental Impact Review Board, Box 938, #200 Scotia Centre, 5102-50th Ave, Yellowknife, NT X1A 2N7, Canada; ^bEmeritus Professor of Environmental Design, University of Calgary, Calgary, AB T2N 1N4, Canada

(Received 21 May 2014; accepted 8 October 2014)

The concept of significance is fundamental to environmental impact assessment (EIA). Even though there are many guidelines describing technical characteristics of impacts (such as magnitude, geographic extent, extent and frequency) that should be considered, there has remained a long-standing need for increased clarity on how significance determinations are ultimately reached by significance determiners, those who, on behalf of governments, make a legal determination of significance in EIAs. This involves the application of societal values, in the form of subjective informed judgement, about the acceptability of the predicted impacts. This paper introduces the significance spectrum, a graphic model that illustrates a process for determining significance, using the following steps: (1) determining the threshold of significance for each valued component; (2) weighing the evidence and considering predicted impacts; (3) deciding which side of the threshold the predicted adverse impact falls on; and (4) for unacceptable impacts, deciding if mitigations can make the residual impact acceptable. Concepts such as ecological significance should not be confused with significance in EIAs, which may not only include ecological significance but also considers societal values. We provide specific steps for determining significance that help clarify this fundamental aspect that lies at the core of EIA decision-making.

Keywords: EIA decision-making; EIA significance determination; significance spectrum; societal values

Introduction

Determining the significance of predicted impacts is one of the most important decisions in the environmental impact assessment (EIA) process. Good EIA should focus on the impacts that matter most, and, as a result, EIA systems involve systematic steps to determine whether the likely adverse impacts of proposed projects are significant. This paper:

- (1) briefly identifies the key academic literature regarding the importance of significance determinations in EIA and the need for improved understandings of how to determine significance;
- (2) looks, from the perspective of the academic literature and practically, at why and how values are part of significance determinations;
- (3) presents a simple visual model, called the significance spectrum, to clarify how significance determinations are made; and
- (4) examines some of the implications of the role of values in significance determinations to contrast ecological significance with significance as it is used in EIA.

Significance is a fundamental question of EIA

The question of whether or not the impacts (in this paper, the terms 'impact' and 'effect' are used interchangeably) of a proposed project are likely to be significant is key in many, if not all, EIA systems (e.g. EC 2001; CEQ 2005; World Bank 2013). Sippe (1999) lists examples of the legislative bases of significance determinations from around the world, including the USA, New Zealand, the

European Union and Australia. The United Nations Environment Programme states that '[p]articular attention is given in EIA practice to preventing, mitigating and offsetting the significant adverse effects of proposed undertakings' (Sadler et al. 2002, p. 103).

Despite this widespread centrality of the question of significance in EIA, straightforward methods for reaching significance determinations remain challenging and sometimes unclear. This is true even though there are many examples of EIA guidance that identify characteristics of a predicted impact that need to be considered in reaching significance determinations. These typically include impact characteristics such as magnitude, duration, frequency, likelihood and reversibility (e.g. EC 2001, p. 25; Mackenzie Valley Environmental Impact Review Board [MVEIRB] 2004, p. 18; Canadian Environmental Assessment Agency 2012, p. 3; Glasson et al. 2012, p. 126). The United Nations Environment Programme describes similar characteristics (Sadler et al. 2002, p. 264). In the USA, the Council on Environmental Quality regulation (CEQ 2005, s. 1508.27) describes the determination of a significant impact as a function of context and intensity. The five characteristics listed in Canadian guidance (magnitude, geographic extent, duration and frequency, reversibility and ecological context) are widely cited and, superficially, appear to suggest that determinations of significance are a scientific exercise. We think not.

Note: Many participants and parties make decisions about the significance of potential impacts throughout the EIA process, such as a developer deciding what mitigation to propose or interveners deciding whether they agree with a developer's impact predictions. Sippe (1999, p. 81–84) and Weston (2000, p. 186) list several others. In this paper,

*Corresponding author. Email: aherlich@reviewboard.ca

we are primarily referring to the determination of significance made on behalf of government(s). Such decisions are made by governments, by regulators, by independent tribunals (environmental assessment panels) and the like. These are different from the views of significance by others because they stand as legal determinations of what constitutes significance.

Need for a clear process for determining significance

The need for greater clarity and understanding of the actual process of significance determination is recognized in the literature ranging from the 1980s to present, but there is little apparent progress evident. Beanlands and Duinker (1983) call significance determinations ‘the very heart of EIA’, and recognize the need for an operational framework regarding significance as a concept to guide EIA practitioners and participants (p. 43). Sippe (1999) observes the centrality of the concept of significance to decision-making in most EIA systems, but notes that ‘despite the prominence of the concept around which decisions turn and the controversy which such decisions attract, the concept remains largely undefined, at least to the point of general consensus amongst decision makers’ (p. 74). Wood and Becker (2004) recognize the need for improved understanding of significance evaluation in EIA. They attribute the complexity of significance determinations partly to the role of values in EIA decision-making. Wood and Becker state:

Decisions that surround the evaluation of the significance of environmental impacts are a critical component of EIA, with implications for all stages in the process. Despite this, significance evaluation arguably remains one of the most complex and least understood of EIA activities, involving a combination of technical ‘scientific’ approaches to appraisal situated within a political decision making arena, characterised by value judgements and case-specific interpretations. (2004, p. 73)

Several others have recognized this need for increasing clarity of the significance determination process:

- Haug et al. (1984) observe of the US National Environmental Protection Act regulations that ‘they provide no clear definition of significance that can be applied objectively and uniformly to environmental issues and the consequences of man’s activities’ (p. 16).
- Lawrence (2005) concludes that ‘(i)mpact significance determination is widely recognized as a vital and critical EIA activity, both in Canada and in other jurisdictions. Yet it remains one of the most complex and least understood of EIA activities’ (p. 33). He lists several criticisms of significance determination requirements, and observes that this ‘suggests a far from settled EIA sub-field. Clear and unequivocal good practice significance determination standards are unlikely to emerge in the foreseeable future’ (p. 12).
- Lawrence (2007) lists numerous criticisms of prevailing practices of significance determination,

and says that ‘[a] necessary first step toward addressing these needs (for an enhanced level of EIA practice) is greater clarity, specifically regarding the basic characteristics of significance determination activities’ (p. 757).

- Wood (2008) states that ‘(t)he evaluation and communication of the significance of environmental effects remains a critical yet poorly understood component of EIA theory and practice’ (p. 22).
- As recently as 2013, Lyhne and Kornov recognized that although there are many checklists, criteria and thresholds available to guide significance determination, non-technical subjective elements make the determination of significance more complex. They identify ‘a need to notice and recognize significance determination, (to) have conversations in interactions about its nature and role ...’.

This paper is intended to add clarity to the significance determination process. The paper and the model it presents are products of the authors’ reflections on direct experiences in numerous deliberations in Canada. Federal Canadian legislation sets the determination of whether a project is likely to cause significant adverse impacts as the main question that decision-makers must answer (Canadian Environmental Assessment Agency 2012, s.52). In EIA under the Canadian Environmental Assessment Act (CEAA), the Mackenzie Valley Resource Management Act (MVRMA), and elsewhere (as described above), much depends on these determinations of significance. Under CEAA 2012 the question of impact significance is fundamental to whether the project may proceed to the regulatory stage or if it is referred to Governor in Council (Government of Canada 2012, s. 52). Under the MVRMA [s. 128], the question of impact significance is fundamental to determining whether a proposed project needs to undergo an environmental assessment, and whether, at the outcome of the environmental assessment, the project is required to proceed with or without with mitigation measures, or indeed if the project is to proceed at all [Government of Canada 1998]).

In our experience, we have observed that technical experts are usually engaged in analysing impact characteristics such as impact geographic extent, magnitude, etc. (typically described as the technical bases for significance determinations). For example, a biologist may predict that a valued component may be affected to a certain degree, over a certain area, over a certain time, with a certain probability. We suspect, however, that if you were to ask that biologist the crucial question of whether or not the predicted change is acceptable, the biologist should respond that the answer is not a strictly scientific judgement.

Subjective informed judgement

In the authors’ experiences, determinations of significance depend on the *subjective informed judgement* of decision-makers concerning the valued component being considered. This does not replace considering the detailed characteristics of the predicted impact, but necessarily

goes beyond that. Subjective does not mean arbitrary – those using subjective informed judgements to make significance determinations still must rely on the evidence that has been brought forth by the participants of the EIA, and must use cogent reasoning. Importantly, when an EIA significance determiner applies subjective informed judgement to make a significance determination, it reflects the significance determiner's (and, ideally, society's) values.¹

Subjective judgement informed by a body of evidence compiled through a fair process and reflective of a set of societal values is not only credible, but it is in fact a mainstay of some of the most important decisions made in society – by the courts. The same principles lie at the heart of significance determinations in EIA. As in the courts, this approach is used to decide between two categories. Court judges must determine whether the accused is guilty or not; EIA decision-makers must determine whether potential impacts are significant or not.

Below, we examine why the role of values is and should be central to EIA significance determinations, and how, step by step, they can be practically applied to go from impact predictions to legitimate significance determinations.

The role of values in significance determinations

The EIA academic literature supports the idea that value judgements are, and should be, an important part of significance determinations.

- Beanlands and Duinker (1983) assert that 'ultimately, impacts would be measured on the yardstick of human values. Any comprehensive definition of a significant impact with respect to environmental assessment must reflect this value judgement' (p. 45).
- Lawrence (2005) notes, among other things, that the 'central role of values and subjectivity' is a factor that makes the emergence of good practice standards for significance determination unlikely (p. 12). In his conclusions, he describes significance determinations as 'subjective, normative and value-dependent' (p. 33).
- Haug et al. (1984, p. 18) conceptually separated the values associated with of a predicted impact (which they refer to as 'the meaning of the impact') from the characteristics of the impact ('the fact of the impact'), and stated:

The fact of an environmental impact is the change itself, its magnitude, direction, units, and the estimated probability that it will occur. The meaning of an environmental impact is the value placed on the change by different affected interests. It is the answer to the question: If this impact occurs, so what? The 'so what?' determines how important or 'significant' an environmental issue is, and to whom. (Italics in original)

- Sippe (1999) asserts that the adaptability of the concept of significance to sociopolitical contexts (presumably including values) has been an important part of the international success of EIA (p. 74).

He includes a decision tree for determining environmental acceptability that considers both of the components identified by Haug et al. (1984) above.

- Glasson et al. (2012) frame significance in terms of impact acceptability (p. 126). The same paper notes (with respect to socio-economic impacts) that significance determinations involve weighing the importance of impacts, and that '[t]his involves interpretation and the application of judgement. Such judgement can be rationalized in various ways and a range of methods are available, but all involve values and all are subjective' (p. 128).

There are several other examples recognizing the importance of value judgements in EIA significance determinations.

- Weston (2000) notes that significance-based decisions in EIA are 'inherently based upon value judgements and are made within a political context' (p. 200), and that these value-based decisions 'will inevitably rely on professional, political and intuitive judgements' (p. 198). Weston further states that 'the (scoping) process is therefore at heart human centred and not ecocentric; it is anthropocentric rather than ecocentric' (p. 199), and describes this as a strength of EIA, not a weakness.
- Harding (1998, p. 79) emphasizes that inadequate consideration of values often underlies apparent disagreements over fact in the environmental decision-making process.
- Sadler et al. (2002, p. 274) describe two steps for evaluating significance that emphasize the consideration of 'impact importance' in the second step, using a subjective value.
- Gibson et al. (2005) state that 'the significance decision involves judgement in light of context' and argue that the unique context-specific nature of the interplay between a particular project and its setting requires 'context-specific choices that depend on fair process rather than regulatory type pre-determined thresholds' (p. 166–167).
- Briggs and Hudson (2013) recognize that subjectivity is a part of determining significance, but observe that there exists concern that developers, or the consultants working for them, can use it to minimize the predicted impacts to increase odds of project approval (p. 17). This is discussed further below.
- Gibson et al.'s sustainability-based criteria and trade-off rules for evaluating the significance advocate for applying specific values (in these cases, based on sustainability principles) to significance determinations (2005, p. 173–178). In this context, Gibson et al. state that '... significance decisions are essentially matters of public choice. Assessment is more about valuing than calculating' (p. 175).
- Rowan (2012, p. 190) argues for applying specific human values to improve the credibility of the social impact assessment process.

It is noteworthy, with respect to the significance spectrum presented below, that some of these authors have described significance in terms of impact acceptability (e.g. Beanlands & Duinker 1983, p. 44; Haug et al. 1984, p. 19; Sippe 1999, p. 85; Sadler et al. 2002, p. 274; Gibson et al. 2005, p. 174; Lawrence 2007, p. 763; Glasson et al. 2012, p. 126). The International Association for Impact Assessment's *Principles of Environmental Impact Assessment Best Practice* also states that the evaluation of significance involves determining the importance and acceptability of impacts (Senecal et al. 1999).

To summarize, there are many published guidelines describing criteria for impact prediction, and there is a recognition that values play a role in significance determinations. However, there is little straightforward guidance available to EIA decision-makers on exactly how to apply values to impact predictions to reach significance determinations. Even though this is a vital part of the EIA process, we have observed that this remains problematic to practitioners. That is the purpose of this paper – to help clarify how significance determinations are actually made. The model below, which we call 'the significance spectrum', is intended to illustrate a clear and straightforward method of determining significance.

Why social values are central to significance determinations

There are two distinct reasons why we conclude that societal values (supraindividual values, according to Rokeach [1979]) need to play a central role in determining significance. The first is more theoretical, based on the proper role impact assessment plays in leading to better development decisions. The second is based on best professional practice in Canada and, we believe, elsewhere.

Theoretical reason for societal values in determining significance

The International Association for Impact Assessment defines impact assessment as 'the process of identifying the future consequences of a ... proposed action'. Impact assessment is important because it leads to better decisions concerning proposed projects. The World Bank (2013) requires EIA '... to help ensure that [projects proposed] are environmentally sound and sustainable, and thus to improve decision making'. This purpose of EIA is made clear in Canada where the Canadian Environmental Assessment Agency indicates 'environmental assessment provides an effective means of integrating environmental factors into planning and decision-making processes in a manner that promotes sustainable development' (Canadian Environmental Assessment Agency 2012).

In short, EIA is used to determine the consequences of proposed actions (projects) to determine if they are environmentally acceptable. Indeed, one of the purposes of the CEAA is to 'to ensure that projects are considered in a careful and precautionary manner before federal authorities take action in connection with them, in order

to ensure that such projects do not cause significant adverse environmental effects' (Government of Canada 1992). It is clear from these features that the use of EIA is to assist decision-makers to avoid significant adverse effects.

This provides the important link between the impact assessment process and the subsequent regulatory decision-making process into which impact assessment feeds. While these two processes (impact assessment and regulatory decision-making) are conceptually different, they are closely linked and it is very desirable to have the meaning of significance be the same, not different. It should be noted that regulatory decision-makers will consider more than what is included in the impact assessment. But what is in the impact assessment documents ought to be in the same 'language' as the decision-makers are using.

Decision-makers in Canada and in most of the world make project decisions based on some form of public interest test. A clear example of such a test is found in Alberta (the Energy Resources Conservation Act) where the test to approve energy projects (from producing wells to oil sands mines) is to determine the project is 'in the public interest having regard for environmental, social and economic matters'. The main point is that significance of effects is determined by the decision-maker. In making a public interest decision, legitimately determined public policies and societal values should properly influence that decision.

As noted above, a purpose of the CEAA is to ensure that 'projects do not cause significant adverse environmental effects'. It is clear that this determination of significance for each effect (and hence the determination of the project as a whole being in the public interest) is the responsibility of the significance determiners. It seems equally clear that significance relies heavily on the values of the society related to the valued component for which the decision is being made. Note that significance is attributed to each effect and thus is determined for the specific valued component affected. The public interest test is applied to the project as a whole. The level of significance for each effect would properly be determined based on ecological, social and financial considerations and would be based on the values of society. For example, in Alberta to determine significance, air quality is often compared to the Alberta Ambient Air Quality Objectives. These are, according to the Alberta Environment web page, determined based on scientific, social, technical and economic factors. Such regulators, for example, should not (barring exceptional circumstances) permit projects that would create effects in violation of laws and regulations. For this reason, the US EPA has provided the following example of a significant adverse effect: 'the activity will introduce pollutants to the air that will cause ambient air quality to exceed established levels' – violating levels established by society. The point being made here is that significance determiners should identify an impact as significant if it does not meet government determined objectives, regulations and standards. However, the corollary is not necessarily true – that is, an impact may

meet government determined objectives, regulations and standards, and still be significant for other reasons.

As mentioned above, Briggs and Hudson (2013) cite the concern that subjectivity in significance determinations allows unscrupulous developers or their consultants to sugar-coat (i.e. minimize) the significance of potential impacts, in order to make them seem more acceptable. While this does sometimes occur, in this paper we are referring primarily to the EIA significance determiner (as described above). In the context in which we are writing, the EIA significance determiner in a procedurally fair EIA must be without apprehensions of bias. Significance determiners are in a good position to use their own subjective informed judgement, when weighing evidence, to consider possible misrepresentations and biases of EIA participants (including those with interests that oppose one another) to reach wise decisions that reflect societal values – which can ultimately help to *reduce* the problem described by Briggs and Hudson.

Our use of the term ‘societal values’ is not at all intended to mean values of individuals or groups that are arbitrary. We mean subjective informed judgements. Examples include compliance with legislation, regulations passed by responsible authorities, regional policies set by authorities following appropriate public consultation and the like.

Sadar (1996, p. 100) states that:

in the first stage (of significance determination) one relies on scientific and/or specialized knowledge. In the second stage, one is concerned with the relative values of the society or segments of it. This latter stage involved value judgements and is not necessarily based on scientific knowledge.

Sadler (1996) mentions that ‘During the more detailed phase of impact analysis, determination whether impacts are significant and acceptable involved both prediction and estimation of nature, magnitude, timing, and duration, as well as the attribution of importance or value to these findings’ (p. 118).

Furthermore, the CEAA 2012 indicates: ‘If the decision maker decides that the designated project is likely to cause significant adverse environmental effects ... the decision maker must refer to the Governor in Council the matter of whether those effects are justified in the circumstances’ (Government of Canada 2012, s. 52). The sequence is first a determination of the significance of (adverse) effects based on a societal threshold of significance (including environmental and ecological features as important factors) and then using this (and other) information to decide whether the project as a whole is in the public interest. In deciding whether the project is in the public interest, it may be necessary to decide if any significant adverse effects are justifiable under the circumstances.

Two features are worth noting. First, if the likely significant adverse effects are justifiable, the project may be allowed to proceed – the public interest may override significant adverse effects. Second, the determination that the likely significant adverse effects are justifiable can only be made by Cabinet, a high level of government.

The regulator uses the term ‘significance’ in such a manner that it includes a variety of social, economic and ecological aspects (public interest). There are two reasons for expecting the word to have the same meaning in impact assessment. The first is that the wise proponent will make decisions regarding mitigation measures based on the analysis presented in the EIS, more precisely, based on the possibility of significant adverse effects. The proponent will almost certainly be paying attention to the decision to be made by the regulator, who will base the decision on the public interest and hence (*inter alia*) on the significance of effects. If the term ‘significance’ has a different meaning in the EIS than it has for the regulator, that will be a disservice to the proponent or will require a complicated discussion between the proponent and its consultant.

The second reason is that, if the term has a different meaning, this will cause much confusion for all participants in the project review process. They will need to use the meaning the regulator will use in spite of the term having a different meaning in the EIS. This confusion may even create uncertainty in the mind of the significance determiner, a situation that could jeopardize the review process, or lead to judicial review. Anyone may make an argument regarding effect significance or regarding project public interest. But such arguments must only be treated as advice to the significance determiners.

Professional practice in implementing the CEAA

Independently of the above theoretical analysis, we took the following two steps to determine best practice in determining significance under the CEAA. We examined the significance guidance document (Canadian Environmental Assessment Agency 2012). In this document, it is stated:

The most common method of determining whether the adverse environmental effects of a project are significant is to use environmental standards, guidelines, or objectives. If the level of an adverse environmental effect is less than the standard, guideline, or objective, it may be insignificant. If, on the other hand, it exceeds the standard, guideline, or objective, it may be significant.

Environmental standards, guidelines and objectives have been established by federal, provincial, and in some cases municipal departments, ministries, and agencies. They often define either maximum levels of emissions or discharges of specific hazardous agents into the environment or maximum acceptable levels of specific hazardous agents in the environment. They are usually based on the results of studies in the field and with laboratory animals, available technology, and/or prevailing attitudes and values.

That is, the guidance document suggests using government determined standards, guidelines or objectives. Because the standards, guidelines and objectives are based on prevailing attitudes and values are used to determine significance, this also suggests that significance can properly be based on prevailing attitudes and values.

In addition, we consulted a very knowledgeable expert on the CEAA, Bob Connelly. Connelly (personal

communication, 2012), conveyed the following message regarding the determination of significance under the Act:

I would agree that societal values should, and I believe are meant, to be included in determining significance ... Public participation is a fundamental purpose of the Act and provision for it is reflected throughout. It is therefore implied and widely accepted that public values will be considered in the CEAA process including, in my view, in determining significance. After all, significance involves value judgements and consequently understanding public values is essential in making this judgement.

This idea of significance determinations being based on subjective informed judgement instead of a purely technical factoring of characteristics means that significance determinations are more than inevitable deterministic outcomes. Because this involves the application of values, it matters who decides. For example, the MVEIRB is a co-management court-like tribunal composed of members who are nominated by Aboriginal (Indigenous) organizations and non-Aboriginal governments in equal numbers. Different board members bring different world views and societal values to the decisions (Christensen et al. 2007).

In the case of co-management, and in other settings where the potentially affected public includes primarily Aboriginal communities, social values of the potentially affected community should be an important factor in determining significance. When these social values conflict with those of non-Indigenous society, reaching significance determinations can be much more difficult. Larcombe (2000) noted that '[t]he practice of determining significance is highly subjective and driven by non-Aboriginal society values' (s. 4.3.2). The MVEIRB's co-management approach to EIA decision-making makes it easier for it to recognize, consider and incorporate Aboriginal social values when making its significance determinations.

Significance simplified

The MVRMA EIA process (Government of Canada 1998) requires that any project that is determined likely to be a cause of significant adverse impacts must have its impacts prevented by measures or be rejected (unless ordered to a review panel for further assessment, which has occurred only twice since the Act was passed). The question of whether an impact is significant can therefore be reasonably interpreted operationally by the decision-makers to mean 'Does the impact matter enough so that it should be reduced or prevented?' If so, the impact is significant. Board members have found that this question has greatly simplified significance determinations. This wording clarifies the decision while emphasizing the subjective determination of acceptability based on social values and considering the public interest.

The following graphic model (Figure 1) further clarifies the significance test, helps show the role of mitigations and clarifies the separate roles of the EIA significance determiners and those of the regulators who will later decide on project approvals for most projects.

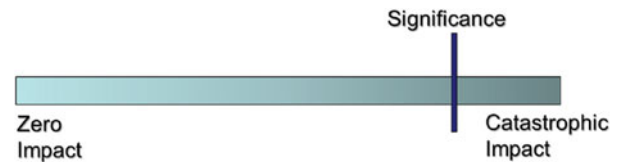


Figure 1. The significance spectrum and threshold of significance. The EIA significance determiner decides where the significance threshold should be drawn for each potentially significant impact.

We call it 'the significance spectrum'. Although drawn from our experiences, the significance spectrum model is not specific to any particular EIA regime. It is intended to illustrate how to go from impact predictions to significance determinations.

One of us (Alan Ehrlich) has used this model successfully to clarify the process of significance determination for EIA significance determiners from different cultures with varying degrees of technical background, prior to actually reaching significance determinations for several high-profile environmental assessments of proposed large-scale projects. In discussions with EIA practitioners at International Association for Impact Assessment conferences, we have determined that EIA decision-makers from other regimes in other countries confirm that it is an accurate representation of the process they too have implicitly undertaken when making significance determinations. This model has been accepted and adapted by regulatory boards in Canada's Northwest Territories as a conceptual basis for an entire adaptive management framework (Racher et al. 2011), and has recently been reflected in a management framework of a major multinational mining company (De Beers 2014).

This model is based on the principle that significance determinations involve the comparison of a predicted change to a limit of acceptable change, which is a case-by-case application of a value-based threshold (Ehrlich 2007). This idea is supported by Haug et al. (1984), which similarly identifies the concept of a threshold of concern, described as 'a maximum or minimum number, or other value, for an environmental impact of resource use which, if exceeded, causes that impact or use to take on new importance' (p. 18), and as 'the point at which an impact becomes acceptable or unacceptable ...' (p. 19).

The significance spectrum model represents the full continuum of possible adverse impacts arising from a proposed project, ranging from the theoretical extreme of no impact whatsoever to the opposite extreme of catastrophic impact (the horizontal bar in Figure 1). Because significance tests focus primarily on likely adverse impacts, the spectrum does not include the range of beneficial effects, although one could reasonably imagine a mirror-image extension of the scale to the left to include a full continuum of desirable impacts.

Note: Likelihood is a common element of significance determination in many jurisdictions (e.g. Government of Canada 1998; EC 2001; Sadler et al. 2002; CEQ 2005; Canadian Environmental Assessment Agency 2012; World

Bank 2013). With respect to the word 'likely', we interpret the term to mean more likely than not (i.e. greater than 50% probability of occurrence; MVEIRB 2006). Haug et al. (1984, p. 24) interpret the term similarly when applying it in significance determinations. We believe that this is a part of predicting the impact, and should be done separately from determining the acceptability of the impact. We further note that for worst-case-type scenarios (meaning low-probability high-consequence events), even an unlikely impact may be unacceptable if it is severe enough; likelihood should be understood in the context of risk when determining significance (see MVEIRB [2013 p. 18–19] for further discussion).

In determining whether a proposed impact is significant, the EIA decision-maker must decide where to establish the threshold of significance – where to draw the line (Ehrlich 2009). This threshold could occur anywhere along the significance spectrum, and how far along it is drawn depends on the informed subjective judgement of significance determiners.

This threshold separates the realm of the acceptable from the realm of the unacceptable (Figure 2). It considers any relevant evidence in the EIA and reflects the significance determiner's (and society's) values. For example, for a wildlife species, if the species is determined to be an endangered species, or is highly valued by society, it would be expected to have a more stringent significance threshold than a similar wildlife species in the same area without those characteristics. The arguments of the parties may play a role in this step.

In deciding where to set the threshold of significance, the idea is to separate the setting of a threshold for a valued component from the determination of justifiability. The former is the setting of a significance threshold for a particular valued component and is not dependent on the project. It depends only on the societal values for the valued component. The latter is a different societal value judgement that does deal with the merits of the proposed project, and should not be confused with the impact significance determinations made in EIA.

It is worth noting that, since the acceptability of adverse effects to a valued component reflects how society feels about the valued component, the significance threshold will be the same whether the impact is caused by a single human activity or by multiple human activities. That is, the significance threshold for given valued component will be the same for project assessment as it would be for cumulative effects assessment.

The decision-maker must weigh the evidence (the impact predictions) and consider the arguments of parties

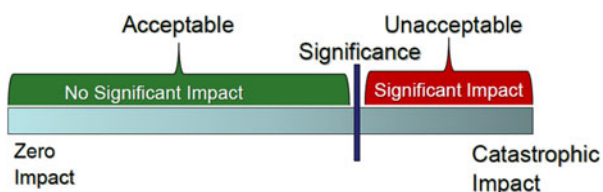


Figure 2. The realm of the acceptable and the realm of the unacceptable.

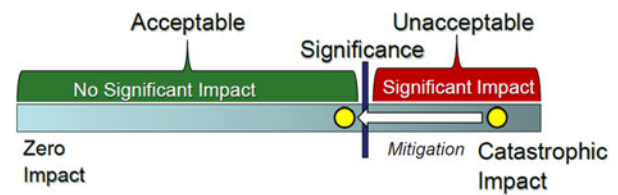


Figure 3. Impact significance and mitigation. The significance determiner decides where on the spectrum a predicted impact (shown as the yellow circle) falls, and weighs the effect of mitigation measures (shown as the arrow) on impact significance.

participating in the EIA. This may include carefully judging between the conflicting predictions of different participants, who may have (deliberately or otherwise) introduced their own values into predictions and who also may have competing views in where the threshold of significance should be for a given valued component. Public participation in the EIA provides a potentially valuable source of input on parties' views on the latter, for decision-maker's consideration in this step.

The significance determiner must then decide where any predicted adverse impact will fall on the spectrum, it falls whether on the side of the acceptable (and therefore is not a significant impact) or on the side of the unacceptable (and is therefore a significant impact) (Figure 3). If the impact falls on the unacceptable side, and is therefore significant, the significance determiner must consider whether mitigation measures are sufficient to shift it across the threshold of significance, so that the residual impact is not significant.

Even though this depends on the values of the significance determiner, the subjective element of significance determination does not make it arbitrary. The significance determiner's judgement should be informed by a reasonable weighing of the evidence, and by the values of society, and, for social and cultural impacts, should particularly consider the rights of, and impacts to, the affected public. For cultural impacts, the cultural context should be considered in significance determinations (Canadian Environmental Assessment Agency 1996). For transparency, the rationale should be reported in a manner that makes clear the reasoning and judgements that led to the significance determination, in language understandable to EIA participants.

In short, the four steps to significance determination using this model are:

- (1) Decide where on the spectrum of potential impacts to place the threshold of significance for that particular valued component.
- (2) Weigh the evidence (impact predictions).
- (3) Decide which side of the threshold the predicted adverse impact falls on.
- (4) If the impact falls on the unacceptable side, decide if additional mitigation measures will shift the predicted impact to the acceptable side.

The role of the EIA versus later regulation

The significance spectrum illustrates a particular relationship between EIA decision-making and the later

regulatory authorization process that usually follows it. A question the authors have encountered is ‘Why do people conducting EIAs bother to consider the significance of impacts that will eventually be regulated by conditions in licenses?’ In most jurisdictions, there are regulators who set specific limits in authorizations. Regulators also have enforcement mechanisms. As well, national standards may apply to the specific valued components. Why, then, is it necessary for EIAs to examine significance of impacts on these? Why not simply leave these for the regulators to take care of during the later licensing stage?

As an analogy, consider the role of the driving examiner, whose job it is to decide whether the applicant who wants a driver’s license is an acceptable driver. Note that the examiner does not need to decide if the applicant is a perfect driver, but only if the driver is good enough to be allowed on the road with others. Clearly, there are regulations, such as specific speed limits and defined traffic rules, that would apply to the driver. There is also a system of enforcement that penalizes drivers who exceed limits. Does this mean that examiners do not need to apply the test?

Obviously not, because despite regulation, an unacceptable driver may still hurt other people, or cause other unintended damage. The question of acceptability must be decided before relying on speed limits and traffic police. The same holds true in EIA. The significance (i.e. acceptability) of potential impacts needs to be established in EIAs before relying on regulation or enforcement.

One reason for this is because regulations are primarily designed to deal with impacts that are not significant. The regulators who issue authorizations such as water licenses are primarily legally able to do so for projects that do not have significant impacts. These authorizations typically define specific limits. The range of these, on the significance spectrum, would appear as an area within the ‘no significant impact’ range (shown as the green oval in Figure 4). Regulators are able to choose the final limits of their authorizations only if the EIA significance determiner *first* decides that the residual impacts are acceptable (i.e. not significant). As shown on the significance spectrum, the regulators select an appropriate range in the realm of the acceptable once the EIA has determined which side of the significance threshold the impact (with mitigations if necessary) falls on. For matters of potential significance, a responsible significance determiner will determine the significance of

potential impacts rather than relying purely on eventual regulatory authorizations.

Ecological significance versus EIA significance

In different processes under the two regimes described here, each of us has encountered developers confusing ecological significance with significance as used in EIA determinations. In each case, the developers used regional population persistence as an assessment endpoint in their examinations of potential impacts of proposed mines on wildlife. They asserted that if the population persists, the impact on that valued component could not be ecologically significant, and therefore there should be a finding of no significance by the EIA significance determiner.

Our view is that this position is not reasonable because it excludes the societal values that a local human population may place on the species or biological community. In the significance spectrum model, these values would be applied to determine the threshold of significance. While ecological significance must play an important role in determining significance of an impact on wildlife, we believe it must not be the only determinant, as societal values should also play an important role in determining what is significant in the overall assessment of a project, for the reasons described above.

The same participants have explicitly rejected using compliance with legislation (the *Species at Risk Act* in particular) as being a relevant consideration in determining significance of effect on a listed species. This is not consistent with the best practice approach or the theoretical approach as determined above because it explicitly rejects the very kinds of societal values that others, including ourselves, insist should be used in determining significance.

So, does this mean that the determinant for a significant adverse effect for a specific population of wildlife should be that the regional population is not persistent? Certainly, if the regional population of a species is not persistent, this would (by most reasonable interpretations) be a significant adverse effect (i.e. population of that species would decline until extirpated). But whether a population that persists regionally would ensure the effect is insignificant is another matter entirely. It may be that the population has other targets set by responsible regulators. Failure to meet these requirements would, by any reasonable interpretation of the word ‘significance’, mean the effect was significant and adverse.

The example one of us (Bill Ross) has used in his capacity as a regulator (temporary appointment for the purpose of hearing the application for an oil sands mine by Alberta’s Energy Resources Conservation Board in 2011) is the determination made that the effect on threatened or endangered species would be significant and adverse if it violated the federal *Species at Risk Act*. This Act has a prohibition against harming an individual of a threatened or endangered species, its residence or its critical habitat. Violating this prohibition, it was determined, would be a significant adverse effect even if the regional population

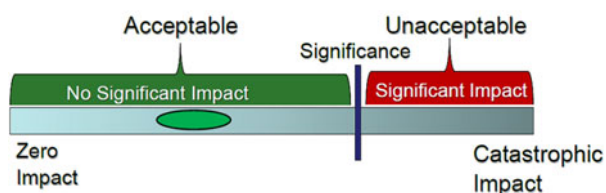


Figure 4. An example of a range of impacts that regulators can allow. Regulators can only authorize activities if the proposed projects are first determined to be acceptable (i.e. do not cause a significant adverse impact).

persisted. Another example of ‘other targets’ is where regulators (e.g. fish and wildlife management agencies) set targets for sustainable harvest (e.g. elk, furbearers, grizzly bears). Is it a significant effect where a target for sustainable harvest (for example, as identified by surplus yield models) has to be reduced because of ‘takings’ by the mine? We would often say ‘yes’.

Similar problems would arise if other regulators set policy or regulatory conditions on regional populations (or sub-regional populations). For example, Parks Canada establishes targets for ecological conditions within national parks. These may go beyond the achievement of persistence of regional populations of species primarily because the legislation governing the Parks Canada mandate expects ‘ecological integrity’ as its first priority. Similar limits may be set for other protected areas.

For species at risk in Canada, recovery strategies or action plans may be determined. These are based on science but reflect social values. Recovery strategies or action plans set goals for the species that are by no means limited to only the persistence of regional populations. Proponents that assert that the persistence of regional populations means no significant impact in EIA could still conduct activities that violate such plans or policies. Doing so would seem to be a clear indication of a significant adverse effect.

But there is a higher principle involved. Proponents are entitled to include (almost) any material they see fit in their applications. Because of this principle, they may choose to define significance as they see fit and use of the ecological significance criterion suggested is acceptable, even if ill advised. For example, one could define a ‘significant adverse effect’ as ‘the presence of purple pigs with no tails’. Then, if one makes the (almost certainly correct) prediction that the project would not cause the presence of purple pigs with no tails, one must conclude that the project would not cause significant adverse effects, by definition. Significance determiners should surely reject this definition (and hence the conclusion), thus nullifying a good deal of significance-related analysis. The consequence of developers using a peculiar definition of significance is that other parties involved in the decision-making process must exercise great care to point out the flaws in the definition to the significance determiners. Significance determiners should use a broader and more correct determination of significance – one that takes into consideration other properly determined societal goals.

As an aside, if the above arguments were rejected and the use of an ecological (not societal) determination of significance was found to be acceptable, we cannot understand how the use of ‘persistence’ of a regional population could possibly be upheld as the sole determination of significance. The simplest counterexample would be for a threatened or endangered species for which a recovery strategy or an action plan is in place. These would have been developed by experts for the species and must surely take precedence over the indicator of regional population persistence. The same argument would equally apply to many such regulations or local policies provided they had been properly developed by knowledgeable experts. Of course, such strategies, plans, policies, etc.,

are almost always required to undergo suitable public consultation. Does this requirement place them outside the limit of ecological significance even if they are initially based on the best ecological expertise? We think not.

Conclusion

The steps described above for reaching significance determinations using the significance spectrum are systematic, clear and consistent with the goals of EIA. The significance spectrum appears to provide some of the additional clarity that Beanlands and Duinker (1983), Sippe (1999), Wood and Becker (2004), Lawrence (2005) and Lyhne and Kornov (2013) have found wanting. The steps provide a reasonable method to use subjective informed judgement to explicitly apply societal values to significance determinations, allowing for a systematic integration of values, as authors like Sippe (1999), Sadar (1996), Sadler (1996), Weston (2000), Gibson et al. (2005) and Rowan (2012) have recognized as essential. The order of the steps in the significance spectrum model conform to the two general steps described in Sadler et al. (2002), while providing a more specific and applicable method to the second step. The steps may help operationalize those described by Sippe (1999, p. 85) and provide a more clear process for how and when to apply values to impact predictions. Likewise, they further operationalize the concepts described by Haug et al. (1984). The steps we suggest are adaptable to a variety of world views and values (as they are not culture specific), and have broad applicability in virtually any EIA system, including international contexts, offering the sociopolitical flexibility that Sippe stated has allowed significance determinations to contribute to the ‘wide international success EIA has achieved’ (1999, p. 74).

In summary, there is a sound theoretical basis for applying societal values in significance determinations, and best practice includes doing so. The steps for applying the significance spectrum model to determine significance of impacts are as follows: (1) determine the threshold of significance for each valued component; (2) weigh the evidence and consider impact predictions; (3) decide which side of the threshold the predicted adverse impact falls on; and (4) for unacceptable impacts, decide if mitigation measures can make the residual impact acceptable. Hopefully, the specific steps prescribed help clarify this fundamental aspect that lies at the core of EIA decision-making.

Acknowledgements

Roger Creasey, before his untimely passing, made helpful contributions to this paper. We gratefully acknowledge his input. Reviewers for the Journal of Impact Assessment and Project Appraisal also made many very helpful suggestions.

Note

1. Noteworthy academic literature relating to values includes Rokeach (1973, 1979), Catton and Dunlap (1978), Dunlap

and Van Liere (1978) and Bengston (1994). We do not summarize these here, as this paper focuses primarily on the practical application of values in EIA, but suggest them to readers interested in further exploring the subject of values.

References

- Beanlands G, Duinker P. 1983. An ecological framework for environmental impact assessment in Canada. Institute for Resource and Environmental Studies. Halifax, Canada: Dalhousie University and Federal Environmental Assessment Review Office.
- Bengston D. 1994. Changing forest values and ecosystem management. *Soc. Nat. Resour.* 7(6):515–533.
- Briggs S, Hudson M. 2013. Determination of significance in ecological impact assessment: past change, current practice and future improvements. *EIA Review.* 38:16–25.
- Catton W, Dunlap R. 1978. Environmental sociology: a new paradigm. *Env. Sociology.* 13:41–49.
- Canadian Environmental Assessment Agency. 1996. Reference guide on physical and cultural heritage resources; [accessed 2014 Mar 6]. Available from: <https://www.ceaa-acee.gc.ca/default.asp?lang=En&n=1BE75513-1&offset=&toc=hide>
- Canadian Environmental Assessment Agency. 2012. Reference guide: determining whether a project is likely to cause significant adverse environmental effects; [accessed 2014 Mar 6]. Available from: <https://www.ceaa-acee.gc.ca/default.asp?lang=En&n=D213D286-1&offset=3&toc=show>
- CEQ (Council on Environmental Quality), Executive Office of the President. 2005. Regulations for implementing the procedural provisions of the National Environmental Policy Act. Government of the United States of America; [accessed 2014 Mar 6]. Available from: http://energy.gov/sites/prod/files/NEPA-40CFR1500_1508.pdf
- Christensen V, Ehrlich A, White G. 2007. Involving Canada's indigenous peoples in environmental assessment: co-management through the Mackenzie Valley Environmental Impact Review Board. Proceedings of the 27th Annual International Conference, International Association for Impact Assessment; Seoul, Korea; [accessed 2014 Mar 6]. Available from: http://www.reviewboard.ca/upload/ref_library/IAIA%20paper%20re%20Co-mgmt%20through%20the%20MVEIRB;%20Seoul%20Korea%20June%202007%20_1182980894.pdf
- De Beers. 2014 Feb. Gahcho Kue Project aquatic effects management plan. Presentation at AEMP Workshop, Yellowknife; p. 75; [accessed 2014 Mar 11]. Available from: <http://www.mvlwb.ca/Boards/MV/SitePages/search.aspx?app=MV2005L2-0015>
- Dunlap R, Van Liere K. 1978. The 'new environmental paradigm'. *J Environ Educ.* 9(4):10–19.
- EC (European Commission). 2001. Guidance on EIA screening. Luxembourg, p. 25; [accessed 2014 Mar 6]. Available from: <http://ec.europa.eu/environment/eia/eia-guidelines/g-screening-full-text.pdf>
- Ehrlich A. 2007 Nov. Thresholds in EIA: where to draw the line. Presentation to the 35th Annual Geoscience Forum; Yellowknife, NT, Canada.
- Ehrlich A. 2009 Nov. The significance spectrum. Presentation to the 37th Annual Geoscience Forum; Yellowknife, NT, Canada.
- Gibson R, Hassan S, Holtz S, Tansey J, Whitelaw G. 2005. Sustainability assessment criteria, processes and applications. London: Earthscan.
- Glasson J, Therivel R, Chadwick A. 2012. Introduction to impact assessment. 3rd ed. New York: Routledge.
- Government of Canada. 1992. Bill C-37: Canadian Environmental Assessment Act, 1992. Sec. 16 (1)(a).
- Government of Canada. 1998. Bill C-6: Mackenzie Valley Resource Management Act, 1998. Part 5. Sec. 128.
- Government of Canada. 2012. Canadian Environmental Assessment Act, 2012. Sec. 52 (1).
- Harding R, ed. 1998. Environmental decision-making: the roles of scientists, engineers and the public. Annandale: The Federation Press.
- Haug PT, Burwell RW, Stein A, Bandurski BL. 1984. Determining the significance of environmental issues under the National Environmental Policy Act. *J Environ Manage.* 18:15–24.
- Larcombe P, Winds and Voices Environmental Services Inc. 2000. Determining significance of environmental effects: an aboriginal perspective. Canadian Environmental Assessment Agency; [accessed 2014 Mar 6]. Available from: http://epe.lac-bac.gc.ca/100/200/301/ceaa-acee/research_and_devt-e/determining_significance/015/0002/0003/4_e.htm
- Lawrence D. 2005. Significance criteria and determination in sustainability-based environmental impact assessment (Final report). Prepared for Mackenzie Gas Project Joint Review Panel, Lawrence Environmental; [accessed 2014 Mar 6]. Available from: https://www.ceaa-acee.gc.ca/155701CEDocs/David_Lawrence-eng.pdf
- Lawrence D. 2007. Impact significance determination – back to basics. *Environ Impact Assess Rev.* 27:755–769.
- Lyhne I, Kornov L. 2013. How do we make sense of significance? Indications and reflections on an experiment. *Impact Assess Project Appraisal.* 31(3):180–189.
- MVEIRB (Mackenzie Valley Environmental Impact Review Board). 2004. Environmental impact assessment guidelines. Yellowknife; [accessed 2014 Mar 6]. Available from: <http://reviewboard.ca>
- MVEIRB. 2006. Reference bulletin: operational interpretation of key terminology. Yellowknife; [accessed 2014 Mar 6]. Available from: <http://reviewboard.ca>
- MVEIRB. 2013. Report of environmental assessment and reasons for decision: Giant Mine remediation project. Yellowknife; [accessed 2014 Mar 6]. Available from: http://reviewboard.ca/upload/project_document/EA0809-001_Giant_Report_of_Environmental_Assessment_June_20_2013.PDF
- Racher K, Hutchinson N, Hart D, Fraser B, Clark B, Fequet R, Ewaschuk P, Cliffe-Phillips M. 2011. Linking environmental assessment to environmental regulation through adaptive management. *Integr Environ Assess Manage.* 7:301–302.
- Rokeach M. 1973. The nature of human values. New York: The Free Press.
- Rokeach M. 1979. Understanding human values: individual and societal. New York: Simon and Schuster.
- Rowan M. 2012. Refining the attribution of significance in social impact assessment. *Impact Assess Project Appraisal.* 27(3):185–191.
- Sadar M. 1996. Environmental impact assessment. 2nd ed. Ottawa: Carleton University Press.
- Sadler B. 1996. International study of the effectiveness of environmental assessment final report – environmental assessment in a changing world: evaluating practice to improve performance. Ottawa: Minister of Supply and Services Canada.
- Sadler B, Fuller K, Ridgway B, McCabe M, Bailey J, Saunders R. 2002. Environmental impact assessment training resource manual. 2nd ed. Geneva: United Nations Environment Programme.
- Senecal P, Goldsmith B, Conover S, Sadler B, Brown K. 1999. Principles of environmental impact assessment best practice. Fargo, USA: International Association for Impact Assessment.
- Sippe R. 1999. Criteria and standards for assessing significant impact. In: Petts J, editor. Handbook of environmental impact assessment volume 1: process, methods and potential. Malden, MA: Blackwell Science; p. 74–92.

- Weston J. 2000. EIA, decision-making theory and screening and scoping in UK practice. *Journal of Env. Assess. Policy & Manage.* 43(2):185–203.
- Wood G. 2008. Thresholds and criteria for evaluating and communicating impact significance in environmental statements: 'see no evil, hear no evil, speak no evil'? *EIA Review.* 28(1):22–38.
- Wood G, Becker J. 2004 Apr. Evaluating and communicating impact significance in EIA: a fuzzy set approach to articulating stakeholder perspectives. Presentation to the International Association of Impact Assessment Conference; Vancouver, Canada; p. 26–29 [abstracts volume, p. 73–74].
- World Bank. 2013. Operational policy 4.01 – environmental assessment. Washington, DC: World Bank; [accessed 2014 Mar 6]. Available from: <http://www.worldbank.org/>