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The Insignificance of Thresholds in Environmental Impact Assessment:

An illustrative case study in Canada

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Abstract

Environmental assessment is *the* process that decision-makers rely on to predict, evaluate and prevent biophysical, social and economic impacts of potential project developments. The determination of significance in environmental assessment is central to environmental management in many nations. We reviewed ten recent environmental impact assessments from British Columbia, Canada and systematically reviewed and scored significance determination and the approaches used by assessors, the use of thresholds in significance determination, threshold exceedances and the outcomes. Findings of significant impacts were exceedingly rare and practitioners used a combination of significance determination approaches, most commonly relying upon reasoned argumentation. Quantitative

thresholds were rarely employed, with less than 10% of the valued components evaluated using thresholds. Even where quantitative thresholds for significance were exceeded, in every case practitioners used a variety of rationales to demote negative impacts to non-significance. These reasons include combinations of scale (temporal and spatial) of impacts, an already exceeded baseline, model uncertainty and/or substituting less stringent thresholds. Governments and agencies can better protect resources by requiring clear and defensible significance determinations, by making government-defined thresholds legally enforceable and accountable, and by requiring or encouraging significance determination through inclusive and collaborative approaches.

Keywords

Environmental assessment; Environmental Impact Assessment; significance; thresholds; significance determination

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Introduction

Evaluations of large-scale project developments can be controversial as decision-makers have to evaluate promised financial gains against potential environmental, social, and cultural impacts. Regulatory bodies rely on the environmental assessment (EA) process to ensure that large-scale industrial projects do not undermine broader ecological integrity or function (Wood 2003; NEPA 2007). Decision-makers decide whether to approve or reject major project proposals through a series of public consultations and participatory processes, baseline data collection, identification and evaluation of possible impacts and proposed mitigation measures. One of the resulting documents, the environmental impact statement (EIS), is reviewed by decision-makers to aid them in making an informed decision on whether the benefits generated by project development justify anticipated impacts to the human and natural environments, and whether additional mitigation or compensation measures need to be prescribed.

The determination of impact significance is the central component of environmental assessment (Duinker and Beanlands 1986; Sadler 1996; Ehrlich and Ross 2015); approved proposals must indicate that no or few significant impacts will result from a project development (e.g. BC EAO 2013). Impacts caused by project developments are evaluated for their "significance" as substantial, adverse and likely changes from a baseline state (i.e., without project impacts) of biophysical, social, cultural and economic indicators (CEAA 2010). Cumulative impacts are also evaluated by identifying impacts caused by existing and anticipated projects in concert with natural drivers within specified regional boundaries. The goal of the EA process is to evaluate potential impacts and develop a framework of mitigation actions so that impacts can be avoided, minimized, or reduced to acceptable levels (Canter 1996). Those impacts that cannot be avoided or minimized and are deemed to cause substantial, adverse changes are termed "significant impacts" (US Council on Environmental Quality 2007).

Impact significance determination remains one of the most varied and complex aspects of the EA process (Thompson 1990; Lawrence 2007; CEAA 2010; Jones & Morrison-Saunders 2016; Noble et al. 2017), despite the availability of environmental assessment guidance documents and best-practices outlining evaluation criteria and processes for significance determination (e.g. CEAA 2015). Regulatory bodies provide legal, regulatory and guidance documents but developers and EA practitioners have some flexibility in how to evaluate the scale and magnitude of impacts to consider and how to address and interpret impact significance for their context (e.g., CEAA 2010).

The way EA practitioners determine impact significance has been classified into three general approaches: reasoned argumentation, collaborative, and technical (Lawrence 2007). The reasoned argumentation approach employs evidence to make reasoned judgements in significance determination. Reasoning is usually expressed descriptively or qualitatively, although it can integrate quantitative data and results. In the collaborative approach the public and stakeholders participate fully in deriving thresholds and criteria and interpret the significance (Lawrence 2007). The collaborative approach aims to utilize a collective, continuous and interactive decision-making model to jointly determine significance of an impact. The technical approach relies on technical data, analyses and knowledge and consists of a range of tools including measurable data collections, statistical models, and quantitative thresholds that allow EA practitioners to quantitatively determine whether an impact is significant (Lawrence 2007). The three approaches are not exclusive of one another; reasoning is often used to interpret data in both the technical and collaborative approaches. Guidance for environmental assessments in Canada suggests that whenever possible, the technical approach should be used to determine impact significance because consistency, transparency and replication are emphasized (CEAA 2015). Well-defined criteria and thresholds are the main building blocks of significance determination under the technical approach.

89 The determination of impact significance using quantitative thresholds, based on field and laboratory
90 studies and prevailing societal attitudes and values (CCME 1999; CEAA 2010; BC EAO 2013) provides a
91 measureable and repeatable evaluation approach. Quantitative thresholds specify a clear delineation
92 between acceptable and unacceptable levels of impact; a decision point at which action must be taken
93 to prevent unacceptable negative outcomes (Kennett 2006; Antoniuk et al 2009; Johnson 2013). For
94 example, quantitative thresholds are most commonly available as "critical load" thresholds for human
95 health impacts (Sevier and Hatfield 2001; Groffman et al 2006). In Canada, these thresholds take the
96 form of regulatory objectives and standards; for example, under the National Ambient Air Quality
97 Objectives (NAAQOs) the maximum tolerable level for sulfur dioxide is 306 parts per billion (ppb),
98 beyond which respiratory health impacts are expected (CCME 1999). Proposed projects evaluate their
99 predicted contributions to the sulfur dioxide in the airshed against this threshold objective. Ecological
100 thresholds are less common but have been derived for some species. For example, a disturbance
101 threshold has been defined for populations of boreal caribou where disturbance from linear
102 development, forestry and other activities combined should not exceed a set percentage of the
103 population's range or declines would be expected (Environment Canada 2011). Proposed developments
104 with potential impacts on caribou populations are expected to evaluate the project's contribution to
105 disturbance and evaluate whether the additional activity will exceed the threshold and affect the
106 probability of maintaining the range conditions necessary to support a self-sustaining population.

107 Thresholds are not available or satisfactory for all impacts considered, and especially for impacts to
108 social or cultural values (Christensen and Krogman 2012; Joseph et al 2017). Additionally, there are
109 important practical limitations to the application of thresholds. Gathering and confirming the scientific
110 evidence to support a biological, ecological or social threshold requires considerable effort and is
111 complicated by the spatial and temporal variability in the extent of loading and responses (Groffman et
112 al 2006). Further, reasoned argumentation is commonly used in the interpretation of technical

thresholds and this subjectivity is a necessary component of EA in order to evaluate impacts appropriately in the context of the unique regional context of the proposed project.

Although acknowledged as a highly politicised and subjective process (Cashmore 2004), EISs aim to be evidence-based, and the EA process is the tool used to protect valued components from substantial and irreversible impacts caused by large-scale infrastructure developments. For EIS to fulfil that promise, it is essential that the determination of impact significance is a transparent and systematic process. Here, we examine the extent to which that is true. We review and quantitatively compare recent EISs conducted in British Columbia, Canada, in order to 1) document current approaches to significance determination and the outcomes and 2) evaluate the frequency of threshold use, predicted exceedances, and significance determination outcomes in these cases. The use of clearly defined thresholds should increase the robustness of significance determination and we hypothesize that we should see more findings of significance when threshold values are surpassed.

Methods

Case study region

Canada's environmental assessment process is regulated under the Canadian Environmental Assessment Act (CEAA 2012) by the Canadian Environmental Assessment Agency. The federal process is triggered under certain conditions: when a development involves a federal authority, a federal authority provides funding, the project involved federal lands or the federal government must license, permit or otherwise approve a project. Two types of environmental assessments are conducted under CEAA (2012): environmental assessment by a responsible authority or by a review panel. The British Columbia assessment process is governed under the BC Environmental Assessment Act (SBC 2002 Chapter 43) by the Environmental Assessment Office (BC EAO). Some projects may need to undergo both a federal and provincial level assessment, which may or may not be harmonized.

The EA process in BC evaluates impacts according to valued components (VCs), defined as aspects of the natural and human environment that are considered to have scientific, ecological, economic, social, cultural, archaeological, historical or other importance (BC EAO 2013). Proponents and stakeholders identify VCs (e.g., water quality, air quality, human health, wildlife, visual quality, etc.) but often at a scale too coarse to allow evaluation, in which case subcomponents (e.g., grizzly bears, amphibians) may be chosen for broadly defined VCs (e.g. Wildlife). Indicators (e.g., sulphur dioxide concentration, population size) are chosen by practitioners for each VC or subcomponent, and baseline conditions for these VCs or subcomponents are then measured, analyzed, and reported upon (e.g. level of dissolved solids, grizzly bear population size, amphibian species richness, etc. see Figure 1). Thresholds for the selected indicators may exist in guidance or policy documents, but significance determination is conducted at the VC level (BC EAO 2013). Analysts take proposed mitigation measures – specifically, each measure's ability to reduce or eliminate impacts—into account when determining impact significance. Overall impact significance is determined for each valued component using results from one or more subcomponents and indicators.

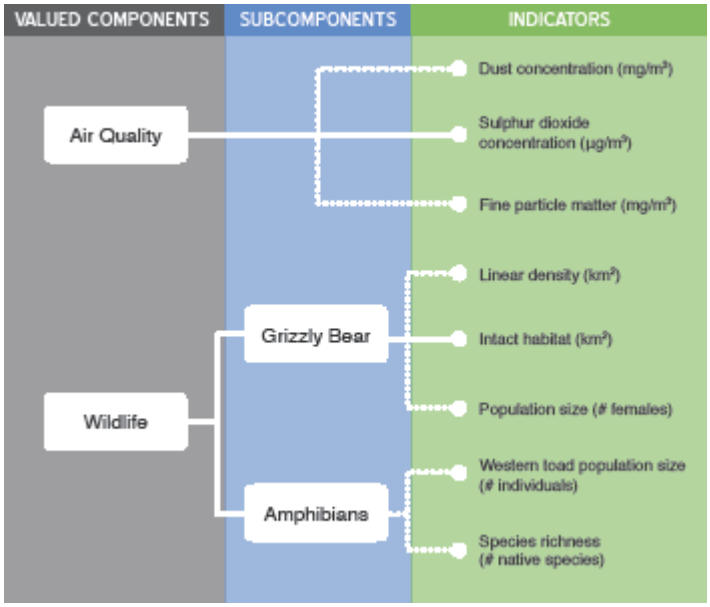

Figure 1. Examples of valued components (grey), subcomponents (blue) and indicators (green) from the Enbridge Northern Gateway Pipeline EIS.

Significance Determination and Threshold Use

Document content analysis, a systematic method of gathering and organising information into categories, was used to review and analyse EISs (Bowen 2009, Krippendorff 2004; Noble et al. 2017). We reviewed ten recently completed EISs listed by the BC Environmental Assessment Office (as of August 2014, submitted from 2010 - 2014) in order to capture current practice and ensure EISs were prepared under the same regulatory regime. We reviewed and scored information from each EIS related to significance determination and threshold use. We only recorded information as listed by the EISs; we did not make any attempts to interpret the intentions of the practitioners and developers.

To examine the practice of significance determination we recorded (1) number of impacts evaluated, (2) significance determinations of impacts, and (3) rationale for significance determination. A single impact unit was defined as an impact evaluated for significance in the EIS reviewed, usually at the scale of the valued component or subcomponent. As the physical scale of the projects differed considerably across the EISs reviewed, we calculated ratios between number of significant impact determinations and the total impacts evaluated. We categorized each EIS according to how significance of potential impacts was determined, either the technical, collaborative, or reasoned argumentation approach or a combination of these approaches (according to the definitions by Lawrence 2007).

To test our hypothesis that threshold use increases the frequency of significance findings we recorded (1) the total number of valued components identified by the practitioner, (2) number of VCs with thresholds for one or more indicators, (3) number of VCs with one or more indicator thresholds predicted to be exceeded, and (4) number of those VCs with thresholds exceeded where significant impacts were determined. All Canadian threshold guidelines and standards in place within five years prior to the EIS application submission were considered thresholds in this study (e.g., BC Water Quality Guidelines, Canadian Ambient Air Quality Standards).

To determine if specific categories of valued components were more likely to utilize thresholds when determining impact significance, we assigned each valued component to five categories: environmental (e.g., wildlife, aquatic habitat, wetland extent, etc.), human health (e.g., air quality, water quality), economic (e.g., employment, revenue, business developments, etc.), social (e.g., recreation opportunities, etc.) or heritage (e.g. cultural resources, heritage sites). The final decision on each project was also recorded (approved or not approved).

Results

After review of the EISs in our study, we documented a median of 281 impacts per EIS. For those impacts identified by the assessor as negative or positive impacts, there were 168 negative impacts and 23 positive impacts to indicators per EIS (Table 1). Of the impacts evaluated in the EISs, significant impacts were rare, median 0 significant impacts (Table 1). Only a very small fraction of the impacts evaluated were identified as significant (median = 0, 10% quantile = 0, 90% quantile =0.02).

All EISs examined used a combination of technical and reasoned approaches to determine significance for potential impacts, while none utilized the collaborative approach. For example, one EIS described a model of underwater noise propagation they developed to predict sound levels from pile driving activity during the construction phase of the project. The assessors used the model results to compare predicted sound levels to that of the hearing range of local whale species to determine if there would be mortality or hearing loss events (technical approach). The predicted number of whales affected and the severity of any injuries were then evaluated in a qualitative risk matrix to determine if there would be a significant impact on whale populations in the area (reasoned approach).

Table 1: Total, negative, positive, and significant impacts to indicators assessed in the ten EISs and the proportion of impacts determined to be significant by the assessors. Not all impacts were clearly identified in all EISs as either negative or positive impacts so the total number of impacts is not always equal to the negative and positive impacts.

Project	Total Impacts	Negative Impacts	Positive Impacts	Significant Impacts	Significant: Total
Kitsault Mine	756	151	40	0	0.00
Line Creek Operations Phase II	205	106	0	4	0.02
Narrows Inlet Hydro	1247	798	75	24	0.02
Kerr Sulphurets Mitchell	130	114	16	2	0.02
Enbridge Northern Gateway	527	430	30	10	0.02
Harrison Lake 3	351	320	31	0	0.00
Meikle Wind Energy	541	520	21	0	0.00
Coastal Gaslink Pipeline	210	185	25	0	0.00
Pacific Northwest LNG	78	70	8	0	0.00
Fortune Creek Natural Gas	85	85	0	0	0.00
Median	**281**	**168**	**23**	**0**	**0.00**
10% Quantile	**79**	**72**	**0**	**0**	**0.00**
90% Quantile	**1198**	**770**	**72**	**23**	**0.02**

Across all ten projects evaluated, EISs evaluated a median of 51 VCs (Table 2). Government-defined thresholds were used to determine the significance of at least one valued component in all EISs examined (Figure 2A; Table 2). Overall, the proportion of threshold use was low (10% of the total number of VCs identified; Table 2). Valued components in the environmental (40 VCs) and human health (7 VCs) categories were the only ones to utilize thresholds for significance determination, representing 14% and 5% of the VCs in those categories respectively. None of the EISs reviewed utilized thresholds for significance determination of economic, social or heritage VCs.

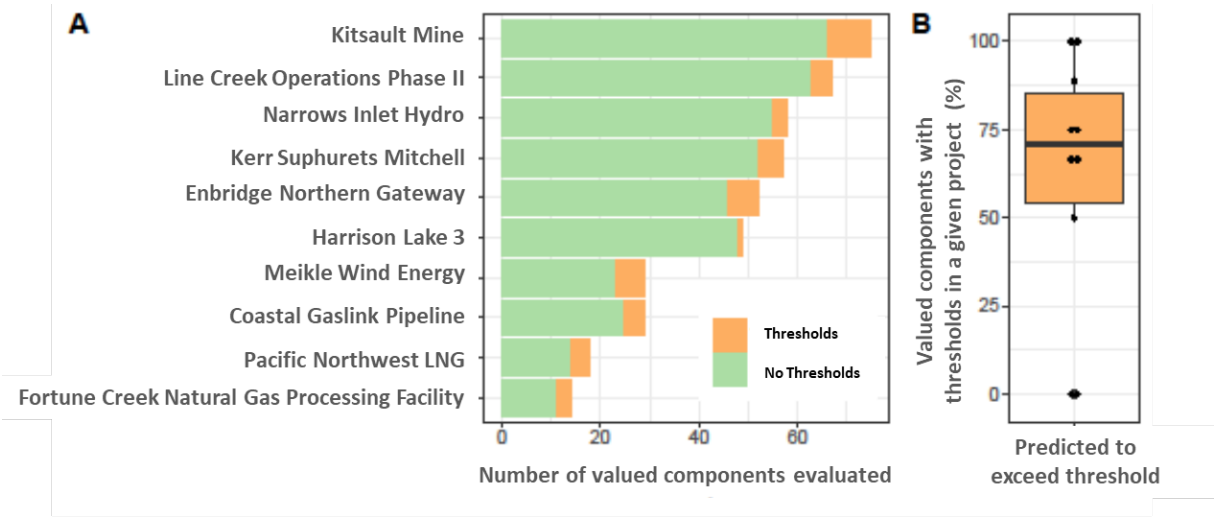

Figure 2. A) Number of valued components (VCs) evaluated for each project, including those with one or more thresholds used to determine significance determination (orange). B) Box and whisker plot of the percentage of VCs evaluated using thresholds in a given project (orange bars in panel A) that were predicted to have threshold exceedances. None (0%) of the predicted threshold exceedances were determined to be significant.

Eight of the 10 BC EISs predicted one or more indicators of VCs to exceed thresholds, even after proposed mitigation measures to reduce impacts were included in the predictions (Figure 2A; Table 2). Of the 47 VCs with established thresholds in these EISs, assessors predicted exceedances for 31 thresholds (66%, Figure 2B) but despite these exceedances, the impacts to all the valued components were considered not significant (100%, N=31; Table 2). Thus, our initial hypothesis that the use of thresholds in evaluation would increase findings of significance was rejected.

Table 2: The Valued Components (VCs) evaluated in each project EIS, the number of VCs evaluated using thresholds, the predicted baseline exceedances, the number of thresholds where the project was expected to exceed the threshold, and the number of threshold exceedances that were determined significant by assessors (out of the total threshold VCs).

Project	VCs evaluated	VCs evaluated using thresholds	Threshold VCs with baseline exceedances	Threshold VCs with project exceedances	Significant threshold exceedances
Kitsault Mine	75	9	8	8	0/8
Line Creek Operations Phase II	67	4	3	3	0/3
Narrows Inlet Hydro	58	3	2	2	0/2
Kerr Sulphurets Mitchell	57	5	5	5	0/5
Enbridge Northern Gateway	52	6	5	6	0/6
Harrison Lake 3	49	1	0	0	NA
Meikle Wind Energy	31	8	0	0	NA
Coastal Gaslink Pipeline	29	4	2	2	0/2
Pacific Northwest LNG	16	4	3	3	0/3
Fortune Creek Natural Gas	14	3	0	2	0/2
Global median	51	4	3	3	0
10% Quantile	30	3	0.5	2	0
90% Quantile	58	6	5	5	0

We identified six common rationales used to explain threshold exceedance: 1) baseline conditions already exceeding thresholds; 2) uncertainty in the assessment models; 3) availability of different guidelines that allow for higher threshold values; 4) the scale of impact (temporal and spatial); 5) literature review contradicted threshold values; and 6) other reasoned argumentation. We found that these rationales were used in combinations of two or more kinds in every finding of non-significance when thresholds were exceeded. Twenty-eight of the 31 valued components (90%) had baseline conditions that already exceeded Canadian guidelines. In these cases, the assessors did not consider additional project contributions to existing threshold exceedances as significant impacts, regardless of the magnitude of the project contribution. Two of the remaining three assessed indicators were expected to exceed Canadian guidelines due to project effects; however, impacts to these valued components were still assessed as not significant because of model uncertainty and the localized scale

of impact. The model uncertainty rationale occurred when assessors argued that their own models overestimated the impact or that the bounds of uncertainty included a non-significant prediction. In the final case, a weaker US EPA threshold was substituted for the more stringent Canadian threshold level when exceedance based on the latter was anticipated, an example of the availability of different guidelines rationale.

The most common rationales used to conclude impacts were not significant despite threshold exceedance were (in decreasing order) scale of impact, existing baseline exceedance, reasoned argumentation, and model uncertainty (Figure 3). For example, one EIS anticipated water quality parameters to exceed derived screening values (based on government-defined thresholds) but scale of impact rationale was invoked, citing impacts as localized in extent and that the wildlife population (i.e. Westslope cutthroat trout) as a whole would not display measurable effects and therefore the impact was judged to be non-significant. This conclusion was reached despite the expectation that individuals will display permanent reproductive effects, with some water quality effects anticipated to be long term in duration and/or irreversible (Teck Coal Limited 2011). The literature review rationale occurred when other published or grey literature studies were used as evidence to contradict the threshold value. The other reasoned argumentations were interpretations used in combination with the other rationales to conclude that a threshold exceedance was not significant. Despite threshold exceedances, all ten projects reviewed received final approval.

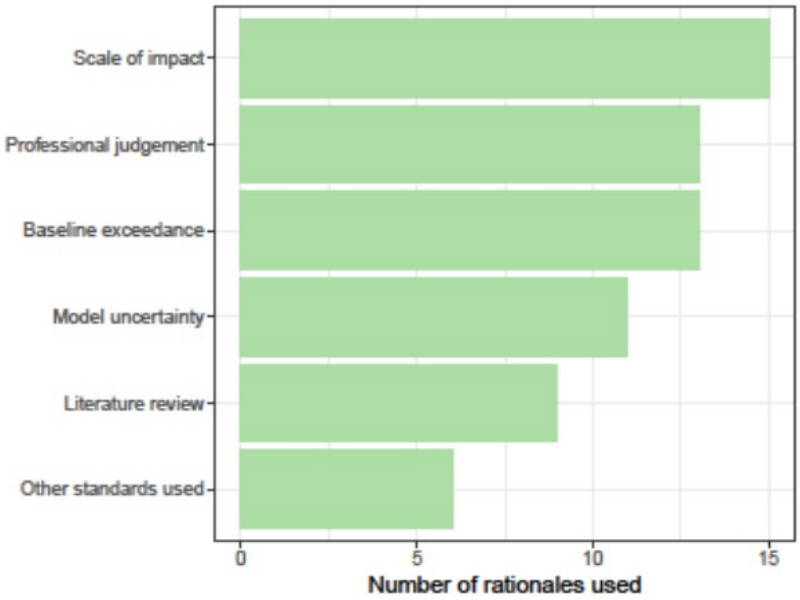

Figure 3. Rationales used for findings of impact non-significance despite predicted threshold exceedances for a valued component (in some cases more than one rationale was used for a single exceedance). Scale of impact refers to impacts on a lesser temporal and/or spatial scale; Reasoned argument refers to other interpretations and reasoning used by the assessor; Baseline exceedance refers to baseline conditions already exceeding thresholds; Model uncertainty refers to uncertainty in the assessors' models of impact; Literature review refers to a review of literature that contradicted threshold values; and Different guidelines used refers to the use of different guidelines that allow for higher threshold values.

Discussion

Subjectivity Prevails Over Significance

Findings of significant impacts are rare in environmental assessment, as has been documented in a previous study (Ehrlich and Ross 2015). We found that even when quantitative impact thresholds were exceeded, weak or flawed reasoning was frequently used to justify designating impacts as non-significant, rejecting our original hypothesis. To illustrate, one EIS reported sulphur dioxide concentrations in the project area to be near threshold baseline conditions and predicted project emissions to exceed even the least conservative Canadian guideline, the Maximum Tolerable regulatory limit (CEPA 1999). When added to existing emissions in the project study area, cumulative emissions

were expected to be nearly twice the regulatory limit. In this case, the EIS authors reasoned that "…*some exceedances of the most stringent regulatory standards are predicted. Simplifying assumptions made in the dispersion modelling exercise, combined with conservative calculations for air emissions, often result in overestimates*." (Enbridge Northern Gateway Pipeline 2010, Volume 6A, p.451). Model uncertainty was just one of the means to justify findings of not significant in our review. Using weak and unsubstantiated reasoning (Hicks 2011) to override results derived from the technical approach allows practitioners to justify exceeding government-defined thresholds and yet conclude that impacts will be non-significant, enhancing the likelihood of project approval.

Ideally, the acknowledgement of significant impacts for threshold exceedance would be consistent and transparent across EISs. A variety of rationales were used to justify non-significance for threshold exceedances, but one of the most troubling rationales for threshold exceedance is the "scorched earth" justification; that the indicator's baseline level is already high and therefore adding more to the system will not make a substantial difference. This argument goes against the fundamental principles of cumulative impact assessment where a proposed project must be viewed within the context of the past, present and future projects (IFC 2013). Contrary to reasoning employed in the Enbridge study on sulphur dioxide emissions, local communities already living with poor air quality would likely consider additional air pollution from a proposed project to be a serious negative impact. One might think that poor baseline conditions might trigger more precautionary decisions and stringent mitigation measures, not fewer. Of course, there are cases where the local environment is naturally high in certain metals and nutrients, but in these cases, a significant impact should still be acknowledged rather than reasoned away. Acknowledgement of significant impacts will provide greater clarity and consistency in the assessment process and support the move toward regional cumulative effects assessments (Dubé 2003; Duinker et al. 2012). Regional cumulative effects assessments consider past, present and future impacts in a more holistic evaluation of impacts from proposed projects within the regional landscape.

307 Legal repercussions for exceeding thresholds would help reduce subjective justifications and enforce
308 thresholds more strictly in the environmental assessment decision-making process. Government-
309 defined thresholds, in the form of regulatory objectives or voluntary guidelines, are generally not legally
310 enforceable despite being identified by governments using credible scientific results and prevailing
311 social values (Ehrlich & Ross 2015). If the exceedance of government-defined thresholds does not result
312 in findings of significance with no penalty or cause for concern, there are clearly substantial issues with
313 either the thresholds or the assessment process; threshold metrics are either too stringent to be
314 realistic or the assessment process is too flexible. The assessment process would benefit from better
315 guidance and policy so that when thresholds are available, they are enforced as a clear parameter to
316 determine impact significance. Defining scientific and value-based defensible thresholds that EA
317 processes are required to use for a broader suite of environmental, social and cultural values would
318 reduce variability and subjectivity in the process (Duinker et al. 2012). Although subjectivity will always
319 be part of the EA process, reducing the latitude allowed in EA practice to argue findings of significance
320 will improve trust and reliability.

321 Under the current EA process, assessors select indicators and thresholds to use in their assessments and
322 define what constitutes a significant impact. Guidance from government agencies in Canada and around
323 the world speaks directly to the general flexibility afforded to developers: "*In some cases, determining*
324 *significance will be a relatively simple process. For other issues, however, developers and their*
325 *consultants will have to use their own judgement and expertise, in the light of past experience and the*
326 *information received during the scoping exercise, as to whether impacts are likely to be important*."
327 (Welsh Office Circular 11/99; Annex B). Practitioners can therefore choose thresholds ranging from weak
328 to stringent; developers that want to minimize significant impact findings can opportunistically select
329 weaker thresholds where their particular project's impacts might exceed more stringent thresholds. In
330 our study, we even found cases where a weaker threshold from another country was substituted for the

more stringent Canadian threshold level when exceedance based on the latter was anticipated. Substitution of thresholds allowed assessors to justify threshold exceedance and determine impacts as not significant. This type of flexibility goes directly against the goal of a rigorous approach to foster sustainable development, and is the very opposite of a precautionary approach where decisions made under uncertain conditions should err on the side of caution.

Insignificant to Assessors, Not to Stakeholders

Environmental impact assessments are lengthy, dense documents filled with technical details and language. As such they are often held up as scientific evaluations of proposed project developments and resulting impacts. Our review found that significance determination is instead the subjective opinion of a small group of people (assessment practitioners hired by the project developers). Subjectivity is a common and arguably even necessary trait of environmental assessment, but the values of those communities directly affected by proposed projects should be included (Weston 2000; Sadler et al. 2002; Gibson et al. 2005; Ehrlich and Ross 2015). Social thresholds were not utilized in any of the reviewed projects, despite recent efforts to identify practical cultural thresholds and highlight their usefulness in the EA process (Christensen and Krogman 2012; Joseph et al 2017).

Although stakeholders and the public remain part of the environment assessment process in the identification of valued components, it is evident that they are not duly involved in decisions of impact significance. Employing the collaborative approach would enable local knowledge and values to be included when assessing the level of significance of impacts to the local, affected communities (Wood et al. 2007; Ehrlich and Ross 2015; Udofia et al. 2017). Despite the important benefits of a collaborative approach, the reasoned approach was the most common method of significance determination, perhaps because the collaborative approach is more time consuming, costly, and complicated to implement. In BC case studies, Joseph and colleagues (2017) demonstrated the utility of clearly articulated and

354 unambiguous thresholds derived from stakeholder values for a number of social and cultural valued
355 components. Expanding the breadth of available thresholds and their evaluation by affected
356 communities will make the EA process more relevant, rigorous and transparent.

357 Scale of impact was the most common rationale utilized by practitioners to decide potential impacts
358 were insignificant. In BC, First Nations and local communities have expressed concerns about the
359 consequences of resource developments (Moore et al 2015) and effects that are deemed insignificant by
360 practitioners that do not reside or depend upon the affected land (Booth and Skelton 2011). Industrial
361 development impacts affect natural resources (i.e. fish and water) and disrupt natural environmental
362 processes affecting local communities and their ability to extract resources to sustain their livelihoods.
363 While practitioners can deem these effects localized and conclude that they may not affect a species at
364 the population level, practitioners are not adequately equipped to assess the impacts of losing access to
365 natural resources for affected local communities. For First Nations in particular, the loss of local access
366 to natural resources is a significant impact that practitioners may not understand, and these impacts are
367 not easily mediated by means such as relocation or shifting to another available resource. Employing the
368 collaborative approach in significance determination would better align the scale of impact with the
369 affected communities as those affected would judge if an impact would exceed acceptable levels.

370 The difference in narrow versus broad categories of valued components and indicators makes it difficult
371 for regulators to govern environmental assessment. There were major inconsistencies in the selection of
372 valued components, subcomponents and indicators across the ten BC EISs reviewed, as has been found
373 in previous studies (Ball et al 2013a,b; McGuigan 2015). For example, we could not compare threshold
374 exceedance for specific metals or nutrients across all EISs since not all projects selected indicators at the
375 same scale. Despite guidance on selection (BC EAO 2013), the variability of the recent assessments we
376 reviewed suggests that flexibility remains in the practice. Applying consistent guidelines for selecting

valued components and indicators would improve consistency, increase transparency and allow decision makers to directly compare between EISs and better monitor and assess EIS predictions.

The Path Forward

Our analysis reveals troubling trends of threshold exceedance and the opportunity for biased assessments that will need to be corrected if environmental assessment processes are to be anything more than a rubber stamp. All projects in BC were approved by regulators demonstrating that threshold exceedances are not a barrier to project approval. It must be acknowledged that environmental assessment proposals are not a random sample of all proposed projects, as some projects do not enter the environmental assessment process at all for political, economic or environmental reasons. Pre-assessment, proponents may learn from discussions with the relevant regulatory office that the proposal would not be well received for a variety of reasons and choose not to enter the formal assessment process. If we assume that these pre-screened projects would be expected to have significant impacts, this may explain in part why BC EISs had extremely low numbers of significant impacts. However, the rarity of significance determinations in environmental assessment has been documented in other regions (Wood 2008; Briggs and Hudson 2013; Ehrlich and Ross 2015). Some have even suggested that the outcome of project approvals has little to do with the content of EISs (Wood and Jones 1997). In order to ensure that the evaluation of potential impacts is evidence-based, significance determination must be a transparent, repeatable, and unbiased step.

Significant impacts in environmental assessment can mean the death of a proposed project, which would appear to incentivize findings of non-significance—incentives that are especially acute because EIS assessors are paid directly by project proponents in BC and many others around the world (Wang et al. 2003; Brazil MMA/CONAMA 2012). The potential conflict of interest suggests that judgement calls made on threshold exceedances should be viewed with caution (Killingsworth & Palmer 1992; Wood et al. 2007). Practitioners and the general public frame EISs as evidence-based, but our findings and those

401 of others show that the often weak reasoning of proponent-paid professionals trumps those of directly
402 affected communities, despite best practices that have been articulated by many authors in the field
403 (Morgan 1998; Lawrence 2005). Subjectivity is an inherent part of EA process, but balancing subjective
404 inputs from proponents and local, affected communities can instead be used to crucially improve EA
405 processes. Stakeholders should directly contribute to the determination of significance where their
406 values are under threat. Government agencies should require or encourage the collaborative approach
407 to make it more common in the EA process. Social and scientific thresholds can be strictly enforced to
408 balance proponent-funded professional judgements and reasoning, allowing a better understanding of
409 the trade-offs between economic gains and environmental, social, and cultural impacts.

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