Evaluating the Cumulative Impacts of Decisions We Make

(The latest draft of this paper is available online here: http://goo.gl/0ah7mG)

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Cumulative impacts analysis[1] is needed whenever some ***new disturbance*** (new project, new process, new technology, etc.) is introduced into any of the three environments (natural, built, or social). But the suggestion to analyze cumulative impacts is met by a groan (or by silence as the whole issue is ignored).

Why is this so hard? There are at least four reasons:

1. We tend to think of events and actions as "one cause, one effect." In my experience, humans seem hard-wired to think this way. Ask a person who has cancer, "What caused it?" More often than not, you'll get an answer that assigns responsibility to a single agent. We don't naturally ask ourselves about the cumulative effects of many seemingly-insignificant disturbances. Our inclination -- like the inclination of "regulators" -- is to assume that a seemingly-insignificant disturbance is just that -- insignificant.

But we now understand that this perception is wrong. ***All problems are cumulative impact problems*** and it's important that we get used to thinking about them in that way.

2. Traditionally, the scientific method has produced reliable knowledge by reducing problems to their simplest form, eliminating extraneous influences ("confounders").[2] The cumulative impacts problem is at the other end of the spectrum -- trying to consider and evaluate **all** the influences that affect an outcome. So, many scientists throw up their hands when faced with a "cumulative impacts" problem; it's beyond their comfort zone, beyond their ken.

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[1] The President's Council on Environmental Quality (CEQ) defines "cumulative impact" as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." 40 CFR 1508.7

[2] After the publication of *Discourse on the Method* (1637) by René Descartes, scientists spent 300+ years studying problems by simplifying them to the extent possible. Only in recent decades has a science of whole systems begun to develop.

3. Our regulatory systems are not designed to consider cumulative impacts. Typically, an agency asks whether a new disturbance, *by itself*, will create a violation of some standard (usually a numerical standard). If the answer is "No," then the disturbance is considered "insignificant" and is ignored.

Instead a regulatory agency could ask, will the new disturbance, *combined with* existing or reasonably foreseeable conditions, violate a standard. The President's Council on Environmental Quality (CEQ) recommends that federal agencies take this approach when they assess the "environmental impact" of a proposed action to comply with the National Environmental Policy Act (NEPA).[3] However, CEQ's recommendation takes the form of a "guidance," not a requirement. In addition, NEPA only requires thorough analysis of "major" governmental actions, thus often exempting decisions that, considered alone, may appear insignificant. Furthermore, in practice, NEPA analyses have tended to emphasize impacts on ecological resources, giving short shrift to other kinds of resources, such as socioeconomic, human health, recreational, cultural, historical and quality of life.[4]

4. A fourth reason why cumulative impacts are hard to analyze: Agencies use quantitative risk assessment in the traditional way, not the new way that was recommended by the National Research Council (NRC) in its report *Science and Decisions* (2009) (http://goo.gl/4SIiw).

Presently, regulatory agencies ask, "Will this disturbance, considered in isolation, exceed some threshold?" For example, will this brownfield cleanup contaminate children in this neighborhood with blood-lead levels that exceed some number like 5 micrograms of toxic lead per deciliter of blood (µg/dL)? If the answer is No, then the cleanup is deemed safe and satisfactory, even though the cleanup might add 4 ug/dL to the blood of many

[3] Council on Environmental Quality, *Considering Cumulative Effects Under the National Environmental Policy Act.* (Washington, D.C.: Council on Environmental Quality, 1997) http://goo.gl/uaqkZE

[4] U.S. Environmental Protection Agency, *Consideration Of Cumulative Impacts In EPA Review of NEPA Documents* [EPA 315-R-99-002/May 1999] (Washington, D.C.: U.S. Environmental Protection Agency, Office of Federal Activities, 1999). http://goo.gl/IcWsWm

children, reducing their IQs accordingly and, in combination with other exposures, perhaps even exceeding the 5 µg/dL "reference" level.[5]

The NRC recommends that ***agencies should first ask***, "In this situation, how can we minimize harm?" Then they can use quantitative risk assessment (and/or other comparison techniques, such as Delphi, to name but one) to assess each alternative. Public participation in decisions is highly desirable, to legitimize the decision process.[6]

5. However, the concept of "violating a standard" is itself problematic because (a) so few standards exist and (b) the ones that exist are so poorly supported by settled science, so plagued by uncertainties, and so conducive to endless disputes and litigation.

So the "violation of a standard" approach needs to be replaced. But replaced with what?

A PROPOSED SOLUTION

Instead of asking whether some new disturbance is violating an existing standard, we could identify conditions that are already intolerable and ***qualitatively*** measure the impacts of a disturbance against those conditions. (Naturally, if quantitative data is available, it should be incorporated into assessments; however, even when there is no quantitative data, we can still assess impacts qualitatively. For example, we can always ask, is this disturbance likely to make intolerable conditions better, worse, or unchanged?

We could use three different kinds of intolerable conditions as the benchmarks (described below): (#1) *the nine planetary boundaries test* and (#2) the *health disparities (*or perhaps simply *health) test*, and (#3) the *justice test*.

#1: The Nine-Boundaries ("Safe Operating Space") Test

[5] R.L. Canfield and others, "Intellectual impairment in children with blood lead concentrations below 10 µg per deciliter," *New England Journal of Medicine* Vol. 248 (2003), pgs. 1517–1526. www.nejm.org/doi/full/10.1056/NEJMoa022848

[6] James L. Creighton, *The Public Participation Handbook: Making Better Decisions Through Citizen Involvement* (Hoboken, N.J.: Jossey-Bass, 2005).

We can ask what effect (good, bad, or none) the proposed disturbance will have on nine ecosystem boundaries. These nine boundaries have been proposed by an international group of scientists to define a "safe operating space" for humans.[7] The concept is simple: There are limits to how much disturbance Earth's critical ecosystems can tolerate without permanent damage. If humans can learn to operate within those limits, intolerable damage to the global ecosystem can (perhaps) be avoided and the human enterprise will become "sustainable," meaning it can continue into the indefinite future.

For each of the nine boundaries, we can simply check off, Bad, Good, or Neutral to describe the effect of the proposed disturbance.

The nine ecosystem boundaries to be considered:

1. Climate change (measured as CO_2 and perhaps methane, emitted into the atmosphere).

2. Loss of biodiversity (perhaps just Red-list species [http://goo.gl/teso], plus anything listed under, or proposed for listing under, the U.S.'s Endangered Species Act [http://www.fws.gov/Endangered/species/us-species.html]).

3. Nitrogen (and phosphorus) cycles -- Amount of reactive nitrogen introduced into the biosphere; amount of phosphorus caused to flow into the oceans (nitrogen and phosphorus are the main ingredients of artificial (meaning "not organic") fertilizers;

4. Stratospheric ozone depletion;

5. Ocean acidification;

6. Freshwater availability and use;

7. Land cover paved over or converted to crop use;

[7] Johan Rockström and others, "A safe operating space for humanity," *Nature* Vol. 461 (Sept. 24, 2009), pgs. 472-475. http://goo.gl/NGeN For more detail, see Johan Rockström and others, "Planetary boundaries: Exploring the Safe Operating Space for Humanity," *Ecology and Society* Vol. 14, No. 2 (2009), pgs. 1-33. http://goo.gl/8iwK For more recent discussion of planetary boundaries, see Will Steffen and others, "Planetary boundaries: Guiding human development on a changing planet," *Science* Vol. 347 (2015), pg. 1259855;. DOI: 10.1126/science.1259855, available at http://goo.gl/yiEMOT

8. Atmospheric aerosol loading (chiefly black carbon, such as diesel emissions, and sulfates);

9. Chemical pollution (e.g., persistent organic pollutants; plastics; endocrine disrupters; heavy metals; nuclear waste and other radionuclides released into the natural environment)

Note: The first three of these ecosystem boundaries have already been exceeded; #5, #6 and #7 are well on their way to being exceeded. There are no recommended quantitative limits for #8 and #9, so the concept of "exceeded" does not apply. However, there's plenty of evidence that #8 and #9 are both large, serious problems that are growing worse, so we can apply the same test to them: will the proposed disturbance improve, worsen, or have no effect upon boundaries #8 and #9?

Of course, in evaluating any disturbance, we should examine the whole life-cycle as materials are mined or grown, moved to a processing plant, moved to the point of manufacture, moved to point of use, then used, and finally discarded. Such an approach is consistent with the National Environmental Policy Act of 1969 (NEPA), which tells us to examine *all* effects and consequences of a project, including those that are distant in time and place. (40 CFR 1508.7-8)

Of any new disturbance, we could ask either (a) that the disturbance not be permitted if it trends toward exceeding any of the nine boundaries, or (b) that the goals of a disturbance be written down, then alternatives for achieving the goals be described, and finally each alternative be evaluated against the nine boundaries, seeking the least harmful alternative.[8]

#2: The Human Health Test

We could simply ask that the disturbance not make any health disparities worse (between racial and/or ethnic groups, or between genders). One problem with this approach is that not very many health endpoints have been well-enough described for comparison.

[8] For excellent discussions of alternatives assessment, see Mary O'Brien, *Making Better Environmental Decisions: An Alternative to Risk Assessment* (Cambridge, Mass.: MIT Press, 2000); and Mark Rossi, Joel Tickner and Ken Geiser, *Alternatives Assessment Framework* (Lowell, Mass.: Lowell Center for Sustainable Production, University of Massachusetts, 2006). http://goo.gl/r9VG4n. And see other Lowell Center publications on alternatives assessment: http://goo.gl/ErgsnQ

Or we could ask for the best available information about the likely contribution of the disturbance to cancer, fetal programming, birth defects, genetic changes, epigenetic changes, or likely effects on inflammation, the immune system, reproductive system, respiratory system, circulatory system, endocrine system, metabolism, growth, development, or behavior (including learning, attention, human bonding, or executive function). Where such effects are not known, our ignorance should be recorded and highlighted.

#3: The Justice Test

This test asks of any disturbance, who will receive most of the benefits and who will pay most of the costs? Will people of color or people of below-average income be further disadvantaged by this proposal? Will those enjoying white privilege be inadvertently and undeservedly rewarded with further advantages? Will intergenerational equity be served by this decision, or will future generations be harmed or disadvantaged?

Will communities already identified as "overburdened" (by N.J. or CalEPA assessment tools) be further burdened in any way? Will vulnerable populations (children, the elderly, the chronically ill, the disabled, those with multiple chemical sensitivities, those already overburdened by pollution where they live, work, learn or play) be harmed by this proposal? How will this proposal affect the least advantaged members of society? (See John Rawls, *A Theory of Justice* [1971; 1999]) Have the affected parties freely given their informed consent (and if so by what legitimate process)? If not, the moral basis for proceeding, or its absence, should be spelled out.

THE DECISION

When it comes to altering the three environments (natural, built, and social), most decisions to create new disturbances are made at the local (municipal) level. Because "cumulative impacts" problems develop as a result of thousands of small (seemingly "insignificant") decisions, all new disturbances -- even small ones -- should be evaluated by these three tests. Ideally, if these tests show that the new disturbance will make things worse, then the proposal would need to be prevented (which raises the all-important question, How can affected parties, especially at the municipal level, say No to harmful proposals?), or modified sufficiently to make it beneficial or at least neutral in effect.

However, even if regulatory bodies or local advisory boards are not in a position to *require* that a project be altered or abandoned, the voluntary, informal use of these three tests could still provide very useful information that, over time, would lead to a better understanding of the impacts of the routine decisions that we make. These three tests could be used to focus the questions we ask about *all* our decisions. Soon we might find that our general understanding of the three environments (natural, built, and social) has improved, and that we are now routinely making better decisions affecting our future.

Impediments to Change

Anyone who is paying attention now knows that -- because of the cumulative impacts of human activities -- we are rapidly ruining the planet as a place suitable for human civilization, so some fundamental changes are needed.[9] In the U.S. (and most of the rest of the world), the legislative route to the needed changes is blocked by perfectly-legal bribery/corruption (now called "lobbying" and "election campaign contributions") -- nearly-limitless infusions of private and corporate money into electoral, legislative, and regulatory processes.[10] This is the elephant in the room any time we discuss what to do about the cumulative impacts of human activities. Maybe it's time we all acknowledged the elephant. If we don't, who will? Until we do, nothing can change.

[9] World Bank, *Turn Down the Heat; Why a 4ºC Warmer World Must be Avoided* (Washington, D.C.: The World Bank, 2012); http://goo.gl/JohGMI; American Association for the Advancement of Science, Climate Science Panel. *What We Know* (Washington, DC: 2014). http://goo.gl/lVTysB; Walter V. Reid and others, *Millennium Ecosystem Assessment; Ecosystems and Human Well-being: Synthesis*. (Washington, D.C.: Island Press, 2005); http://goo.gl/hpfmEE. And see May Antoniette Ajero and others, *Global Environment Outlook 5 (GEO-5)* (Nairobi, Kenya: United Nations Environment Programme, 2012); http://goo.gl/tfnxFb

[10] See https://www.opensecrets.org/ and http://www.freespeechforpeople.com/ and https://movetoamend.org/