theRightenvironment Ltd.Co.

912 Rocky Spring Road
Austin, TX 78753

Phone: 512 821 1809
Cell: 512 669 2305

info@therightenvironment.net
www.therightenvironment.net

EcoSeeds
Attn. Barton Kirk
827 N. Sheridan Ave. #2
Pittsburgh, PA 15206

Date
February 27, 2008

Your reference
-

Our reference
L08.003

Concerning
Peer-review of the thesis 'Suburban stormwater management, an environmental life-cycle approach'

Dear Barton,

I enjoyed reading your thesis and would like to congratulate you on the thorough job you have done. Not many LCA studies are carried out with such scrutiny. The most important ISO 14040 series requirement is to document well. You have excelled in this respect.

I send you my final review following our discussion. It was a pleasure to have a good discussion with you and I hope our communication will benefit you in future work.

Best wishes,

Joep Meijer
President

Appendices: draft review

Review

Barton Kirk, 2006. 'Suburban stormwater management, an environmental life-cycle approach'. Thesis for the University of Vermont

Status
This review is the result of an initial review of the reviewer, teleconference between the author and the reviewer, formal response from the author and final review from the reviewer.

Introduction
I contacted Barton related to a reply on the SimaPro users servlist. This resulted in me offering to review his above mentioned thesis. Below you will find my draft findings and questions for clarifications.

I did not follow the proper guidelines prescribed by ISO 14043, but have focused on the thesis as the authorization of a report of a colleague before publication.

General
I believe that the study is well documented and shows great scrutiny and effort. The methodological choices for databases and impact assessment reflect the current status of LCA science in the U.S.A. The report is well written.

I also believe that the author is sometimes a bit too humble. The major comment I have is that I would have liked to see more sensitivity analysis as to provide insight into the robustness of the results and some conclusions.

[Kirk] I am aware of the lack of sensitivity analysis. I had designed the LCA model to make sensitivity analysis easier, but simply ran out of time to complete it. What areas would you suggest I focus on for the sensitivity analysis?

[Joep] The starting point would be assumptions that relate to system boundaries (what has been left out), assumptions for key for allocation where system boundaries are crossed (cut-offs) and assumptions related to major contributions. Sometime specific goals need to be added based on the study itself, especially where scenarios are involved.

Specific
<u>Functional unit</u>
The functional unit is defined as 'the management and treatment of stormwater runoff from 0.4 ha (1 acre) of 100% impervious surface for one year, with reference to the New York State stormwater design

criteria, precipitation characteristics of Durham, NH, and the runoff pollutant characteristics of the University of New Hampshire's West Edge Parking Lot — the watershed of the Stormwater Center'.

Was it possible to define treatment in terms of a function of either 'cleaning', or 'drainage' or something else. This might add value to the analysis, where all variants have to perform equally.

[Kirk] I choose the following functional unit, because cleaning or treatment requirements are far from universal and most everything is related in terms of volume, i.e. water quality volume. I choose to focus on the standard that was consistent across BMPs

I am not sure how decommissioning was modeled. It looks like abandonment was assumed. Is there a reason why the end-of-life scenario's is defined as abandoning and not different, like, recycling or removal and restoration, or have I misread it?

[Kirk] I choose abandonment because that was the scenario my committee and I agreed was most likely to occur. Evaluating other decommissioning scenarios should be easy as it's built into the model. The model was created to do far more than I had the time to report on.

Hybrid-LCA and materials

The use of input-output LCA databases and therefore the lack of specific material LCA datasheets is recognized as an improvement option. The thesis states ''However, given the limited number of materials actually employed in the construction of stormwater BMPs, it may be reasonable to examine material production in greater detail using process level data as opposed to the highly aggregated input-output data utilized in this study.'

LCA information of the used materials is available in LCA database, although not specifically for the U.S.A. With this information a hybrid-LCA could have been compiled resulting in a more specific assessment of these foreground materials. Several approaches could have been followed.

Was it considered to use available LCA sources and try to tailor them to U.S.A. conditions as a first attempt?

[Kirk] Not really. I used up most of my budget on purchasing Umberto and other data and felt that I could not justify purchasing European data. But I'm not familiar with the process of "adjusting" data to suit US conditions? Can you elaborate?

[Joep] As a first approximation or as a source for validation the use of other data for similar processes and technologies is a valid technique. The biggest adjustment that needs to be made is trying to regionalize background data (such as power generation) and transportation distances.

And secondly, for a lot of inventory information primary data has been collected from stakeholders, was it considered to contact the material industry to ask for their information?

[Kirk] I considered starting with primary material data and working from there, but choose to put more effort into developing a robust MFA model that I didn't use to its entirety. It's as though I changed my strategy mid-stream.

The thesis states that the plastic components are more dominant than aggregates and concrete components. Other studies comparing different options for sewers show a pretty broad range of conclusions where sometimes concrete options and other times plastic options are preferable.

[Kirk] If we are talking about the same paragraph 1st parapgraph page 51. I was not intending to suggest that the plastic components were more dominant, just that in sum, the components of the ADS (which were largely plastic) were larger than the sum of component impacts of the others that were largely aggregate and concrete.

Was it considered to perform a sensitivity analysis using different inventory data?

[Kirk] That was my original intention, but I ran out of time. My original thesis proposal consisted of two studies (or two papers). The first was to conduct entirely attributional comparative LCA of the BMPs under evaluation at UNH. The second was to perform a more consequential LCA evaluating various scenarios of applying the UNH BMP models in a real community context through UVM's Redesigning the American Neighborhood Project.

<u>Energy sources</u>
Reference to consumption and emission patterns are documented well.
Does the study include cradle-to-gate production data of the fuels needed for energy accounted for?

[Kirk] Yes. Although I don't appear to have mentioned it in my thesis, I included well to pump fuel data from the NREL LCI Database, I did include it in my research publication manuscript however.

<u>Use phase</u>

The operational impacts have been excluded for most of the interpretation and conclusions. The thesis states the following reason for this: 'The degree of exaggeration cannot be determined without normalization values that account for the per capita contributions of non-point source pollution. For this reason, the operational inventory and subsequent impacts have been excluded in Figure 7 in order to better understand the impact contributions of the other life cycle phases and activities'.

The inventory data in table 7 suggest that the alternatives have different performances that are significant and vary in order of magnitude. This could be a potential discrimination factor, especially since this is one of the key functional performances of stormwater management. It is correct to exclude it from parts of the interpretation to be able to judge the other parts better. It seems not correct to leave them out of the rest of the interpretation and conclusions. An assessment can be done on the inventory level as well. When characterization data are missing, inventory data can be analyzed as is. Differences there can be used during interpretation and have just as much value when environmental impacts are suspected but can not be characterized due tot the lack of factors. LCA reporting leaves as much room for qualitative assertions as for quantitative.

Therefore I believe you are very strict on yourself not including the cleaning efficiency. If it is more important the following approach could have been followed for decision making: 1) Define a BPM with the best efficiency and/or least failure rates as your major decision criteria, and then 2) optimize/reflect based on the other life cycle phases and impact assessment.

[Kirk] Yes this is the approach I had intended to suggest. I will try to make that clearer in subsequent pubs.

Also I've spoken with Jane Bare about the normalization issue and she does not agree with me or at least she doesn't feel I've offered enough proof to warrant not using the normalization values. I applied for research money to investigate this issue further because it has implications for more than just stormwater treatment.

I had considered using the inventory weighting approach or some hybrid between LCI and LCIA weighting for the second study, but didn't feel it was appropriate for the comparative analysis of the BMPs without obtaining weighting values from a representative stakeholder group.

Maintenance

I do not agree with the statement 'Accurately modeling the corrective maintenance was one of most challenging parts of the BMP LCA. It is even arguable that it should not be included, as only normal operating conditions

should be modeled according to LCA guidelines and it is difficult to define what constitutes normal operating conditions and behaviors (Baumann and Tillman 2004; Guinee 2001).'

The reason is that by definition functional unit means: in order to function well over a defined period of time. This includes maintenance to keep performing for the full 30 years.

[Kirk] That's good to know. I understand your point. This is where sensitivity analysis would be helpful again.

Claiming the right credits for the work

The thesis includes a very humble and modest statement: 'In reflection of this example, the environmental life cycle impact was not the critical factor in differentiating the BMPs, but provided an environmental reinforcement to the rankings based on life cycle cost.'

The opposite is just as true. Both LCA and LCC analysis are of equal importance as to select options.

[Kirk] Good point. I was assuming that economics would take priority to the decision makers, but it's good to point that the depending on your perspective, each are equally effective.

A second example where the author can claim more credits is here: 'But before the full utility of LCA can be realized in stormwater decision-making further development of the life cycle assessment methodology, is necessary.'

I agree with the notion that a better methodology will result in a more sound assessment, but that a methodology is in development is very normal in science. What do you think happened when cost calculations started?

[Kirk] Good point. I will attempt to be bolder in claiming the significance and value of the work. I will also devote more discussion to the utility of this work in future applications in an interpretation context.

Major contributions

I would have liked to see a more thorough assessment of major contributions within each impact category to define the life cycle phases, the processes or materials, and the single inventory impact data.
This will inform the reader on 'what matters most' and give hints to define sensitivity analysis for the author.

[Kirk] What do you mean by more thorough assessment? Do you mean that you would like to see a contribution analysis for each individual impact category?

Sensitivity analysis

I have found little evidence of sensitivity analysis for major assumptions. Defining scenarios for variations or assumptions in terms 'best-case' and 'worst-case' can be a powerful tool. This might help the author in defining the robustness of the conclusions and therefore be more certain in some areas.

[Kirk] Agreed. Part II of my thesis proposal (which my committee allowed me to drop) was to evaluate numerous scenarios, examining scale, material types, distance from resources, construction methods, etc as well as more comprehensive sensitivity analysis of the model variables. I simply ran out of time. I could write numerous articles just playing with the model, if I had funding to spend the time on it.