Peer Review Report for the Draft *EPA HANDBOOK ON THE BENEFITS, COSTS, AND IMPACTS OF LAND CLEANUP AND REUSE*

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I.   <u>Introduction</u>

This report summarizes six peer reviewers' comments on the <u>EPA Draft Handbook on the Benefits, Costs and Impacts of Land Cleanup and Reuse</u>[1]. The Draft Handbook was completed in September 2010 with the collaboration of EPA's professional staff from the National Center for Environmental Economics (NCEE) in the Office of Policy, Economics, and Innovation and the Center for Program Analysis in the Office of Solid Waste and Emergency Response. After initial discussions and e-mail exchanges between Drs. Robin Jenkins, Kevin Haninger, Heather Klemick, Lura Matthews and the author, a strategy for the peer review was developed in early September, 2010.

The process was based on suggestions derived from an initial review by the author of the Handbook as well as a collaborative definition of the goals and resulting key focus areas for the review. In addition, this group developed a set of charge questions/discussion issues that would be circulated to the peer reviewers. Figure 1 provides the background description for the Handbook, description of the purpose of the external review, and the issues for discussion. Associated with each focus area for the review Jenkins, Haninger, Klemick, Matthews, and the author identified leading economists to develop the reviews. In all cases leaders in the field accepted the invitation to develop a review. Table 1 summarizes (in alphabetical order) the peer reviewers, hereafter designated as the review committee, their affiliations, and the focus area(s) requested of each person.

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[1] The text of each reviewer's comments is provided in Appendix A.

Figure 1

<u>Background and Questions for External Review of</u>

<u>EPA's Draft Handbook on the Benefits, Costs, and Impacts of Land Cleanup and Reuse</u>

Background:

Analysts need reliable methods to assess the economic effects of land cleanup and reuse, including social benefits, social costs, and a variety of economic impacts. In the past decade, two separate Science Advisory Board panels have evaluated EPA proposals to examine the social benefits and costs of land cleanup programs. Their feedback primarily addressed what *not* to do and contained some contradictory advice. In 2006, EPA hosted a workshop of experts with experience in assessing land cleanup benefits. One outcome was clear–the experts are still debating the best approaches for estimating especially social benefits. The unique circumstances surrounding land cleanup and reuse seem to pose special challenges for economic analysis.

EPA has drafted a Handbook exploring issues surrounding the estimation of social benefits and costs, and economic impacts of land cleanup and reuse. The Handbook has multiple objectives, including to summarize the theoretical and empirical literature, sometimes reaching outside of economics. The Handbook begins by describing EPA's land cleanup and reuse programs and outlining some unique aspects that have complicated efforts to develop economic analyses. An early chapter clarifies the differences between benefit-cost and economic impacts analyses (a distinction that has proven confusing for analysts in the past). The heart of the Handbook presents conceptual background, discusses empirical challenges, and offers practical suggestions for estimating benefits, costs and economic impacts. The knowledge base for estimating the effects of land cleanup and reuse is still in its formative stages. Thus, another purpose of the Handbook is to raise important questions that remain in the literature.

The Handbook is intended to serve as a supplement to the more general and prescriptive EPA *Guidelines for Preparing Economic Analyses* (U.S. EPA 2008a). The *Guidelines* provides instructions for how best to perform agency benefit-cost and impact assessments, whereas the Handbook provides only soft recommendations and more narrowly targets the land cleanup and reuse scenario. The Handbook's intention is to offer practical suggestions when the state of knowledge is sufficient to justify them, though these suggestions would not have the status of EPA-mandated guidance. The information provided in the Handbook, when used in conjunction with the *Guidelines*, should allow analysts to more fully characterize the net benefits and impacts of EPA policies targeting land cleanup and reuse.

Purpose of External Review:

This external review has several objectives including to assess whether the literature summarized is comprehensive and accurate as of 2010, and whether the Handbook's original portions are sound and useful. It should also give feedback on the recommendations made and whether they seem reasonable and informative. Finally, the review should gauge whether the Handbook provides sufficient detail when describing the studies that have assessed benefits, costs, or impacts. Part of this latter task is to ensure that the document identifies key data sources for use in future policy analyses.

Figure 1 cont.

Issues for Discussion:

1.   Has the Handbook adequately described the conceptual framework, empirical implementation strategies, and data requirements for the key methods—revealed preference, stated preference, cost estimation, and economic impacts? Have important differences across the methods and their implications for interpreting results been discussed?

2. Are there important omissions from the literature, recent and otherwise, that have been overlooked?

3.   Does the document deal adequately with how to interpret the results from revealed preference studies (which are retrospective) and apply them in policy evaluations (which are prospective)? Examples include:

- Size of the cleanup activity in relation to the size and composition of local markets
- Nature of the local economy—e.g. unemployment; measures of connections to other regions
- Definition of group who would be willing to pay for cleanup i.e. extent of the market
- Interrelationship between the results for benefits and impacts from different methods
- Relationship between hedonic (such as Kiel and Williams) and capitalization studies (such as Greenstone and Gallagher) of effects of cleanup and reuse
- Likely usefulness of meta analysis of past work versus other approaches to benefits transfer; adequacy of discussion of benefits transfer
- Importance of general equilibrium effects for policy analysis
- Interpretation of benefit estimates from property value studies when the change in contamination is non-marginal (e.g., NPL site cleanup)
- Relevance of topics like habitat equivalency and restoration scaling
- Discussion of distributional effects and gentrification
- Should there be coverage of model calibration as alternative to estimation?
- Should the Handbook discuss the need for continuous experimentation and *ex post* evaluation as proposed recently by Greenstone [2009] in this context?

4.   Are the research questions posed by the document forward-looking and on target? Which do you think are most important? Please identify any additional research questions important to the evaluation of benefits, costs, and impacts of land cleanup and reuse.

5. Comment on the accuracy and usefulness of the discussions on jobs and wages, land productivity benefits, and use of compliance costs as an approximation for social costs.

6. Is the document written clearly? Please specify sections in which the clarity can be improved.

7. Does the handbook provide practical advice and useful recommendations for policy analysts?

8. Please comment on any additions you feel would enhance the handbook.

Table 1: The Review Committee for the Draft Handbook

External Reviewer	Field	Focus of Review
H. Spencer Banzhaf Associate Professor Department of Economics Georgia State University	Environmental Economics Environmental Policy Analysis History of Economic Thought	Complete Handbook; extra consideration of quasi-experimental methods
Timothy J. Bartik Senior Economist W.E. Upjohn Institute for Employment Research	Urban Economics Labor Economics Public Economics	Discussion of treatment of job creating effects in benefit cost analysis; evaluation of economic impact analysis
Jan Brueckner Professor Department of Economics University of CA, Irvine	Urban Economics Public Economics Industrial Organization Housing Finance	Urban economic perspective on treatment agglomeration effects and benefit analysis (partial and general equilibrium considerations)
William H. Desvousges President W. H. Desvousges and Associates Inc.	Environmental Economics	Whole Handbook Treatment of benefit analysis from private sector perspective; best practice in private context; treatment of the role of stigma
Ted Gayer Co-Director, Economic Studies Joseph A. Pechman Senior Fellow Brookings Institution	Environmental and Energy Economics Public Finance Housing Regulatory Policy	Treatment of quasi-experimental methods
Nicolai Kuminoff Assistant Professor Department of Economics Arizona State University	Environmental Economics Econometrics	Whole Handbook Hedonic and structural modeling; quasi-experimental methods and benefit analysis generally
V. Kerry Smith (Chair of Review Committee) Regents' Professor & W.P. Carey Professor of Economics Department of Economics Arizona State University	Environmental Economics	Whole Handbook Selected review committee in consultation with EPA professional staff and prepared summary report

The process of enlisting the help of the external reviewers proceeded reasonably quickly. However, preparation of contracting procedures and conflict of interest forms delayed the process, in some cases, until early November before official requests were made of all the external reviewers. All of the reviews were completed and sent to the author by December 24, 2010.

A draft of the summary report was prepared early in January. As initially agreed, this draft was first circulated to the review committee for their comments. After hearing back from the committee early in February a revised (but unofficial) draft was submitted to EPA professional staff for their comments to assure it clearly documented the suggestions. After both sets of comments were compiled and changes made the final report submitted on **(DATE)**.

This review is composed of four sections after this overview of the process. Section II summarizes the general impressions of the review committee. The committee identified the potential for the Handbook to offer an innovative vehicle for monitoring ongoing research activities and making the findings of this current research available to policy analysts before there is sufficient research accumulated to warrant a change in EPA's *Guidelines for Economic Analysis*. The Handbook recognizes the need to monitor new research so that the practice of policy analysis can be updated with the latest research.

This role is especially important for policy analyses of rules that fall outside a well established architecture for benefit-cost analysis.[2] Policies associated with land cleanup and reuse can be evaluated in a variety of ways. Past practice with RIA's for rules in this area has not

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[2] Smith and Mansfield [2010] introduced the term, analysis architecture, to describe the logic a regulatory agency uses to organize its activities in evaluating sets of rules. For example in the case of EPA's benefit cost analyses of rules involving the criteria air pollutants, the practices EPA uses to develop benefit cost analysis have a clearly established logical structure linking risk assessment and benefit measurement. This structure is what Smith and Mansfield described as an analysis architecture.

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developed a single format for assessing the benefits attributed to the results that arise from the rules. A rule can lead to activities that serve to reduce risks. However, it can also lead to other changes. As a result, the risk assessment/benefit measurement strategy used in other contexts by EPA would be an incomplete basis for meeting the full goals of an assessment of the benefits and impacts of policies associated with land cleanup and reuse. If some aspects of the outcomes attributed to a rule were described as reducing risk then the benefit assessment strategy would also require the analysts to determine areas where tradeoff measures overlapped in the effects that people were taking into account in their choices.

Section III summarizes the review committee's responses to the discussion issues. The fourth section is the most detailed component of the report. It extracts the primary suggestions for changes in the Handbook from the reports of each member of the review committee. In the process it explains the reasoning for specific recommendations for revisions to the Handbook. The last section outlines some ideas for future research identified in the review committee's reports.

II.   <u>General Impressions of Reviewers</u>

On the whole, the reviewers felt EPA staff should be commended for developing a Handbook that covered the relevant topics and properly summarized all but the most recent literature. A summary and assessment of the literature that meets this standard was viewed as especially laudable given the rapid pace of change in current research in this area. Economic research relating to hedonic models and the role of quasi-experimental versus structural models is evolving very quickly. Indeed, some of this new research was influenced by earlier EPA

assessments.[3] As a result, some of this literature has become available since this initial draft of the Handbook was completed. Indeed, the committee's ability to identify some of this new research stems from the fact that several members were the authors of the new work.

The strategy of using a Handbook as a vehicle for summarizing new research continues the tradition of EPA's efforts to design mechanisms that assure its economists remain current and are able to incorporate new findings into the practice of policy analyses. The review committee felt the concept of developing handbooks for key areas should be considered for policy areas where analysts must conduct assessment in the face of a rapidly changing research landscape. It offers a practical strategy for a periodic "window" on literature relevant to the tasks required for policy evaluation.

If the staff responsible for preparing the Handbook agrees with this interpretation of their potential generic role, then this logic could be explained in a new section of the first chapter of the Handbook. It could be described as a way that review and discussion can be encouraged for current, perhaps unpublished, literature relevant to practice. This discussion does not require a handbook recommend modifications to the practices identified in EPA's Guidelines for Economic Analysis.

If the Handbook authors agree with this conception, then the Review Committee felt EPA staff might also consider several general changes in the description of the Handbook, including a description of how literature was selected along with the addition of some further appendices. The extended discussion could be placed as a new section in Chapter 1. It could identify two goals of the Handbook: (a) describing what is known about the performance of methods for benefit, cost, and economic impact assessment for these types of problems and (b) highlighting

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[3] The summary of EPA workshop described in Smith [2007] was specifically noted by some reviewers.

how recent research offers new considerations for practice. Illustrations of the specific considerations could be assembled in a new appendix.[4] A second appendix could identify sources for past regulatory impact analyses where these considerations might be important if redone today.

The only general issue that reviewers raised that may warrant some change in the description of the methods and results involves a perception that was described as a "confirmation bias" (Gayer's comments).[5] That is, the analysis takes as <u>a maintained hypothesis</u> that an externality is "important enough" to warrant intervention. The committee felt some changes could be made to address this issue and they are developed in more detail in our recommendations. Moreover, some context on interpretations of results from benefit cost analysis might also help. For example a finding that the best available estimates for the net benefits of a policy are zero or negative does not imply the externality is nonexistent. Rather, it implies the cost of the policy exceeds the gains that can be measured. One can add a rhetorical question as part of these assessments when it is felt there may be important omissions. For example, one might assemble indirect evidence to investigate whether it was reasonable to suspect that the *unmeasured* gains from a policy were likely to be large enough to tip the balance from negative net benefits to positive? Such a result could mean the net benefits are not large enough given the form of the policy. This situation might suggest that a policy redesign or a change in priorities is warranted. One might want to consider whether policies had irreversible

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[4] Examples would include Gayer's recommendations for specific documentation of tests for exogeneity, the Kuminoff et al [2010] new findings on preferred functional forms for hedonic price functions, updating the Cropper et all [1988] recommendations; and the evidence Bartik cites for treating labor costs under conditions of unemployed resources.
[5] Both Banzhaf and Desvousges also noted a tendency to assume positive net benefits are "real" and zero or negative net benefits are not.

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consequences and be especially cautious in these cases. It could also identify areas where supplemental research would be especially valuable.

What is important from the perspective of the analysis is what is taken as the maintained hypothesis in interpreting any set of results from a benefit cost analysis. That is, it would not be appropriate to search for new approaches only when existing results fail to confirm positive benefits. This impression suggests two changes. First, the type of general discussion of role for Handbooks and second the revision in how examples such as the Greenstone and Gallagher study and the Gamper-Rabindran and Timmins studies are presented. This second suggestion is discussed in more detail in Section IV.

III.   <u>Feedback on Issues for Discussion</u>

Appendix A to this report includes the detailed reviews of the Handbook provided by each member of the committee. This section extracts from them a composite summary of these responses to the issues circulated to the external reviewers. Because some members were given specific charges on sub-parts of the Handbook they did not attempt to prepare complete responses to all of the questions. Others provided responses indirectly in the framing of the elements identified in their reviews. This summary extracts from these comments what should be viewed as a "rough and ready" sense of the committee's answers to the discussion issues. It uses the questions as they were posed to the committee to organize the material.

Question 1:

Has the Handbook adequately described the conceptual framework, empirical implementation strategies, and data requirements for the key methods—revealed preference, stated preference, cost

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estimation, and economic impacts? Have important differences across the methods and their

implications for interpreting results been discussed?

There was uniform agreement that the Handbook provided appropriate background and discussion of an organizing conceptual framework.

The specific comments indicated that some aspects of the coverage of methods and the issues in interpreting results from some methods should be revised. Table 2 identifies the chapters with recommended changes and some brief highlights of the proposed revisions. Section IV below explains them in more detail.

Table 2: Recommended Changes in Handbook

Chapter	Number of Recommendations	Highlights
1	1	Revise section 1.4 to reflect new outline based on how subsequent recommendations are treated.
2	1	Update data on programs and include maps and tables describing spatial and temporal attributes of programs.
3	6	Clarify and expand discussion of concepts of benefit cost and economic impact analysis; extensive revisions to discussion of effects of policies on jobs and output and to increase citations; remove judgments about costs of research methods or ease of implementation.
4	2	Move discussion of stigma to this chapter; include discussion of limited quality of professional appraisal methods to assure practices tolerated in this context are evaluated using same standards as for policy analysis.

5	8	Revise Table 5.1; develop more complete description of figures and link to this model as traditionally used in Urban Economics; introduce new section on hedonic models distinguishing estimation, interpretation, and uses; reorganize discussion of Greenstone-Gallagher and Gamper-Rabindran and Timmins; update studies cited; expand discussion of stated preference research; include recent work on benefit transfer; drop Table 5.2
6	3	Remove discussion of partial and general equilibrium analysis and put in new chapter; include short and long run analysis; update data.
7	1	Follow Bartik's comments on the treatment of the job creation effects of rules and the method used in economic impact assessments.

In addition to these specific changes, as noted earlier, it would be useful to provide background on the role of the Handbook as a window on specific new research findings considered important for analysts involved in evaluating policies related to land cleanup and reuse.

It was also considered appropriate to explain the reasons for the greater emphasis given to new hedonic research over recent stated preference research. Some reviewers speculated as to whether readers might interpret this focus as implying the authors of the Handbook would recommend analysts seek to use revealed preference methods over stated preference techniques. Another potential explanation would be the Handbook authors felt the recent stated preference research did not alter the common understanding of the limitations and qualifications to these estimates so there was no needed for extension discussion of current work. Under this perspective new research would only be included if it had potential to change commonly held beliefs about the performance of methods or the interpretation of their results. Some further

explanation of both criteria for inclusion and the specific treatment of stated preference methods are recommended

Question 2:

Are there important omissions from the literature, recent and otherwise, that have been overlooked?

As with question #1, the committee was impressed by the coverage of the Handbook. Several reviewers identified two types of additional references—new literature reviews that could be cited, replacing existing citations (see Bartik and Kuminoff's comments for the specific suggestions) and changes based on new results (see the discussion in part IV of this report).

Question 3:

Does the document deal adequately with how to interpret the results from revealed preference studies (which are retrospective) and apply them in policy evaluations (which are prospective)? Examples include:

- *Size of the cleanup activity in relation to the size and composition of local markets*

- *Nature of the local economy—e.g. unemployment; measures of connections to other regions*

- *Definition of group who would be willing to pay for cleanup i.e. extent of the market*

- *Interrelationship between the results for benefits and impacts from different methods*

- *Relationship between hedonic (such as Kiel and Williams) and capitalization studies (such as Greenstone and Gallagher) of effects of cleanup and reuse*

- *Likely usefulness of meta analysis of past work versus other approaches to benefits transfer; adequacy of discussion of benefits transfer*

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- *Importance of general equilibrium effects for policy analysis*

- *Interpretation of benefit estimates from property value studies when the change in contamination is non-marginal (e.g., NPL site cleanup)*

- *Relevance of topics like habitat equivalency and restoration scaling*

- *Discussion of distributional effects and gentrification*

- *Should there be coverage of model calibration as alternative to estimation?*

- *Should the Handbook discuss the need for continuous experimentation and ex post evaluation as proposed recently by Greenstone [2009] in this context?*

Most reviewers would characterize responses to the themes to be considered areas of active research rather than situations where there is sufficient consensus to offer a specific conclusion about each issue to policy analysts. Within the reviewers there were some differences in judgment, largely in the emphasis given to what has and has not been established in recent research. For example, Brueckner and Kuminoff's respective comments on some of the complexities in making a judgment about the importance of discrepancies between partial and general equilibrium measures of benefits illustrate this point. Both reviewers agreed the answer can be tied to the size of the site being cleaned up in relation to the size of the community being studied. As Brueckner notes in his comments, the model he used to develop specific insights on this relationship is stylized with important simplifying assumptions. Both reviewers agree this question would be a desirable area for future research.

The next section develops the specific recommended changes that were highlighted in Table 2 above. For the most part, these changes would entail using some of the most recent

research to describe what we know or don't know about these issues rather than identifying a specific conclusion from current research that was overlooked.

Question 4:

Are the research questions posed by the document forward-looking and on target? Which do you think are most important? Please identify any additional research questions important to the evaluation of benefits, costs, and impacts of land cleanup and reuse.

Reviewers felt important research questions were identified. However, they were dispersed throughout the report. As noted in section IV, it would be desirable to collect the primary research recommendations and include them in a single section. The second and third parts of this question are answered in more detail in section V below.

Question 5:

Comment on the accuracy and usefulness of the discussions on jobs and wages, land productivity benefits, and use of compliance costs as an approximation for social costs.

This question is most comprehensively addressed in Bartik's comments (see Appendix A) on this component of the report. A few highlights of his responses include:

- Distinguish the task of measuring job impacts and economic impacts of a project from the conceptual task of measuring the social value to be attached to these effects in some areas.

- Recognize the important distinction between the effects of jobs that are export based (providing goods to markets outside the region impacted) versus non-export based jobs.

- Consider the sources of the resources used for the projects; as discussed in the next section this raises the issue of how shadow prices should be computed in a distorted second best context.

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- Be clear to acknowledge it is the net change in jobs acknowledging losses in other areas that reduce the net gain in the area affected by cleanups.

- Opportunity costs of labor (or the excess capacity) in regions with underutilized resources will vary. Given the diversity of literature and potential contexts EPA may wish to consider developing standards for how opportunity costs should be adjusted.

One reviewer felt this chapter was the least specific in identifying methods that should be considered and criteria for evaluation. Bartik's comments provide a detailed roadmap to address this concern.

Question 6:

Is the document written clearly? Please specify sections in which the clarity can be improved.

In general the review committee felt the Handbook was clearly written. Appendix B has a list of areas where some minor re-wording would be helpful.

Question 7:

Does the Handbook provide practical advice and useful recommendations for policy analysts?

It is not clear the Handbook should provide recommendations. If the objective is to provide a "window" on recent research that identifies findings before there is sufficient consensus to warrant a change in the guidelines for analysis, it should distinguish between recommendations for how to interpret research, diagnostics that may be considered in evaluating how well a specific study has dealt with threats to exogeneity, and factors that might contribute to large differences between partial and general equilibrium measures for benefits.

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Several of these types of recommendations are included in the next section. The Handbook currently does not have a specific "how to" format or a set of detailed recommendations. Most of the reviewers felt there were good reasons for this approach. However, they also felt some greater specificity in how to use and evaluate research findings would be desirable.

Question 8:

Please comment on any additions you feel would enhance the Handbook.

The next section makes specific recommendations for additions. This is not an exhaustive list. Several reviewers had further recommendations in their individual comments. Those identified in the next section reflect situations where the proposed changes were viewed as important and are shared by multiple reviewers.

IV. <u>Concrete Suggestions for Revising the Handbook</u>

This section distills the major comments of the review committee along with the chair. It organizes them by chapter of the Handbook. It is not intended to be exhaustive. As discussed at the outset of this report, state of knowledge assessments that extract practical guidance for those analysts doing benefit cost and impact assessments are never "done". As such, it is important to establish a process that balances continuous updates to best practice, where current research suggests it is warranted and relevant to the quality of the information developed for policy makers, with the practical constraints of the budget and time constraints for those analyses.

A. <u>Chapter 1 Introduction</u>

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The committee felt this chapter set a good context and clear description of objectives. Section 1.4 should be updated to reflect the final decisions of the EPA authors and associated changes in the Handbook based on the committee's recommendations for potential revisions.

B. Chapter 2 EPA and State Cleanup Programs

As with chapter 1, the committee felt this chapter was clear and provided very helpful background. The only comments related to updating the information about programs which is now "old". For example in section 2.1 the expenditures under the Superfund program are discussed as of 1999—over ten years ago! This chapter needs to be specific in defining "recent years" in describing activities. RCRA is discussed as of 2005 and the UST as of 2009. Could all of these programs be put in consistent terms with respect to the years used in reporting activities, accomplishments, and effort levels?

In addition some comparative data by program and description of locations of the sites throughout the United States would be useful. For example: include current information and some temporal patterns by program:

- Annual expenditures by program over time.
- # sites with cleanup expenditures, by program.
- National map of locations for different types of sites.
- #NPL sites by current phase of cleanup.
- Acres of sties. How much land are we talking about?
- Distribution of counties by # of sites within the county.

More information on state programs, tables with the number of sites and the expenditures by site, for those affected by the program, would be desirable.

C. Chapter 3: Benefit Cost Versus Economic Impact Analysis[6]

This chapter revisits an issue addressed in the early literature in benefit cost analysis and not considered in much detail in the mainstream literature since that time. As a result, the committee was impressed by the effort to bring up these topics. Nonetheless, the committee felt the chapter will need considerable revision and expansion, in part because there is not the well established background literature that analysts can use for further information.

Six recommendations for revisions can be extracted from the comments.

1. *Expansion in definitions for benefit cost and economic impact analysis*. Benefit cost is about a measure of the net gains (or losses) arising from a proposed change in a resource allocation due to policy. It is not a measure of "overall well-being" (p. 16 of Handbook). It is a measure of the <u>change</u> in net benefits. Distribution also needs clarification. In many economic contexts an important focus is on distributions among demographic groups, income groups, regions etc. Impact analysis is about <u>the nature of the resource re-allocation</u> due to a policy. Thus distribution can have many meanings—in all cases it is attempting to characterize the nature of the resource re-allocation (p. 10 first two paragraphs); discussion of "winners" and "losers" could imply a Kaldor-Hicks discussion and that is not what is intended.

2. *Defining clearly the nature of the terms being used*. The discussion of jobs and wages (3.3.1) needs to define what a change is. The characterization of "social cost" needs a clearer description of what is involved. Given the presence of excess capacity, the social

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[6] The comments here summarize the recommendations of Drs. Bartik and the Chair and integrate a few of the comments of the committee members (Desvousges and Kuminoff in particular).

cost of employing under or unemployed resources should be based on the shadow prices of the resources involved. Several committee members (see the comments of Kuminoff and Bartik) felt this discussion needed clarification.

Unfortunately we don't have an ideal basis for explaining underemployed resources in a static model. There are many ways to "describe" it. None are fully ideal and this discussion needs to be especially clear to avoid the examples cited by Kuminoff (p. 11 in his comments). Bartik suggests a distinction between approaches to measuring the jobs and other economic impacts of a project from the "social value" attached to them. This would be an important start. One way to conceptualize the existence of distinct shadow values is that there are institutional constraints (rules) that create a wedge in markets— i.e. differences between the supply and demand prices for resources.

Bartik's discussion of financing of projects—whether private sector, state and local, or federal, reflects one feature of the factors contributing to what is labeled here as the wedges—differences in the opportunity costs of these resources due to the distortionary effects of taxes. To the extent a policy can be envisioned as "removing a wedge", in the presence of these other pre-existing taxes (that may not be removed) the logic could be described as similar to the Goulder et al [1999] analysis of environmental instruments in a second best setting.

Clearly even with analogies the discussion is complex. It would seem the types of revisions required are to:

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a. Distinguish measurement of impacts from social valuation

b. Develop the concept of shadow values and acknowledge that it needs to reflect all important distortions so the sources of project funds and their uses contribute to the computation of the implied shadow values.

c. The construction of measures of these shadow values could be a future research issue.

3. *Expand the citations and links to the literature for discussion of jobs and economic impacts.* Bartik's discussion (p. 3-7) provides a rich set of citations. His delineation of the types of impacts would easily fit within section 3.2 and help to clarify concerns he raises with later discussion. These recommendations are important precisely because these issues have come up in discussions of employment policy and not regulatory analysis. This more specific delineation would also serve to set the stage for addressing Brueckner's concerns with section seven (and implicitly this introduction to it).

4. *Clarify terms*. Table 3-1 should replace the term "values" with effects to avoid confusion between benefits and values. It should consider the ways effects are evaluated in markets compared to when the effects are evaluated outside markets and the associated potential for feedback effects.

5. *Off-hand judgments on the "costs" of doing different types of analysis*. The discussion of affordability of EIA versus BCA in section 3.3.2 seems misplaced without the distinction of how they are undertaken. The cost depends on how the analysis is undertaken and affects the quality of results. Inexpensive benefit cost analysis can be undertaken. Perhaps

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what is intended here is a discussion of the research issues in measuring impacts. There

exist well established regional economic impact models to evaluate the impacts of the

projects. There are no analogs to BENMAP (the program for benefit analysis of air

pollutants) for land cleanup and reuse policies[7].

6. *Assure consistency in Chapter summaries*. These changes would imply a re-working of

   the conclusion.

D. Chapter 4: Special Considerations for Evaluating Land Cleanup and Reuse

Overall, the committee had few comments on this chapter. It establishes the full

dimensionality of the problems and highlights important issues. Two recommended additions

should be considered based on the committee members' (and the chair's) reviews.

1. *Revise and move the discussion of Stigma*—this chapter would seem to be a good place

   for a discussion of stigma. Desvousges' comments identify literature that would provide

   important background for moving the stigma discussion (Banzhaf makes a related point

   concerning section 4.1.2). Kuminoff (p. 14) questions its treatment as a cost. Both

   Desvousges and Kuminoff discuss the role of information for perceived stigma. This

   strategy would also help to resolve Banzhaf's comment that the section seems to

   contradict 6.5.1. By integrating the two issues it should be possible to acknowledge that

   information could have spillover effects—tainting locations near sites that do not have

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[7] This example illustrates how an established architecture for analysis can promote the development of modules
that facilitate analysis of multiple rules and ,in turn, can reduce costs and assure consistency.

the liability or risks associated with contaminated sites and reduce demand for these locations.

To the extent expectations about adjoining land uses affect nearby site values, then these interrelationships could have agglomeration effects. This perspective also links to the discussion in sections 4.2 and 4.4.

2. *Add specific information about practices in the private sector*. Desvousges notes that the report should acknowledge Randall Bell's assessment of the property value at Love Canal and in adjoining areas. The citation for this summary is:

Bell, Randall, 1998, "The Impact of Detrimental Conditions on Property Values," *The Appraisal Journal*, Vol. 6(4): 380-391.

In another comment, Desvousges notes stated preference studies reported in <u>The Appraisal Journal</u> are not high quality. As a result, he recommends that it may be desirable to include some assessment (perhaps in an appendix) of the differences in quality of the analyses undertaken in these hedonic (and stated preference) studies compared to conventional academic studies and to the expectations routinely considered in policy evaluations. It might be useful to follow-up and review the chapters of the book by Randall Bell, *Real Estate Damages,* second edition (Chicago, Ill.: The Appraisal Institute, 2008). Chapters 1, 8, and 11 provide a context for Desvousges' comments.

E. <u>Chapter 5: Benefit Estimation</u>

The largest component of the committee's comments related to this chapter and the discussion of benefit estimation methods. Some of these comments outline new research questions that are discussed in section five below.

Eight specific recommendations can be extracted from the comments. Several of these suggested changes emerge from new research that was in press or had recently appeared in print. As Kuminoff's comments suggest, some of this research was motivated by the earlier EPA report [Smith, 2007]. Because some of the recommendations integrate suggestions across committee members' separate reports, this discussion covers the simplest proposed changes first. Then, it develops the logic for the more detailed revisions after an initial explanation that attempts to unify some of the comments.

1. *Clarify the components identified as parts of total benefits for a change and the methods or effects used to estimate them.* Table 5.1 was discussed by several committee members. The content of the table and some added explanation were suggested as desirable changes.

   A qualification noting that the concepts measured from some methods could completely or partially overlap (Brueckner and Desvousges) was suggested as an important addition. Further Desvousges raised concerns about the classification scheme. The current formatting gives the impression that aesthetics are under Human Health Improvements. I think indenting and adding the categories would help clarify what was intended

   - o Human Health Effects
   - o Aesthetic Effects
   - o Ecological Effects
   - o Materials Effects
   - o Land Productivity Effects

Also row categories above all three columns for the sub-groups in each class would help. Reversing the column methods and examples would help. Relabeling "Potential Valuation Methods" to "Methods for Measuring Tradeoffs". Specific additions such as household production/averting models and more accurate labeling of the other methods would help.

In addition, the table needs more discussion of the components if it is to be effective. The various methods overlap in the concepts measured. Moreover, in some cases particular methods change the concept of well-being that is used in defining each type of tradeoff measure. When the effect is treated as a risk, the behavioral model usually measures tradeoffs holding expected utility constant. By contrast, using a hedonic property value (as explained later) with effects that are considered "certain" the best one can hope to estimate without additional assumptions is a marginal willingness to pay. "Travel cost" not a method –it can mean many different types of models. It is a strategy for identifying a constraint to some types of choices.

Clearly the intention here is not to be exhaustive—so the text needs to explain that a short hand is being used to identify revealed preference behavior and functions that can assume some form of optimizing behavior (e.g. profit and cost functions versus production functions). Travel cost demand and indirect utility functions are used in modeling the structure that underlies the observed recreation choices and so forth. The Brueckner-Desvousges concerns can be easily remedied with more text explaining the intent—

labeling the terms, identifying sources that should be considered as part of developing the relevant revealed and stated preference models. This discussion could identify background sources for specific types of guidance on methods and it could highlight the types of economic frameworks used with each type of data.

2. *More background and context*. Several committee members "wondered" if the figures and associated description in 5.1.5 should go in an appendix. Others felt they were helpful in the body of the text. We recommend they stay in the body of the Handbook with a paragraph or two before the first paragraph of the section explaining how the willingness to pay is derived and relating that to the figures. The logic follows immediately from a mono-centric city model—so citations to a few papers and even Brueckner's stylized example in his comments could be used to make this point.

The next set of recommendations requires a bit of background to integrate the committee members' comments and to interpret what may appear to be contradictory suggestions. These all relate to some type of analysis of housing or land prices

Seven separate dimensions of these analyses were raised as considerations in defining, interpreting, and using these models:

   a. Models using housing (or land) prices rely on some concept of an equilibrium matching of buyers and sellers of heterogeneous goods—the parcels with homes that have different structural and locational attributes.

b. The analyst does not know all the attributes that may be important and the spatial nature of the commodity makes it likely that observed attributes will be correlated with unobserved attributes.

c. As a rule, the analyst does not know how to measure the perceived dis-amenity services of a contaminated site. Size, toxicity, access to groundwater, and a number of other factors may be important. In effect cleanup may not mean the same type of change for different types of sites.

d. The housing (and land) transactions providing the prices span different locations and can span different time periods.

e. Often the analysis can include observations before and after a policy change that affects homes and lots in some locations differently from others.

f. If the analyst is prepared to assume the conditions maintained with a hedonic equilibrium, then the hedonic price function, at the time of the equilibrium, can yield a point estimate of the marginal willingness to pay (MWTP) for small changes in the continuous attributes associated with each house (and period) comprising the equilibrium. This potential is a *theoretical possibility* that does not assure the function and the MWTP can be estimated without bias.

g. The hedonic price function under condition (f) is a description of an equilibrium. While past research has demonstrated that an expression for the form of the price function can be derived under specialized conditions; applications generally assume the "true" specification is not known. As a result, all empirical models are usually treated as approximations.

These issues are emphasized in different degrees in the comments of each of the committee members who commented on the appropriate uses of hedonic models. To organize them in relationship to specific recommendations it is important to distinguish the tasks of: *estimation, interpretation of the results, and use of the results for policy*.

Considering first *estimation*: Banzhaf, Gayer, and Kuminoff emphasize the issue of omitted variables from specifications of hedonic price equations and the relationships of

what is omitted to the attributes whose impact on price is especially relevant (identified as item(b.) above and discussed in Banzhaf p. 4-7, Gayer p.1,3,5 and Kuminoff p.5).

The issues in how to deal with these omissions depend on the spatial and temporal dimensions of the data available for analysis (point (d.) above). Over time, the nature of the conditions affecting the equilibrium may change for other reasons that are not fully captured with temporal fixed effects, but that could also affect the interpretation of estimates. Thus, to establish context for the comments and the associated recommendations, it is helpful to consider the framework used by Kuminoff and Pope [2010] (KP), comments of Banzhaf, and an early discussion of localized externalities by Palmquist [1992]. First, the KP framework—they derive an extension to the Epple [1987] analytical derivation of a hedonic price function to describe how they would interpret what is labeled as capitalization rate or price effect. This is defined as a discrete change in the prices for a house from an unexpected shock to an attribute that can be assumed to affect the price paid for a house at a specific location. To be specific, assume an equilibrium price function is derived following the Rosen [1974]-Epple [1987] logic and is given in equation (1), using the KP framework.[8]

$$P(g, x; \psi) = P(g, x(g, A, B), \psi(g, A, B)) \tag{1}$$

g = the attribute of interest (that is affected)

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[8] ψ is used instead of another Greek symbol for parameters of the price function (capital theta) because lower case (θ) is used for marginal willingness to pay in their discussion and a change was made here to avoid confusion.

x = housing and land attributes and other location specific characteristics

ψ = parameters of the equilibrium hedonic price function

A = parameter vector describing joint distribution of household income and preferences

B = parameter vector describing distribution of producer attributes

So equation (1) tells us that the parameters of the equilibrium price function are themselves functions of other parameters (i.e. the A and B vectors). Now when we consider the comparison of pre and post shock prices for house j we are comparing two functions leading to those prices as in equation (2).

$$\Delta P_j = P(g_{2j}, x_{2j}(g_2, A_2, B_2), \psi(g_2, A_2, B_2)) - P(g_{1j}, x_{1j}(g_1, A_1, B_1), \psi(g_1, A_1, B_1)) \qquad (2)$$

The subscripts 1 and 2 denote the two equilibria. The change from g_1 to g_2 is the shock. g_{1j} to g_{2j} is how it affects house j. Where subscripts are not provided the relationship is incorporating all the general equilibrium effects arising from households resorting (and producers adjusting).[9] Now consider the thought experiment envisioned with a capitalization measure. It holds other house and site characteristics constant and seeks to measure the effects of the discrete, exogenous shock and how the change in price related to the change in g should be interpreted. This expression is given in equation (3).

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[9] This derivation abstracts from the real world adjustment costs and time for these changes to take place. Nonetheless, it helps to frame the discussion and assumptions being made.

$$\phi_j = \frac{P_{2j} - P_{1j}}{g_{2j} - g_{1j}} = \frac{P(g_{2j}; \psi(g_2, A_2, B_2) \mid x_{2j} = \overline{x}) - P(g_{1j}; \psi(g_1, A_1, B_1) \mid x_{1j} = \overline{x})}{g_{2j} - g_{1j}} \qquad (3)$$

Now, with this background, it is possible to describe the issues raised by the reviewers.

I. How is this effect measured, given our incomplete information?

II. How should the various approaches for measuring this discrete change in price relative to the change in the attribute be interpreted, assuming we can develop consistent estimates of it?

III. How should the estimates be used in a policy context?

It is useful to step through these issues before turning to the recommendations for revisions in this chapter.

Estimation of the effect of a change in *g* through some type of hedonic can be derived from a cross-sectional analysis (Banzhaf's characterization of the hedonic case); observation of some policy induced changes and a quasi-experimental method to address selection effects (of treated and controls—see the conditioning terms in equation (3)) and exogeneity (due to omitted variables) as described by Greenstone and Gallagher in this chapter (and discussed by Gayer, Banzhaf, and Kuminoff); or through a difference in difference that uses temporal change that could be linked to a policy. Consider each of these alternatives in turn.

Estimates of a cross sectional hedonic would assume a single hedonic price function. As a result, they would need to address two issues—how is the attribute, *g* measured and how is the omitted variables that are threats to the assumed exogeneity controlled? It is in response to these questions that the spatial fixed effects enter. Quasi-experimentalists would argue that these fixed effects may not be "enough". Under the most favorable interpretation, their focus is on research design and the isolation of some event or manipulation of what can be observed to: exercise the control implied in (3) of the *x*'s; isolate a process that assures the *A*'s and *B*'s are approximately equal; and assure that ϕ does not change with the difference in *g* that can be isolated in a cross-section. This is a "tall order". Indeed, the practice of deciding whether these conditions are satisfied involves a significant dose of judgment. For example, in applying discontinuity designs judgments about the similarity in groups (or housing transactions) separated by some exogenous condition can be based on a simple comparison of means and variances across the groups. So while those in the quasi-experimental camp tend to favor isolating an exogenous condition that helps in organizing treatment and control, the process is less formal in assessing whether the groups are different in other dimensions. This approach causes the discussion to focus on discrete changes as if there was an on/off switch (see discussion of quasi experiments by Meyer [1995]).

As a result of these design choices, there is a tendency to believe that difference in difference or equivalently defined fixed effects that isolate the houses experiencing changes from others would be sufficient—provided there are appropriate controls. As Imbens and Wooldridge [2009] suggest, it is important to decompose the logic of a quasi-

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experimental analysis into three elements: (a) the distinction between potential and

realized outcomes; (b) the properties of assignment mechanisms that "select" treated and

control entities: and (c) the potential for interaction and/or general equilibrium effects

that might link treatment and control entities through market or non-market processes.

This context brings us to the Banzhaf comment and the simulation results in his

comments. The measure for the g (identified as issue (c) above) can imply both the

change and the initial level for g should enter the estimating equation. The KP discussion

is developed in very general terms, but this is the importance of the fact that the

parameters of the hedonic are functions of the level of g (i.e. changes in MWTP that

Banzhaf's discussion highlights). Table 3 organizes how the committee's comments

relate to each of these dimensions of the development and use of hedonic models.

Table 3: Organization of the Concepts

Tasks	Dimensions of Problem							
	Maintained Assumption of Matching Equilibrium	Incomplete Observability of Attributes	Measures for Attributes	Spatial Features of Information	Temporal Features of Information	Size and Character of Policy Change	Assumption of Equilibrium	Form of Hedonic Price Specification
Estimation	Kuminoff	Gayer	Banzhaf	Banzhaf Gayer Kuminoff	Banzhaf Kuminoff	Banzhaf Gayer Kuminoff	–	Banzhaf Desvousges Kuminoff
Interpretation of Estimates	Kuminoff	Kuminoff	Banzhaf	Banzhaf Gayer Kuminoff	Banzhaf Kuminoff	Banzhaf Gayer Kuminoff	–	Banzhaf Kuminoff
Policy Use of Estimates	Banzhaf, Kuminoff	–	–		–	Banzhaf Brueckner Kuminoff	Banzhaf Brueckner Kuminoff	–

* Modeling assumptions are made as part of the definition of the features of each problem. These assumptions can influence our ability to perform specific analysis tasks. A modeling assumption that enhances our ability to complete one task may well hinder a framework's ability to complete another. The authors cited have pointed out the specific links between modeling assumptions and estimation, interpretation, and policy evaluation.

With this context, there are recommendations for changes to the Handbook in its discussion of hedonic methods. The numbering sequence continues from the format used at the outset

3. *Discuss logic of using hedonic model in KP framework or equivalent*. A revision to the Handbook should add a new section to the hedonic property value analysis that describes how the assumptions, data issues, challenges and models (columns of Table 3) interact with what are sometimes viewed as the stages of an analysis. These are the tasks associated with developing results and interpreting them. These are represented by the rows in Table 3. The table is used here to emphasize how the assumptions used in characterizing a problem affect different stages in the analysis of the problem and interpreting the results that follow from that process.

4. *Consider the tasks as identified in Table 3 for re-organization of discussion*. Reorganize the discussion in sections 5.3.1.1, 5.3.1.2, 5.3.1.6 and Box 5-2 to deal with the issues associated with estimation, interpretation, and use of results in generic terms. In this context the Greenstone and Gallagher and Gamper-Rabindran and Timmins papers provide examples of the issues but would not be profiled as definitive alternatives.

   Giving special attention to them in a boxed insert in the text gives the impression that the Handbook is attempting to refute the Greenstone and Gallagher work with an as yet unpublished study. Instead what are at issue are the assumptions and interpretations and how they affect results. This is clearly the intention of the handbook and reorganization and discuss of tasks would help to make this clear.

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5. *Add most recent findings*. Update the studies being recognized to include several

   important additions to the very issues raised. Some of these are identified in Kuminoff's

   comments. It is especially important that the Handbook reflect:

   a) The new work on selecting a functional form in the context of fixed effects
      (Kuminoff, Parameter, and Pope [2010]);

   b) The Kuminoff and Pope [2010] discussion of interpretation of capitalization
      results;

   c) The examples given by Banzhaf and Brueckner of specific modeling results in
      their comments to help in explaining the issues in using hedonic results.

   The comments on stated preference methods were primarily from Desvousges. Based on

   them another recommended change is suggested for the benefit chapter.

6. *Expand discussion of stated preference methods*. Some recognition of misuse of stated

   preference methods in appraisal literature with examples and cross references to other

   EPA and related documents with more current and extensive discussion of stated

   preference research.

   If there is to be extensive discussion of nonuse values in the Handbook then specific

   attention to how they would be measured with stated preference methods. If not, then the

   appropriate references to other sources and a table with the methods and issues—scope,

   consequentiality and hypothetical bias seems warranted.

Discussion of the Exxon-Valdez CV study seems out of place when there are more current studies and summaries. The Carson et al [2003] study may give the wrong impression. While it was published in 2003, the study was actually completed twenty years ago. It also introduces the potential for confusion between the objectives of a natural resource damage assessment and a benefit cost analysis. Both can involve sites that have hazardous substances. The damage assessment seeks to measure compensation for the loss of services of the natural resources affected by releases of hazardous substances –while the benefit cost analysis is generally associated in this context with rules associated with site cleanup and resuse.

Several reviewers commented on benefits transfer and the special problems it posed for evaluation of policies related to cleanup and reuse.

7. *Include more current discussion of reliability of benefit transfer methods*. Section 5.3.4 should be updated to reflect the extensive review of transfer methods by Kevin Boyle [2010]. There are several papers recently published or forthcoming that should be acknowledged and the committee feels a more continuous recommendation is warranted with indications that there is too limited research for these specific policies to suggest defensible estimates or models for transfer are available. Context effects seem especially important as the discussion of the hedonic results suggests.

8. *Delete Table 5.2.* The reviewers felt Table 5.2 did not contribute to the chapter. With the changes discussed earlier, this table could be deleted.

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F. <u>Chapter 6: Cost Estimation</u>

There were a smaller number of comments on the chapter on cost estimation. Earlier we recommended moving the discussion on stigma (section 6.5.1). Three sets of considerations can be extracted from the committee comments.

First Brueckner's stylized model offers a direct illustration of the difference between partial and general equilibrium. However, this analysis is within the context of benefits, not costs. A further issue that should be considered in a discussion of partial equilibrium (PE) versus general equilibrium (GE) issues is the role of pre-existing distortions. This also affects Bartik's comments on the development of shadow prices for computing the costs of using unemployed resources. He considers both the sources of the funds (i.e. alternative levels of government and the associated excess burdens of their taxes) and the extent to which the activities involved lead to outputs that were "exported" outside the region affected by the project.

A further issue raised by Banzhaf is the comparative assessment of long run and short run effects on cleanup using Figure 6.2. His comments relate to long run analysis and 6.1 relates to short run but his point considering the effects of cleanup on the owners of the land offers an important integrating comment. Capitalization is relevant to residential sites as well as to commercial and industrial locations.

1. *Update the summary statistics*. As noted earlier the data underlying section 6.2.1 could be updated. It seems out of date, since analyses were completed a decade ago.

2. *Expand discussion of short and long run effects.*The analysis associated with Figure 6.2 could be represented with short and long run descriptions and the capitalization point made. This discussion would allow a link to issues raised for residential uses of land and might better motivate the discussion of agglomeration effects.

3. *Re-organize location of discussion of PE and GE effects.* Consider moving all the discussion of partial and general equilibrium effects to a new separate chapter that would use Brueckner's example to initiate the discussion and then comment on the development of shadow prices for unemployed resources and other issues related to GE assessments of policy.

G. Chapter 7: Economic Impact Analysis

As noted in Bartik's comments there are several areas where the discussion in this chapter could be reordered and some discussion and references added. His comments (p. 7-9) are straight forward, specific, and constitute our primary recommendations.

V. **Research Issues**

The length of this report together with the detail and thoughtful nature of the reviewers' comments confirm that the Handbook idea is an exceptional one that should be considered for other areas where EPA must take stock of recent research. Windows on what has been found and how the results are relevant to current policy evaluation methods offer a strategy for keeping analysts up to date while research accumulates to a stage when EPA's guidelines would be updated.

Assembling this summary of the reviews was an exciting process due to the quality of the review team's comments. It would be unfortunate to have the potential synergy of the ideas developed in these comments lost. There are a rich set of ideas for future research in all the comments. When they are combined with the first rate proposals for research in the Handbook,

the result would be ideal for a Research Issues Workshop partnering EPA professional staff with members of the review committee. This could be a way to further promote future research.

This section selects four issues as themes to consider in evaluating areas for future research. More could be identified and the process of developing them from the reviewers' comments could be one of the outputs of a workshop. Each of the themes selected will be discussed briefly and linked to review committee member comments.[10]

A. Defining an Architecture for Evaluating Land Cleanup and Reuse Policy

Last fall, the author and Carol Mansfield developed a workshop on benefit cost analysis for policy staff at DHS. To organize a review of methods for benefit analysis we described the logic EPA staff developed for evaluating rules associated with the criteria air pollutants as framing a "policy architecture." It is a logical framework that consistently links the features of rulemaking to the methods used in the benefit cost analyses of those rules. It is based on linking risk assessment to benefit analysis. Our objective was to recommend the development of such an architecture for DHS policy analysis.

The comments on the Handbook (Banzhaf, Bartik, Brueckner, Desvousges, and Kuminoff) whether reacting to Table 5.1, or expressing concerns about double counting, indicate that the reviewers could not identify a consistent framework or architecture for integrating the results from various benefit and cost methods. This would entail, as Banzhaf suggests, recognizing the potential integrated roles for impact analysis *and* benefit cost. It would describe how agglomeration and job effects "fit in". It is a "tall order" but would help to address the challenges identified in the Handbook and by the review committee.

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[10] The order of presentation does <u>not</u> imply a priority order.

B. Developing an Updated Template for Hedonic Property Value Models

If EPA's professional staff agree with the proposed distinction between estimation, interpretation, and policy uses of hedonic methods it would be useful to develop some candidate examples of how recent research would alter the practices of using hedonic results in specific analysis tasks.

Clearly, this is applied research but we feel it would serve to yield insights for the research and policy communities on the issues important in addressing estimation and interpretation issues with hedonic models used for policy. For example, when an average treatment effect is consistently estimated what does it measure and how can it be applied? This would entail comparing specific hedonic studies with specific policy needs. This proposal relates to comments extracted from Banzhaf, Desvousges, Gayer and Kuminoff's reviews.

C. Partial and General Equilibrium Analysis of Policy

As the comments by Banzhaf, Brueckner, and Kuminoff reveal there is considerable interest and difference of opinion on the importance of GE effects for benefit analyses of individual cleanups. Equally important, the features of the structure defining the equilibrium price function influence how we can interpret the results. As equation (3) above emphasized, the interpretation of ϕ depends on how the change in g affects the importance of any differences in A and B in the two equilibria. While design decisions can seek to control the vector of attributes enter x, ψ (.) is a function of the parameter vectors (A and B) and the different level for g.

Moreover, there would be a distinction in effects for how a national program would have GE effects compared to local impacts of a cleanup on a single market hedonic price function.

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Thus, there is clear scope for research here defining the different ways the nature of the policy impacts the framing of the partial versus general equilibrium analysis.

There is also the potential to integrate the role of agglomeration effects as altering "site attributes". In a local market one might parallel the Nash equilibrium logic used in Walsh [2007] for open space, Timmins and Murdoch [2007] for congestion, and Klaiber and Smith [2010a] for education to consider whether agglomeration effects could be introduced into a stylized model for cleanup and site amenities.

D. Challenges to Equilibrium Assumption of Hedonic Models

The final issue is an indirect consequence of the issues raised in Banzhaf and Bartiks' comments. The hedonic framework relies on an equilibrium in the housing market. The pattern of foreclosure and abandonment in several major housing markets suggests a need to rethink these equilibrium concepts. Research should consider their role in what is revealed by price functions under these circumstances. Both conceptual and empirical analyses are warranted here. Understanding the effects of the "meltdown" in housing markets in some areas may well help in understanding situations with limited transactions near sites with contamination. Studies designed to track how the timing of restoration of housing market conditions responds to local and national conditions could also help to inform models for the effects of site cleanup and land reuse on local markets.

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Appendix A

Reviewer Comments

Comments on
EPA Draft Handbook on the Benefits, Costs, and Impacts of Land Cleanup and Reuse
by
Spencer Banzhaf[†]

I think this is a very useful document and believe it does do a good job describing a conceptual framework and addressing the important literature. Thus, I would answer "yes" and "no" respectively to the first two questions posed as "Issues for Discussion" in the *Background and Questions* memo.

Assessment of Handbook's Practical Advice

I am less certain about Question 7, "Does the handbook provide practical advice?" It seemed to me that while the *Draft Handbook* provides useful discussion for economists and policy analysts, it does not provide as much practical *advice* or "practical suggestions." Putting myself in the shoes of an EPA employee called on to perform a benefitcost analysis of land cleanup, I think I would find more questions than answers in the document. Although the outstanding questions are important and cannot be ignored, my sense is that economists as a profession and EPA as an agency have made enough progress to be more definite on some things.

For example, the most definitive statement I could find about how to measure benefits was buried in §5.3.1.6, where the *Draft Handbook* notes that experts at the NCEELRO workshop reached a consensus that hedonics represented the "best prospect for defensible studies." Does NCEE agree, and if so, shouldn't this be the *Handbook's* advice? And then too, shouldn't it be elevated up to §5.4, as an overarching recommendation about benefits measurement rather than a comment about hedonics? Following that recommendation, a number of detailed recommendations could be made. For example: where practicable, actual housing sales should be used as data; as a rule of thumb, logged sales prices are the best simple functional form; the spatial scale should be capable of picking up effects within 1 mile of hazardous waste sites and perhaps less for brownfields, and so forth.

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<u>Hedonics, Capitalization, Difference-in-differences, and Regression Discontinuity</u>

Turning to more specific content, my largest point relates to the fifth bulleted item under EPA's third "Issue for Discussion." In considering the property-value approach to measuring benefits of cleanup and reuse, an important issue is the distinction between what EPA calls the "hedonic" approach (e.g. Kiel and Zabel 2001) and the "capitalization" approach (e.g. Greenstone and Gallagher 2008 and Gamper-Rabindran and Timmins 2010). This terminology strikes me as conflating two issues.[‡] On the one hand there is the question of the economic interpretation of price differences across houses in time and space. The hedonic model emphasizes that the derivative of the hedonic price equation with respect to an amenity, *understood as a cross-sectional relationship holding at a point in time,* is equal to marginal willingness to pay for the amenity (more on this below). More controversial is the interpretation of the total derivate of hedonic prices over time. A variety of papers addressed this issue in the 1980s, and the consensus is that while such price changes have a simple interpretation is a variety of special cases (marginal policy changes, changes to a small open area), in general the price changes from non-marginal policy effects are not equal to willingness to pay (Scotchmer 1986, Bartik 1985; see also Freeman 2003, Klaiber and Smith 2009).

A second issue is the use of a difference-in-differences methodology to empirically estimate hedonic price equations, rather than relying on a cross section. In this context, another question, which seems to be overlooked in the literature, is the interpretation of the recovered parameters from a difference-in-differences hedonic regression, even in terms of marginal willingness to pay. A related issue is the use of the regression discontinuity (RD) design. Both of these innovations in capitalization/hedonic studies deserve further consideration.

Suppose prices (or alternatively log prices) in location i in period t can be related by the equation:

$$p_{it} = \alpha_t + \beta_t LULU_{it} + \mu_i + \varepsilon_{it},$$

[‡] I find this terminology confusing in other ways as well. Both sets of studies embrace the notion of capitalization, which simply follows Ricardo's logic that locational amenities are priced into real estate values, and the notion of hedonic pricing, which extends that logic to the idea that prices can be econometrically estimated as a function of amenities.

where α_t is a time-specific constant, LULUs are a measure locally undesirable land uses, such as the number of brownfields or the hazard ranking score of a Superfund site, and μ_ii represents a time-invariant effect in community i, which is at least partially unobserved. Suppose there are two time periods: $t \in \{0,1\}$. Then first differencing we have:

$$\Delta p_i = \Delta \alpha + \beta_1 LULU_{i1}\ \beta_0 LULU_{i0} + \Delta \varepsilon_i.$$

Adding and subtracting $\beta_1 LULU_{i0}$, this is equivalent to:

$$\Delta p_i = \Delta \alpha + \beta_1 \Delta LULU_i + \Delta \beta LULU_{i0} + \Delta \varepsilon_i.$$

Two features of this equation are noteworthy. First, note that the unobserved μ cancels out of the differenced equation. Essentially, the use of panel data allows for a fixed effect to control for time-invariant neighborhood attributes. This is the greatest advantage of this approach and one that is typically (and justifiably) highlighted by proponents. When the dependent variable is in logs, the model controls for those unobserved attributes in a way that suggests they have a constant percentage effect over time, which is not unreasonable. But when the dependent variable is in levels and in nominal dollars, the model is controlling for those attributes in a way that suggests they have constant (nominal) dollar-value over time. Even assuming constant relative prices, this may be unrealistic if there is inflation over the period. For example, over the 10year period considered in Greenstone & Gallagher and Gamper-Rabindran & Timmins, 3 percent inflation would imply an increase in the value of the unobserved attribute of about 35 percent. Deflating the dependent variable by the CPI or similar deflator would be appropriate for models in levels.

The second noteworthy feature of this equation is that the effect of LULUs like hazardous waste sites enter it in two terms: $\beta_1 \Delta LULU_i + \Delta \beta LULU_{i0}$. The first term is the effect of the change in LULUs weighted by ex-post marginal values. Crucially, it's these ex-post values that are measured, not ex ante values that one might prefer for a benefit-cost analysis using compensating variations. The second term is the change in marginal values weighted by baseline LULUs. This so-called Oaxaca-decomposition is common in the labor literature, but environmental economists routinely ignore the second term in hedonic valuation contexts. Essentially, they are assuming that β_t is constant for all t, so $\Delta \beta$ is zero.

There are a host (no pun intended) of reasons why $\Delta\beta$ might not be zero. After all, these are implicit prices—prices for hedonic commodities. Even the prices of traded commodities, where inter-temporal arbitrage is possible, change from day-to-day let alone from year to year. In this case, "large changes" in the supply of the amenity, caused by the policy to be evaluated itself, can affect the hedonic function. Even in the case of the so-called "localized externality," with policies inducing small, local changes, implicit prices could still over long time periods, like a decade. For one thing, over ten years preferences for spatial amenities like LULUs might well change. Then too, even if tastes were constant, changes in real per-capita income, changes in population, changes in the prices of substitutes or complements for producing household services, changes in the productive value of land in the area, and so forth could all change β over time. And finally, even if relative prices were constant, pure inflation would change β over time unless, again, the model is in logs or real dollars.

Ultimately, the economic logic of the hedonic model is that at a point in time, households choose those houses—those bundles of attributes—that they most prefer given their relative prices. With a continuum of choices, equilibrium at that point in time requires that the *differences across space* in LULUs are associated with price changes that are equal to households' marginal willingness to pay. But inter-temporal arbitrage is not possible, so there is no equilibrating force to make *differences across time* in LULUs, in isolation, have any clear interpretation, at least not as some time-independent marginal (let alone non-marginal) willingness to pay. The hedonic model is inherently cross-sectional. [§]   The equation above shows that the recovered coefficient on ΔLULU does have an interpretation as the ex-post willingness to pay, when $LULU_{i0}$ is used as a control variable.

When $\Delta\beta$ is mistakenly assumed to be zero, the estimate of β will be biased because of a form of omitted variable bias—after all, $\Delta\beta LULU_{i0}$ is omitted from the estimated model. Using the standard formula, the bias in β would be:

Bias in $\beta_1 = \Delta\beta *$ COV/ $VAR_{\Delta LULU}$,

where COV is the covariance between baseline pollution (the omitted variable) and the change in pollution (the included variable) and $VAR_{\Delta LULU}$ is the variance in the change in pollution.

[§] This issue arises in the discussion surrounding Figure 53 in the *Handbook*, which notes how changes in supply conditions (perhaps because of the reuse of contaminated land) can affect local real estate prices.

In applications to cleanup and reuse of hazards, COV is likely to be negative, because clean sites cannot be cleaned further, while dirty sites are likely to be cleaned up the most. That is, there are likely to be high negative values for $\Delta LULU$ where $LULU_0$ is high, and values of $\Delta LULU$ near zero where $LULU_0$ is near zero. Consequently, the bias will be in the opposite direction of the sign of $\Delta\beta$. Moreover, if $\Delta\beta$ is large relative to β_1 or if the COV is large relative to the VAR, the effect could be quite substantial.

Consider the following example. Let $LULU_0 \sim u(0,1)$ and let $LULU_1 \sim 0.5*u* LULU_0$ where u is also drawn from another, independent uniform distribution. That is, pollution is cleaned up 50% to 100%, with the percentage cleanup uniformly distributed on this support. In this case, it is possible to use the laws of expectations to compute analytically $VAR_{\Delta LULU} = 0.0538$ and COV=1/16. The ratio of these two terms is about 1.16. Thus, in expectation the omitted variable bias is about $\Delta\beta*1.16$.

This bias can be confirmed in simulations. For example, consider a situation where LULUs are distributed as above and

$p_{i0} = 10 \; LULU_{i0} + e_{it}$

$p_{i1} = 11 \; 3*LULU_{i1} + e_{it}$

$\Delta p_i = 1 \; 3*\Delta LULU_i \; 2*LULU_0 + \Delta e_i.$

In this case, β is increasing over time, perhaps because of income effects or greater concern about the environment. The results from a simulation with 100,000 observations are given in the following table, with confidence intervals in parentheses. β is 1 in the first period and 3 in the second period, so $\Delta\beta$ is 2. Model 1, which omits $\Delta\beta$ estimates only 0.7 for β, nowhere near β_1 and 30% below even β_0. Model 2, which includes the term, correctly estimates β_1 to be about 3. (I will return to Model 3 below.)

Parameter	Model 1: D-in-D	Model 2: Corrected	Model 3: Restricted Sample
ΔLULU	0.67526 (0.68084, 0.66969)	3.00031 (3.00135, 2.99926)	2.58967 (2.60161, 2.57773)
$LULU_0$		2.00053 (2.00137, -1.99968)	
Constant	.87119 (0.86873, 0.87366)	1.00014 (0.99997, 1.000327)	.48107 (0.48906, 0.47308)

Now suppose instead: $p_{i0} = 10$ $LULU_{i0} + e_{it}$

$p_{i1} = 11$ $0.2*LULU_{i1} + e_{it}$ $\Delta p_i = 1$ $0.2*\Delta LULU_i + 0.8* LULU_0 + \Delta e_i$. In this case, β is falling over time, perhaps because as more and more LULUs are cleaned up over time, we move down the market demand curve for "absence of LULUs," so that the marginal household now living near a LULU has a lower WTP for avoiding one. The results of the simulation this time are given as follows.

Variable	Model 1: DinD	Model 2: Corrected	Model 3: Restricted Sample
ΔLULU	1.12988 (1.13213, 1.12762)	0.20112 (0.20217, 0.20006)	0.36423 (0.36917, 0.35930)
$LULU_0$		0.79913 (0.79828, 0.79998)	
Constant	1.05158 (1.05058, 1.05257)	1.00007 (0.99989, 1.00024)	1.59234 (1.58904, 1.59564)

This time the bias is in the other direction. Marginal values are estimated to be 1.1 instead of the true ex-post value of -0.2.

It goes without saying that these are just illustrative examples, but they demonstrate the importance of the issue. Moreover, the application of this principle is not limited to hedonic price effects. As the Draft *Handbook* emphasizes, other outcomes may also be of interest in EIAs. For example, the environmental justice literature frequently considers equations like those above, but with demographic outcomes rather than prices as the dependent variable (see §7.2.2.3 of the *Handbook*). In this context, Banzhaf and Walsh (2010) consider a general-equilibrium model in which land prices and demographics are determined endogenously, while households sort on those outcomes as well as amenities, like say LULUs. They then consider an exogenous cleanup of those LULUs. In both the ex ante and ex post cross sections, reduced form equations fitted to the equilibria in the model show that minorities live nearer LULUs. That is, β_t is positive in both time periods. But the uncorrected difference-in-difference equation gives an estimate of β that is *negative*.

The importance of the RD now comes into play. In general, the regression discontinuity insures that variables that vary continuously in the neighborhood of the discontinuity will be approximately equal for both the treatment and the control observations, so that they cancel out. This has the virtue of controlling for unobservables. But a particular example is the omitted variable $LULU_0$, a problem which was created by the mis-specified difference-in-differences regression in the first place. As the sample becomes restricted to a narrower value of $LULU_0$, it becomes a way to control for that omitted variable. In the limit, as the sample becomes restricted to an epsilon-ball around the discontinuity, $COV/VAR_{\Delta LULU}$ tends to zero and, hence, so does the bias in β_1. The third column in the above tables illustrates this by restricting the sample to those observations i for which $LULU_{i0}>0.75$. Using this restricted sample improves the estimates, though they remain imperfect. In most applications, controlling for $LULU_0$ will still be appropriate.

"Imperfect Information" and Effects of Listing

I cannot help but feel there is a subtle bias in the *Handbook* to the effect that all evidence of the positive effect of Superfund cleanup speaks to the benefits of the program while all evidence of the negative effects are to be explained away.

Consider for example one of the features distinguishing the Gamper-Rabindran & Timmins hedonic study from the Greenstone & Gallagher study. While Greenstone & Gallagher combine the effects of listing and delisting from the NPL, Gamper-Rabindran & Timmins distinguish between them, finding (in most specifications) first a negative price effect from listing and then a positive effect of delisting. The distinction is a very important improvement when it comes to understanding human behavior and markets.

The distinction is more ambiguous when it comes to benefits. GamperRabindran & Timmins and the *Handbook's* discussion of the issue at least implicitly, and sometimes explicitly, assume that only the latter effect "counts." The former effect is to be understood as the impact of revealing true information about the site and so a cost to be attributed to the earlier industrial activity rather than to the Superfund program per se. In §4.1.2, the *Handbook* refers to this situation as "imperfect" or "asymmetric" information. I am puzzled by what the asymmetry is. Presumably, the asymmetry that EPA has in mind is that they have better information about the contamination than local residents and that the listing of the site makes the information public.

That is one possible interpretation of course. But there is another interpretation, that people are perfectly aware of the health risks and that listing the site imposes costs on the community, by stopping the redevelopment that would have occurred but for Superfund. This would have a direct effect on the specific property evaluated and a spillover effect on nearby properties. As the *Handbook* notes, avoiding such effects was part of the motivation of the 2002 brownfields law.

In §6.5.1, the Handbook returns to this issue and does explicitly label it a "cost." This section seems to contradict, at least in spirit, much of §4.1.2. Until better evidence is available, a compromise might be to perform EIAs under both interpretations and allow them to serve as bounds on the welfare effects of the program.

General equilibrium price effects

The Handbook notes at several points that, in general equilibrium, cleanup and reuse might affect other neighborhoods indirectly. This raises at least four issues.

- §5.1.5 notes that reuse of contaminated land can improve its productivity and change the supply of housing units (or other real estate) in the neighborhood. Explicit in this discussion is the fact that if the supply effects are big enough, it will affect land prices. Implicit is the fact that this can distort the interpretation of capitalization as pure amenity effects. This relates back to the discussion above: land prices can change for numerous reasons, not just because of the effect of the improved amenity through demand.

- §5.1.5.2 notes the possibility of agglomeration effects nearby. One important implication of this is the effect on nearby land prices, with a ceteris paribus increase in prices because of the agglomeration effect. If a hedonic study limits its set of "control" neighborhoods to those nearby, those controls will actually be treated through this indirect effect. This will bias the identified direct effect downward.
- Another possibility though is that demand for other nearby neighborhoods falls if they serve as close substitutes. In this case, these control neighborhoods will again be indirectly affected, but in the opposite way. A hedonic study that limits its set of control neighborhoods to these will overstate the direct effect of the cleanup and reuse. Either way, there is a catch22 here. Similar communities are better controls because they can be expected to have similar values of unobserved attributes and because linear functions controlling for observables will be more accurate. But they are worse controls because they are more likely to be affected by the program.
- The *Background and Questions* memo highlights the importance of the "nature of the local economy" (bullet 2, Question 3). A bit more could be done here. On p. 80, the *Handbook* notes Vigdor's (2008) point about the slackness of the housing market. This affects more than demographic composition (the context in which the *Handbook* raises the issue). It also affects prices. If there is a large vacancy rate in a community, increases in demand may show up in lower vacancy rates rather than prices. Hedonics are much more complicated in cases of disequilibria or dynamic equilibria with search costs and equity constraints.

More minor points

I have a number of smaller points that I will list as bulleted items.
- The *Handbook* seems to emphasize the EIA is something completely different from BCA (e.g., the introduction to §3). This may be EPA's standard uses of the terms, but I do not think it is universal. I rather think of BCA as a subset of EIA, one which attempts to get effects in benefit-cost analyses, from "multi-objective benefit-cost analysis," which refuses to reduce effects to a single scalar-valued function, to benefit-cost analysis with distributional weights, which does precisely that. See e.g. Banzhaf (2009, 2010a) for more discussion.
- In §5.3.1, the *Handbook* claims "hedonic models only capture health benefits when market participants are well-informed about the health risks posed by proximity to contaminated sites." That is one point of view, but it is not the only one and not one around which there is a clear consensus. This viewpoint proceeds from a radically utilitarian perspective in which the analyst can make a judgment about what is good for individuals independent of their own choices. Another perspective, rooted in consumer sovereignty, limits welfare analysis to values revealed in actual choices. For a recent

example of this perspective, see Sugden (2009); for historical discussion, see Banzhaf (2010b).

- More could be said about the importance of spatial scale in §3.3.2. For example, for economic impacts such as local development and jobs, shrinking the scale at which impacts are assessed has two effects. On the one hand, it becomes more likely that dollars spent on the project are net inflows, diverted from areas outside the region rather than from competing uses within the region. On the other hand, it also shrinks the multipliers as it's more likely that each successive round of spending leaves the region.

- There are some problems with Figure 6¬2. It purports to show a long-run competitive equilibrium, but yet there are economic profits. Furthermore, the local cost increase does not affect the market as a whole, so if prices are brought down to ATC then the shift up to ATC' for this firm would force it to exit the industry. The problem can be resolved when we recognize that the cost envisioned does not really affect the opportunity costs for this productive activity at all, since it affects all uses of the land. This means that the costs of the cleanup fall on the owners of land rather than this activity. Whether the firm owns the land or not is irrelevant. From the standpoint of the firm, the cost of the cleanup is offset by the lower implicit cost of holding the land.

- At the end of §5.3.1, the third limitation of the hedonic approach is that it only suitable for retrospective analysis. That's true for a new study, but previous hedonic studies canat net benefits in dollar units. Moreover, there is a long history of including distributional be used as a basis for "benefits transfer" for prospective analysis. (Although benefit-transfer studies often use integrated assessment or damage-cost methods to identify health effects and then transfer monetary values of health effects, as described in §5.3.4, this is not the only approach.)

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Date: November 19, 2010

To: Kerry Smith and EPA

From: Tim Bartik

Re: Comments on "EPA Draft Handbook on the Benefits, Costs, and Impacts of Land Cleanup and Reuse", with a particular focus on employment impacts and regional economic impacts.

This memo begins with my overall comments on how I would advise approaching the issue of employment and other regional economic impacts. This was written after reading the entire report. This is then followed by some "real time" commentary on specific sections of the report. I wrote this commentary as I read the report. Some of this "real time" commentary is repeated in the overall comments.

Comments on jobs impact and economic impact

1. First, I want to consider how you would ideally approach this issue. There is the issue first of how we would measure the jobs impacts and economic impacts for both the local economy that contains the site that is being cleaned up, and the effects of cleaning up this site on the employment and output of all other local economies. Then there is the separate issue of what social value we would attach to those impacts in various areas.

2. In considering jobs impacts and economic impacts in the area with the site, the issue of whether the jobs directly impacted are export-base jobs (in regional economics jargon) is absolutely crucial, and needs to be highlighted much more in the report. I would give some examples in the report of how this makes an enormous difference. A clean-up that leads to a new manufacturing plant or a new corporate headquarters will have a quite different effect from one that leads to new residential housing or a new strip mall. There is some economic impact from increasing non-export-base jobs, but the effects on overall local jobs and output will be far less.

3. There also are the jobs impacts and economics impacts from the temporary jobs associated with the clean-up. Again, what these impacts on the local economy are depend enormously on how the clean-up is financed, as discussed below.

4. All these effects can be calculated best with the REMI model. Input-output models are an inferior substitute and will overstate total effects of shocks to export-base employment because these models overlook the increase in local wages and prices. EPA would provide a useful service to analysts by providing some rules-of-thumb for how the relatively cheap input-output estimates of impact could be scaled back for shocks to export-base companies. Alternatively, REMI would tend to increase the impacts of increases in non-export base companies, again because it allows for lower prices and wages due to shocks to the non-export-base to boost overall local output. EPA may be able to provide some rules of thumb here. Alternatively, EPA might want to provide some rules of thumb from directly using the REMI model in various sample areas.

5. Another crucial issue is the magnitude of agglomeration economy effects. Actually, REMI has some estimates here, but I'm not sure how good they are. We don't know a great deal about marginal agglomeration economy effects by industry and how they vary with local economic characteristics. In principle, this could be quite important in determining the net employment and output effect by location. (As I will discuss later, adding additional activity in an industry in an area where that marginal increase in economic activity has very large agglomeration economy effects could yield national efficiency benefits, as these effects will outweigh any losses of output elsewhere. Here I am just dealing with the fact that agglomeration economy effects, if they exist, will tend to yield different employment and output effects by location than if such agglomeration effects do not exist.)

6. The report does not deal at all with the issue of the jobs and economic impact from how the clean-up is financed. As I understand it, these clean-ups are funded in part by the corporations responsible or their successors, in part by EPA, and in part by state and local governments. All these sources of financing may have different impact on employment and output elsewhere in the country. So, the effects on the corporations responsible would be similar to a tax on capital, and that effect on output and employment in the rest of the nation needs to be deduced from that literature. State and local government can be assumed to be tax financed, and that impact can be calculated from a literature on how state and local taxes have both demand-side and supply-side effects on local economy. EPA may be tax financed or deficit financed. I think it would be useful for EPA to provide some general formulas for the employment and jobs impact elsewhere of these different sources for financing the project. Furthermore, these employment and jobs impacts elsewhere might vary with whether the national economy is in a recession. For example, a deficit-financed EPA clean-up will have different impacts when the economy is in recession than when we are at full employment, due to crowding out in financial markets. I can imagine that corporate clean-ups will also have different effects depending upon whether corporations are sitting on piles of cash or not.

7. Potentially there is also a negative economic impact elsewhere of the increase in employment and economic impact in the local economy with the site that is being cleaned up. In other words, even if the clean-up is financed by Martians, there could be some spillovers on the national economy. Some ideal general equilibrium model might estimate how the increase in effective land supply leads to some new price vector and some new national output level. In the absence of such a model, it might be assumed that in the absence of financing effects, the Federal Reserve and macroeconomic authorities accommodate the supply-side increases in output in the local economy receiving the clean-up, as it represents an increase in the productive capacity of the economy. Then these spillovers can be ignored, which is convenient.

8. So, we now have a vector of employment and output effects by industry for the local economy j with the site that is cleaned-up, and similar vectors for all other local

economies in the U.S. The question is what social value to attach to these vectors. From a national perspective, the issue is whether these social values "net out" when summed over the nation.

9. From a local and national perspective, there are five types of impact that might be considered:

    (9.1) The increase in employment rates here, and reductions elsewhere, will yield net social benefits here, and net social costs elsewhere, if the wage rate paid exceeds the opportunity cost of labor. If opportunity costs of labor differ across local areas due to higher unemployment in some areas rather than others, then it is possible for any redistribution of economic activity to yield net social benefits.

    (9.2) The shock to local economic activity here, and reductions elsewhere, may result in some workers acquiring human capital experience that leads to higher productivity and wages in local economy j, and the reverse in other regions . Again, whether this nets out to zero nationally or could be positive nationally probably depends upon some national circumstances that cause employment shocks to have different impacts by local economy. So, for example, if local economy j where the clean-up site is located has much more long-term unemployment, and we assume that giving a job to a long-term unemployed person has more human capital implications than someone in some other area with lower unemployment losing a job, then there may be some productivity gains even if jobs are simply shuffled around across areas.

    (9.3) The increased labor demand here, and reduced labor demand elsewhere, will tend to cause pure wage changes. From an efficiency point of view these are pecuniary effects both in local economy j, and in all other local economies. But they are part of "economic impact analysis" even if not part of an efficiency analysis.

    (9.4) The increased labor demand and output in local economy j, and reduced labor demand and output elsewhere, may have some positive agglomeration economy effects on productivity in location j and negative agglomeration economy effects elsewhere. If marginal agglomeration economy effects differ across locations, this may net to positive (or negative) national effects.

    (9.5) The increased labor demand and output in local economy j, and reduced labor demand and output elsewhere, may have some positive fiscal effects in local economy j, and negative fiscal effects elsewhere, due to differences between tax revenues collected and required public service costs to accommodate growth. If marginal fiscal effects differ across locations (for example, if local economy j has unused capacity in infrastructure), then these fiscal effects may not net to zero when summed across the nation.

    Effects 9.1, 9.2, 9.4, and 9.5 are all cases where prices are not optimal, and the vectors of employment and output changes in different locations cause changes in economic "rents" in different locations that may not sum to zero over all locations.

10. For effects of type 9.1, we really have little reliable information on how reservation wages or other measures of opportunity cost vary with local unemployment rates. One

study finds that each 1 point rise in the local unemployment rate reduces reservation wages by 1.2 to 1.6 percent (Jones 1989). Another study finds no effects of local unemployment rates on reservation wages (Haurin and Sridhar 2003). Several studies find that longer unemployment duration reduces reservation wages (Fishe 1982; Kasper 1969; Kiefer and Neumann 1979; Stephenson 1976). Higher local unemployment rates would increase unemployment duration. This suggests that higher local unemployment rates should reduce reservation wages. However, I think it is hard to translate these results into specific estimates. (With one exception, all these references to the reservation wage literature, which seems to have mostly died out, can be found in my 1991 book, *Who Benefits from State and Local Economic Development Policies?* The Haurin and Sridhar 2003 reference is in *Applied Economics* 35 (13): 1469-1476))

Therefore, perhaps the EPA needs to provide standards for this. Perhaps we assume an opportunity cost equal to the wage rate for any local economy that is at 5% unemployment or below. For economies above that rate, we consider alternative scenarios for the reservation wage, ranging from zero to 90% of the wage rate. If local economy j has unemployment at least 1% point above the national unemployment rate, we consider scenarios where the local economy's opportunity cost of labor is from 10% to 90% of the wage rate less than the national opportunity cost of labor.

In addition, there is the problem that not all local jobs created will in fact create jobs for the unemployed or the non-employed. From my 1991 book, which was followed up on in 1993 (**"Who Benefits from Local Job Growth: Migrants or the Original Residents?"***Regional Studies* 27(4) (September 1993): 297-311), about 3 of every 10 new jobs in the short-run go to the local unemployed, and another 3 or so go to local residents who otherwise be out of the labor force. The unemployment rate effects fade completely after 5 or 6 years, while the labor force participation rate effects are still at around 2 extra labor force participants after 20 years. We don't know much about the reservation wages of the otherwise unemployed vs. the otherwise "out of the labor force". One would think that the latter is higher, but I know of no hard evidence on this. In any event, these types of estimates need to be done to translate differences in local employment rates into resulting differences in local unemployment rates and local labor force participation rates. And we need to consider whether the new labor force participants are treated as having similar reservation wages to the unemployed, or are treated as if their reservation wage is equal to the market wage rate.

11. For effects of type 9.2, we have reasonable evidence of long-run effects on occupational attainment of local labor demand shocks. But we have no good evidence on how these effects vary across location. Absent any evidence, we might assume the same effects of a local labor demand shock everywhere. Therefore, if the net employment effects nationally of this site clean-up are zero, there is no net national effect. But net employment effects nationally may not be zero, for example they are unlikely to be so during a recession if the clean-up is financed either by EPA and deficit financing or by corporate entities. In addition, for economic impact analyses, we would need to know the magnitude of these effects. At various places, I have estimated that these increases in wages due to long-run effects on occupational attainment of a labor demand shock to be

0.13% for a 1% local growth shock, or about $6,000 per job created. See **"Solving the Problems of Economic Development Incentives."** *Growth and Change* 36(2) (Spring 2005): 139-166 [Reprinted in *Reining in the Competition for Capital*, edited by Ann Markusen, Kalamazoo, Mich: W.E. Upjohn Institute for Employment Research, 2007, pp. 103-140]

12. I personally don't think there are large pure wage effects of local labor demand shocks, as employers seem to accommodate these shocks by changing hiring standards. But others differ on this. Short-run wage effects can be derived by calculating effects of local demand shocks on unemployment, and then using the wage curve estimates of Blanchflower and Oswald's book, *The Wage Curve.*

13. For agglomeration economy effects, in my opinion by far the best evidence is in the paper referred to in the report, by Greenstone, Hornbeck, and Moretti. It is the best evidence because it is closest to a good "quasi-experiment", as opposed to most of the studies of agglomeration that rely on cross-sectional regressions or panel data regressions. I would use that study to try to measure productivity effects of shocks to employment and output.

    However, I don't think there is any good evidence on how marginal agglomeration effects differ across local economies. So if the vector of direct employment and output effects sums to zero nationally, then I know of no reliable basis for saying that agglomeration economies and diseconomies wouldn't also sum to zero. So the only reason for agglomeration economy effects to be non-zero would be if the initially estimated direct effects on output don't sum to zero nationally.

14. The fiscal benefits will tend to be positive in the local economy where the site is cleaned up, and negative elsewhere. Whether they net to zero depends most crucially on whether the local economy containing the clean-up site tends to have excess capacity in infrastructure compared to the average local economy. State tax effects of growth shocks are measured for each state in the following study: Bruce, Donald, William F. Fox, and M.H. Tuttle. 2006. "Tax-Based Elasticities: A Multi-State Analysis of Long-Run and Short-Run Dynamics." *Southern Economic Journal* 73(2): 315–341. For an example of how such a paper can be used to generate estimates of fiscal benefits, see The Employment and Fiscal Effects of Michigan's MEGA Tax Credit Program, Timothy J. Bartik and George A. Erickcek, 2010, Upjohn Institute working paper No. 10-164.

    Any analysis that counts fiscal benefits must be careful not to doublecount this with the infrastructure savings benefits component of greenfield preservation noted in section 5.1.5.4. of the report.

    EPA might want to try to provide some cookbook formulas for calculating fiscal benefits, based on whether the local economy has excess capacity in infrastructure or high local unemployment. Net national benefits might only be calculated if there is some reason to think that the local economy in which the clean-up is taking place has above-average unemployment or above-average excess infrastructure.

Detailed comments on selected sections of EPA document, made as I read the document.

Section 3.3.1.

p. 18: "…this labor imposes a cost to society equal to the value of the output the workers would have produced in their highest-valued alternative employment – in other words the opportunity cost of labor".

I think this is a bit confusing. The opportunity cost of labor that is used by some project is equal to the value of how that labor time would have been alternatively used, which may be in market employment, may be in non-market employment, or may be in leisure. The way in which that labor time would have been used in that counter-factual may not be the highest-valued alternative usage because the worker may not be free to choose that highest value alternative usage. If we're assuming labor markets don't clear, we can't assume that the worker is always able to choose his or her highest value alternative use of his or her time.

p. 19: "we take care to note that the value of an unemployed individual's time could be greater than zero as he or she may be engaged in productive activities outside of the market such as child care, home maintenance, or volunteering." Or indeed, even if their time is spent in pure leisure, it is likely to have some positive value.

p. 19: "Analysts should carefully consider the proportion of hired workers who were previously unemployed."

What analysts should carefully consider is how the vector of employment effects of the project affects employment of the unemployed, and other non-employed, at this site and elsewhere. This may be affected by whether the project hires the unemployed, but is not identical to it. For example, suppose that all hired workers were previously employed locally. Then the project creates local vacancies in other employers. Suppose that 50% of those vacancies were filled by the unemployed. Then the project's hiring reduces local unemployment by 50% of the employment involved, even though none of the project hires were unemployed. Who the project hires may be an indicator of the project impact on the unemployed, but it can also be seriously misleading. I think project analysts would be better off using models of local employment impact. I prefer net impact measures of the type that I have estimated, for example in my 1991 book, *Who Benefits from State and Local Economic Development Policies?* (By net impact, I mean models that relate the local unemployment rate and local labor force participation rates to the local area's employment growth.) I think we have some pretty good estimates here, with wide agreement on short-run impacts of local labor demand shocks. Alternatively, there have been some attempts at more structural models of local job chains, for example the book by

Persky, Felsenstein and Carlson, *Does "Trickle Down" Work? Economic Development Strategies and Job Chains in Local Labor Markets*. This uses occupational transition matrices to estimate how a jobs shock to a given wage level of job will be translated into effects throughout the local labor market. However, such models are less developed.

p. 20: "Only jobs that, on balance, put structurally unemployed labor or other resources into productive work are relevant."

The balance is important, in terms of what happens elsewhere. But it is not "structural unemployment" necessarily, but any unemployment in which it is reasonable to think that the wage rate exceeds the opportunity cost of the labor. This arguably includes cyclical unemployment as well as structural, and may include high local unemployment which might or might not be considered structural.

pp. 33-34 on hedonic property value stuff (a digression from unemployment and economic impacts, but an interest of mine)

I think the figure on page 34 is potentially confusing. Some may think that the reduction in property values due to declining land prices at non-contaminated property, due to the shock increasing effective land supply, should be counted. As an indicator of efficiency benefits, it should not be counted. The change in non-contaminated land prices due to the change in overall land supply is a pecuniary externality, which matters from a distributional perspective but not from an efficiency perspective.

p. 35, section 5.1.5.2 on Agglomeration economies: The project results in some change in vector xj of business activity by industry in local economy j. There are also effects in a variety of other local economies, with a vector of changes in industrial activity xi in other local economies i. Just as the employment benefits in location j have to be evaluated from an efficiency perspective net of the foregone employment benefits in alternative locations j, the same is true of agglomeration economies. Of course, since we don't have good econometric measures of marginal agglomeration economy benefits and how they vary with industry and with the characteristics of the local economy, all of this probably goes into the category of potentially important benefits that we don't know how to measure.

Section 6: I was very surprised that section 6 did not have any subsection that reminded readers that any labor costs really should be measured as the opportunity cost of labor, as pointed out earlier in the manuscript.

Section 7.1.1. p. 76. "…redevelopment can have indirect and induced effects….Indirect effects are changes in employment and output off-site as a result of increased business activity

stemming from reuse. Induced effects are changes in jobs and output resulting from increased consumer spending attributable to the reuse."

I think this needs more elaboration.

How about:

"Either temporary direct jobs and output or permanent redevelopment direct jobs and output may have local multiplier effects that might be considered as part of economic impact analysis, or as part of a regional benefit-cost analysis, or, after accounting for offsetting effects at other locations, as part of a national benefit-cost analysis. Local multiplier effects are most likely to occur if the direct jobs created are "export-base" jobs, that is generated by dollars from outside the local economy. If the jobs created are not export-base jobs because they are paid for locally such as through sales to local residents, then any direct jobs created at the site will displace other local jobs by displacing sales. In contrast, export-base jobs will generate some other local jobs at suppliers to these export-base industries, and from the increased consumer demand from workers in both the direct local export-base jobs and the suppliers. The exact quantity of these employment and output effects depend upon both input-output relationships, and on general equilibrium changes in local wages and prices. From a national perspective, any net efficiency implications of these local employment effects, in terms of a differential between wages and the opportunity cost of labor, must be calculated net of the effects on other local economies."

p. 77, section 7.1.2. "Business Openings and Output". Again, I think it is appropriate to note that from a national benefit-cost perspective, what is important is whether the marginal agglomeration economies at this location j are greater than the marginal agglomeration economies that are foregone in other locations i. Conveniently, since we don't have good measures of any of this, we can just put this in category of "unmeasured".

pp. 77-78. Taxes and Government Impacts. Again, from a benefit-cost perspective at the national level, the question is whether the amount by which marginal fiscal benefits exceed marginal fiscal costs at location j exceeds the same gap measured at other locations. This is likely to depend upon unused or underutilized infrastructure at location j versus the typical alternative location. I think the paper might usefully cite for tax effects the following paper: Bruce, Donald, William F. Fox, and M.H. Tuttle. 2006. "Tax-Based Elasticities: A Multi-State Analysis of Long-Run and Short-Run Dynamics." *Southern Economic Journal* 73(2): 315–341. For an example of how such a paper can be used to generate estimates of fiscal benefits, see The Employment and Fiscal Effects of Michigan's MEGA Tax Credit Program, Timothy J. Bartik and George A. Erickcek, 2010, Upjohn Institute working paper No. 10-164.

p. 82, section 7.2.1.1. Economic base theory needs to be presented much earlier on, as it is absolutely crucial in terms of whether the jobs created directly at the site will in fact raise total local employment.

pp. 85 and 86. Input-output models and REMI. REMI is preferable to input-output because it allows for the local price and wage changes. But REMI is far more expensive. I think users should know this. In practice, REMI estimates will moderate the input-output effects of a direct labor demand shock, as the REMI models allow for local housing price and wage effects to moderate the direct input-output effects. EPA could provide a useful service for analysts by getting some folks with REMI models to compare the REMI impact estimates with IMPLAN impact estimates. This would allow analysts to use the much cheaper IMPLAN estimates, and then scale them back by some percentage to allow for likely local wage and price effects.

Review of EPA Draft Handbook on the Benefits, Costs and Impacts of Land Cleanup and Reuse

J.K. Brueckner

The *Handbook* is well done on the whole, covering the relevant topics and properly summarizing the state of the literature. I have a few minor suggestions for improvement, but the main point I want to make possibly falls under the topic of further research. The point concerns the general-equilibrium effects of cleanup, which are acknowledged in Figure 1 and the surrounding discussion. The question left unaddressed by this discussion is how the partial-equilibrium benefit measure compares to the general-equilibrium measure. A simple calculation gives some insight into this question, as explained below. But first, let me offer a few comments on other issues:

1.   A major shortcoming of the hedonic method as a way of computing cleanup benefits involves the information problem. If residents surrounding a site fully understand the health impairment caused by exposure, then the hedonic method can be used to measure cleanup benefits. But if health costs are not well understood by the public, then the hedonic approach will give an inappropriate answer. If, as is likely, the public doesn't understand the full extent of health costs, then the decline in property values understates these costs, and the benefits of cleanup are thus understated. By contrast, public impressions could be too pessimistic, so that property values fall near polluted sites by more than is justified by health costs. Then the hedonic approach will overstate the benefits of cleanup. The *Handbook* does not perhaps say enough about these issues, and the discussion that is already present seems to appear a bit too late. I think that additional exploration of these issues would be worthwhile.

2.   A related point is that the hedonic estimates of cleanup benefits cannot be added to those coming out of an epidemiological approach. Such an addition involves double counting, given that the hedonic impacts are already capturing health benefits. The *Handbook* recognizes this notion, but on p. 41, I wrote "double counting" in the margin since at that point, it looked like this mistake would be committed. More foreshadowing of awareness of this issue would be helpful.

3.   The *Handbook's* emphasis on the point that employment effects are not necessarily a benefit is useful, and it would be probably seem novel to someone not used to the economist's way of thinking. The discussion of economic impact analysis in section 7 is presented properly given this perspective, being billed as way of enumerating the effects of cleanup that does not purport to measure welfare. Despite this virtue, section 7 is perhaps the least useful part of the *Handbook*. I found it to be somewhat vague and unspecific, not really providing much beyond a list of possible economic impacts. I'm not sure how to improve the section, but as it stands, the material doesn't seem to give much specific guidance on the best way to perform an economic impact analysis of a site cleanup. Maybe some concrete examples could be added to give more help to a practitioner.

Let me now turn to the subject of partial versus general-equilibrium benefit measures. Hedonic price analysis is the source of the partial-equilibrium measure, which relies on the city's existing land-rent patterns. The hedonic approach takes the general level of rents in the city as given while predicting land-rent gains at and around the site, gains that constitute the partial-equilibrium benefit measure. But, as acknowledgedinFigure1, since site cleanup raises the supply of land, it may *reduce the level of land rents throughout the city* while at the same time affecting rents near the site. If it occurs, this land-rent reduction falls under the heading of a general-equilibrium effect. Two questions then arise: when will such an effect occur, and how does it change the benefit calculation from a cleanup?

If the site cleanup happens in a single city within a system of cities among which frictionless migration can occur, then the partial and general-equilibrium effects of cleanup are the same. In particular, the general level of land rents in the cleanup city is unaffected, with rents changing only at the polluted site and in its vicinity, where they rise to a normal level for those locations. In urban economics, this setting involves what is called an "open city," whose consumers can freely relocate and who enjoy whatever utility level prevails in the rest of the economy. Since the open city is small relative to that economy, whatever happens in it has no effect on the economy's prevailing utility level. In this case, when a site cleanup occurs, additional residents move in to the cleanup area, which can now be developed for residential use. Since the cleanup occurs in a single city, it has no effect on the utility level of consumers in the economy, so that there is no consumer benefit from it. However, landowners benefit from the cleanup-induced change in rents. Rents at the site rise to the normal level, and rents around the site, which were previously depressed, rise as well(as shown in the Figure 5-2 of the *Handbook*). With consumer utilities fixed, the benefits of cleanup thus accrue entirely to landowners in the form of higher rental income.

An alternative model, the closed-city model, generates a different answer. This model captures two different possible cases. The first case is that of a city closed to migration, where the population cannot move, and where a site cleanup occurs within the city. The second, more realistic case, is one where consumers can move between cities, but where site cleanups occur in parallel fashion *in all of the economy's urban areas*. Since cleanups will affect each city similarly, no consumers end up moving in response to their occurrence, and the population of each city can be treated as fixed(even though relocation is possible in principle).

The closed-city model can be used in both cases, and its key implication is that, by making more land available for residential use, a site cleanup will lower the level of land rents in the city, which will raise the level of consumer utility. With this additional change, the computation of the proper benefit measure becomes more complicated than in the previous case. To see how, it is useful to explore a simple mathematical setup.

Suppose the city is a rectangle1unit wide with the employment center at one end. Imagine also that consumers each consume one unit of land(in effect consuming slices of the rectangle). Suppose the polluted site occupies the entire width of the city, starting at a distance of x_0 from the center and extending out to a distance of $x_0 + \delta$, giving it a length of δ. Suppose for the moment that there is no externality around the site, so that land rents are not depressed in its vicinity(this effect will be introduced below). Suppose, though, that the site is unusable without a cleanup, generating land rent of zero, as in Figure5-2 of the *Handbook*.

Consumers pay land rent of r and consume e worth of a nonland good. Letting y denote their income and t denote commuting cost per mile to the employment center, the budget constraint for

a consumer living x miles from the center is $e + r = y - tx$ (recall that land consumption equals one unit). Land rent as a function of e is then $r = y - tx - e$. Letting N denote the city's population, the distance to the edge of the city is $N + \delta$. The city then contains N units of residential land, subtracting off the δ units at the site, and thus fits N people. Suppose for simplicity that agricultural land rent is zero. Then, urban land rent must fall to zero at the edge of the city, which means $y - t(N + \delta) - e = 0$. This condition then gives the equilibrium level of non-land consumption, equal to $e = y - t(N + \delta)$. Substituting e back into the r function $(y - tx - e)$ and simplifying, land rent is then

$$r = t(N + \delta - x), \tag{1}$$

a decreasing function of distance x to the employment center.

The partial-equilibrium measure of cleanup benefits would ignore the change in the level of land rents when cleanup occurs. The benefit would just be the increase in land rents over the site area (starting from a level of zero), based on the existing land-rent function. Using (2), the partial-equilibrium benefit measure is then

$$B^{pe} = \int_{x_0}^{x_0 + \delta} r \, dx = t\delta(N - x_0) + t\delta^2/2. \tag{2}$$

When the cleanup occurs, the site area is now available for development, so that the distance to the edge of the city shrinks by δ, falling from $N + \delta$ to N. Thus, the land-rent function from (1) becomes $r = t(N - x)$. Comparison with (1) shows that land rent is lower at each value of x than before the cleanup, declining by $t\delta$.

To use this fact in computing the general-equilibrium benefits, the proper welfare measure must be used. This measure takes account of both consumers and the land rent flowing to landowners, and it equals the total nonland consumption of the city's residents plus the total land rent earned by landlords. Letting R denote total land rent, this welfare measure is equal to $W = Ne + R$.

To compute W, total and rent is thus needed, and it is given by

$$R = \int_{0}^{x^0} r \, dx + \int_{x_0 + \delta}^{N + \delta} r \, dx, \tag{3}$$

Which is the integral of land rent over the city(with the site contributing zero). Note that rent in the post-cleanup city is gotten by setting $\delta = 0$, with r adjusted appropriately using (1).

Evaluating (3) and adding it to Ne yields

$$W = N_e + R = N_y + \frac{t(x_0 + \delta)^2 - x_2^0}{2} - \frac{t(N + \delta)^2}{2} \tag{4}$$

The benefit of site cleanup is the change in welfare in going from $\delta > 0$, where the site creates a gap in the middle of the city, to $\delta = 0$, where the site is developed and the gap eliminated. Therefore, the general-equilibrium benefit measure is given by

$$B^{ge} = W_{\delta=0} - W_{\delta>0}. \tag{5}$$

Evaluating (4) with $\delta = 0$ and then subtracting off (4) with $\delta > 0$, (5) reduces to $B^{ge} = t\delta (N - x0)$. It can be shown that this B^{ge} expression equals the reduction in aggregate commuting cost following the cleanup, which puts the urban residents closer on average to the employment center. Using this result along with (2),

$$B^{pe} = t\delta (N - x_0) + \frac{t\delta^2}{2} > t\delta(N - x_0) = B^{ge} \tag{6}$$

Given (6), the partial-equilibrium benefit measure overstates the cleanup benefits achieved in general equilibrium, with the amount of overstatement equal to $t\delta^2/2$. Use of the partial-equilibrium benefit measure could then cause some socially undesirable cleanups to be undertaken (clean ups for which the benefit-cost calculation yields a positive value based on the partial-equilibrium measure but where the correct value is negative).

The presence of externalities around the site has no effect on this conclusion, as can be seen via the following argument. If the externality exists and depresses land rent by an amount μ within a distance λ on each side of the site, then the partial-equilibrium benefit measure includes he elimination of this land-rent discount, adding a term $2\mu\lambda to$ (2) (the discount times the length of the two externality zones). Note that, when it is present, the land-rent discount exactly offsets the consumer welfare loss from living near the site, raising the consumption level e to compensate for the loss. With cleanup, the loss disappears but land-rent rises as well, negating the beneficial e gain and leaving consumer welfare unchanged.

With an externality, the general-equilibrium benefit measure increases by this same $2\mu\lambda$ amount. The easiest way to see this conclusion is to decompose the general-equilibrium land-rent change over the externality zones in to two components: the partial-equilibrium change plus the difference between the general and partial-equilibrium changes. The partial-equilibrium land-rent change over these zones is just the gain of $2\mu\lambda$. But this change puts land rents at the pre-cleanup level that would have obtained had there been no externality. However, the general-equilibrium adjustment from this starting point has already been analyzed, yielding the B^{ge} expression in (6). Therefore, with an externality, the term $2\mu\lambda$ is simply added to this benefit expression. Since the same term is added to the B^{pe} expression on the left-hand side of(6),the general-equilibrium benefit measure exceeds the partial-equilibrium measure by the same amount as before, namely, $t\delta^2/2$.

Note finally that if $\delta =0$, so that the site occupies a negligible land area, then $t\delta^2/2$ equals zero and $B^{ge} = B^{pe}$, so that the partial and general-equilibrium measures are equivalent. The reason is that cleanup of the site has a negligible effect on the amount of land available for residential use, so that no downward shift in the land-rent function occurs.

Summarizing, the main conclusions from this analysis are as follows:

Partial vs. General-Equilibrium Evaluation of Cleanup Benefits. Regardless of the spatial extent of the externality around the polluted site, the partial-equilibrium benefit measure overstates the general-equilibrium benefit realized from cleanup by the amount $t\delta^2/2$, where δ measures the size of the site. While this overstatement may lead to the approval of some socially undesirable cleanup efforts, the overstatement is close to zero for sites occupying a

negligible land area, where δ is very small.

These conclusions are tied to the structure of the simple model used to gene rate them, particularly the assumptions that consumer land consumption is fixed and that the externality from the site affects consumer welfare in an additive fashion. While the conclusions are likely to be fairly robust, an analysis using a more general consumer utility function would be needed to verify this conjecture. Such analysis could be subject of further research.

A final point concerns site cleanup and greenfield development. In order for development at the site rather than at greenfield locations to lead to the additional gain discussed in the *Handbook*, rent for nonurban land (assumed to be zero) must give a false signal of its social value. Accordingly, suppose that open space yields a social value of $\theta > 0$ per unit of land. Then, the shrinkage of the city by the amount δ following clean up generates $\theta\delta$ worth of open-space benefits. In other words, development of the site limits urban spatial expansion that is already inefficient for other reasons (i.e., the failure to consider open-space benefits) and thus creates additional gains. This effect, however, is not captured in the partial-equilibrium benefit measure, and it would tend to reverse the previous conclusion that $B^{ge} < B^{pe}$. But since the measurement of generalized open-space benefits is problematic, their inclusion in a cleanup benefit measure may not be practical.

December 21, 2010

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Dear Kerry:

I have completed my review of the "EPA Draft Handbook on the Benefits, Costs, and Impacts of Land Cleanup and Reuse." To organize my comments, I have divided them into two sections: Major Comments and Specific Comments. In the major comments, I discuss my concerns about the treatment in the draft handbook of several important topics. In the specific comments, I provide my reactions to more minor issues, such as word usage, sentence clarity, and the like.

Overall, I think this draft handbook offers a thoughtful treatment of the important issues in measuring the benefits of land cleanup and reuse. It is well-written for the target audience that it defines. I do have some suggestions for making it better, and those suggestions are offered in the following comments. I have written my comments based on my experience in working in the area of stigma damages, property valuation studies, and in writing handbooks on various benefits measurement topics over the years. I hope you and the Environmental Protection Agency (EPA) find my comments helpful.

General Comments

These four comments are intended to pose broader questions for EPA to consider in revising the Draft Handbook.

The Role of Stigma

Based on my review, I think the treatment of the concept of stigma is inadequate. The current view of stigma presented in the handbook is that stigma is a cost of the Superfund program because it draws negative attention to a site and results in lower property values. I think the handbook requires a more thorough examination of the literature on stigma, starting with the early articles by Paul Slovic, in which he explores the notion of stigma (Slovic 1987; Slovic, et al. 1991; Gregory, Flynn, and Slovic 1995; Kunreuther and Slovic 2001). I have included some references that may be helpful. The critical question from a benefit cost standpoint is what is stigma and how it attaches to a particular site.

My intuition about stigma is that it is a condition that results in perceived risks that are greater than the technically measured risks associated with the site. If this is indeed the case, then from a benefit-cost standpoint, I think you would be interested in measuring the reductions in both perceived and

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technical risks because it will be the combined risks that are likely to drive ultimate behavior in the market place. Then, the relevant question to ask is how the stigma attaches to a site.   If stigma attaches to a site because of the potential risks associated with the site, then the listing as part of Superfund may or may not increase the level of stigma. My intuition is that it could likely reduce stigma because it would indicate that the site will be addressed, or at a minimum, would not make it worse.   In this situation, stigma should not be viewed as a cost of the program.   In fact, to the extent that the program eventually reduces stigma, then it is a benefit.

My experience is that many of the sites that eventually are listed on the National Priorities List are well known before the listing occurs. There is often a lot of publicity about the site from a variety of sources: local media, environmental/neighborhood organizations, and members of the legal community that might benefit from more controversy about a site. Even sites that are being cleaned up under some other program, such as the Underground Storage Tank (UST), are probably known to some populations, even if those populations are likely to be much more localized in nature. Only in situations where the Superfund program listing draws attention to a heretofore unknown site, and then stigma attaches as a result of the listing, would the program have imposed a cost on society.   Even in these situations, I am unsure about viewing the program as having imposed costs.   It has potentially increased perceived risks associated with the site, but it does not change the level of technical risk that would be found at the site.   The listing itself also serves as another source of information to residents and potential buyers who may be in the market place.

I think viewing stigma damages as a cost of the Superfund program is a misconception of the role of stigma.   The handbook contains a fair amount of discussion from the relevant economic literature on the timing of potential benefits over the "lifecycle" of a site. I think stigma is more properly included within the context of that larger question of the knowledge that people have about a site, the level of perceived risks, and how those two factors change over the course of the regulatory process. I am not at all convinced that we still know very much about that larger question.

The Treatment of Stated Preference Methods

I strongly recommend EPA consider revising and expanding its treatment of stated preference as an approach to measure the benefits of land re-use. Currently, the handbook devotes two pages to stated preference methods compared to nine pages on the hedonic method. Given that hedonic type methods are more likely to be used in benefits analysis, this allocation makes a certain amount of sense.   However, I am particularly concerned about the misuse of stated preference methods.   All one has to do is look at the Appraisal Journal to see that quite a few appraisers/economists are using stated preference methods to value reductions caused by property contamination.   Many of the practitioners who publish in this journal are less familiar with the broader resource economic literature on the use of stated preference methods. If EPA were to review four or five of the stated preference studies that have appeared in the Appraisal Journal, it would share my concerns that more guidance is needed on the misuse of stated preference methods.

Additionally, I am concerned that the treatment of stated preference methods needs to be parallel to the revealed preference methods.   If one is to understand the role of perceived risks, the formation of stigma, and the way people make decisions in markets, then similar consideration should be given to the application of stated preference methods.   Moreover, one might consider that property market

valuation might offer another situation for the application of jointly estimated stated preference/revealed preference models to better understand how people make decisions in the market place and how to model those decisions.   I am suggesting a reemphasis as to what information should be provided and the types of issues that could be discussed in the stated preference section, not a re-prioritization of stated preference methods relative to revealed preference approaches.   I think revealed preference methods are the preferred approach but more consideration needs to be given to potential misuses of stated preference methods and ways to use the approach more intelligently.

I also recommend that some consideration be given to the nature of nonuse benefits that might be measured using stated preference methods.   Frankly, I am not sure what is meant by nonuse benefits in the context of property markets.   Are these benefits that are associated with the existence of natural resources?   If so, then how does the Land Reuse Program influence these?   If the majority of sites are industrial sites, then I am not sure how likely nonuse benefits are likely to be relevant.   If we are considering that there are off-site influences on other natural resources that may have existence values, then some consideration needs to be given as to how often this might occur and how relevant they might be to the program as a whole.   My general perception after reading this treatment is that someone has indicated that stated preference methods can measure more than just use benefits.   I do not think anyone would disagree with this notion.   However, I am not convinced by the current treatment as to how relevant and how important such a consideration might be.   If the handbook is be useful to practitioners, then some further thought needs to be given to this topic. This thought should also reflect that the measurement of nonuse benefits is likely to much more controversial than use benefits.

Finally, I recommend that a discussion of hypothetical bias be added to the stated preference section. Currently, there is no mention of this important concern in the application of stated preference methods.   There is a large literature that is available on this topic.

The Benefits Taxonomy

The handbook attempts to provide a taxonomy of the benefits of land cleanup and reuse and the potential valuation methods that might apply.   The current version is contained in Table 5-1.   I find this table to be very confusing. The current version includes aesthetic improvement under the broader classification of human health benefits. I don't understand this placement.   Perhaps it is merely a matter of poor formatting that causes this positioning.   If not, then some explanation is needed.

Additionally, I find the inclusion of hiking, fishing, and boating as an ecological benefit to be very confusing.   These are human use services from natural resources, not ecological.   I think it would be much more straightforward to have human health, human use, ecological, materials damages, and land productivity as the major benefit categories. In that sense, aesthetics would be a component of human use, which is more consistent with the drinking water improvement example.   I find it helpful to think of aesthetics as an attribute of a specific product or service, not a separate category.

I also think some consideration needs to be given as to how likely some of these categories of benefits might really be.   For example, I think it is highly unlikely that commercial fishing benefits would ever be a significant benefit of the land cleanup and reuse program, given the dominance of imported fish and shellfish in influencing prices and quantities.

Table 5-2 provides criteria for benefit assessment studies.   I think these criteria need considerably more thought.   For example, external validity is usually viewed as comparison to other approaches or some type of norm, not whether the results can be generalized over time or space.   I also think that theoretical validity can be expressed best as to whether the results vary with parameters that theory suggests should matter and do not vary with parameters that should not matter. This notion was expressed by the SAB in their criteria for evaluating stated preference studies for valuing ecosystem services (EPA 2009). Internal validity also seems to me to be more of a question of sensitivity to sample composition, functional form, heterogeneity of preferences, and other measures that one would associate with a careful empirical analysis.

Additionally, it is unclear whether the benefits of cleanup and reuse should be counted if a potentially responsible party (PRP) funds the cleanup.   In that instance, the PRP would incur the costs to clean up the site.   The only costs to the government would be the oversight and related administrative costs. However, in most instances, the primary reason the PRP cleans up the site is regulatory/liability requirements imposed by the government, and that imposition may be enough to count the benefits. If one continues to do so, then it would certainly be necessary to include all the costs borne by the private parties in calculating any net benefits.   For sites where the government funds the cleanup, then there is no question about counting all the benefits and that the only direct costs would be borne by the government.

It also will be important for each site to clarify any relationships that may exist between the Superfund program and any natural resource damage regime.   I am not suggesting that the handbook try to include a lot of material on natural resource damages. I am simply suggesting that a recommendation be made that one should consider whether there is some relationship to natural resource damage matters that may be relevant to measuring benefits at a particular site.

Finally, I am concerned that some connections that are discussed between the program and potential changes in environmental quality are very tenuous.   I think it will be very difficult to ever link changes in reuse of land to changes in air quality, given the importance of other sources of emissions, such as plants or automobiles.   I think it is even less likely that any reduction in greenhouse gases could ever be measured given the local nature of the program effects and the global nature of such benefits.   While I think the handbook at times offers frank appraisals of such uncertain benefits, it is not always consistent. I think a thorough review of the various statements that are offered should be conducted.

The Extensive Reliance on an Unpublished Study

I am concerned that the handbook gives considerable weight to the Gamper-Rabindran and Timmons (2010) unpublished study.   The study appears to be well-designed and executed, but since it is unpublished, it is hard to fully judge. Given that the draft handbook relies heavily on the published literature throughout the remainder of the volume, the extensive reliance on this unpublished manuscript appears out-ofplace.

Specific Comments

This section offers page by page comments on a range of specific topics.

- I found the Federal Cleanup Program descriptions to be very helpful and informative. I like the extensive use of links to other programs. That is a very effective way to manage the length of the handbook.

- I found the discussion of jobs and economic benefits to be very well considered and well-written.

- Page 22: I would substitute "plagued" or "hindered" for "dogged."

- Page 23: I am really unsure about the use of market transactions as a potential benefit category. I think that transactions volume can be influenced by many factors. What matters to a benefits analysis is the price at which properties sell. I think that timing would be very difficult to conceptualize as a separate category of benefits. Transaction rates are a metric, but they are no substitute for prices indices.

- Page 24: I recommend a footnote to the analysis by Randall Bell of long-term property values in the Love Canal area. He finds that substantial recovery has occurred and that only the site itself has been lost to reuse.

- Page 30: The first sentence under ecological benefits is not consistent with the earlier discussion of the nature of habitats that are likely impacted by Superfund sites. Most of these are industrial sites as was pointed out earlier in the handbook. Now, they are described as "defiling pristine habitats." I think that is highly unlikely and this language should be made consistent with the earlier language.

- Should you consider moving the conceptual discussion to an appendix? If not, I think it would be helpful to be better develop the implications of these graphs. I realize that the handbook refers to them later in the text, but some discussion upfront as to why this is important may encourage the reader to consider it more carefully.

- Page 34: There is a discussion that liability concerns may make potential buyers more reluctant to take on contaminated properties. I am not sure what the rationale is for this discussion as it might relate to potential program benefits. Is the cleanup and reuse program going to clarify or reduce those concerns? If so, then how? And how would they be measured?

- Page 35: I think the summary on agglomeration benefits is an honest one and consistent with current knowledge.

- Page 36: Same is true for peer group effects.

- Page 36-37: I am less sold on the benefits of Greenfield Preservation. I think some discussion is needed of the baseline conditions from which benefits would be measured. I also think there needs to be some discussion of the likelihood of development and how it would be measured and how this relates to overall market conditions. Finally, I find the connection between miles traveled and greenhouse gases and air emissions to be tenuous. This discussion seems honest in terms of its assessment of the state of knowledge and the types of data that would be required.

- Page 40: Am I the only one that finds it just a little disconcerting that one site accounted for 90 percent of the averted cancer cases in the sample of sites in the Hamilton and Viscusi analysis? Wouldn't that suggest further scrutiny as to the nature of that site and what it would imply more generally for the program as a whole?

- Page 44: "delve" vs. "explore"

- Page 46: Footnote 34 raises some significant issues that might be better addressed within the handbook text.

- Page 48: The discussion on panel data studies on the relationship between prices and distances would be better supported with some references. Also, the discussion of micro sales data would benefit from some examples.

- Page 49: "lackadaisical" vs. "inconsistent".

- Page 50: Wouldn't data on a control group also be needed to determine the effect of an entire cleanup project?

- Page 51: What's the welfare effect from changes in transaction rates? Don't lower transaction rates simply defer the timing of eventual sales? I don't think this is a significant issue.

- Page 54: Is the only SP study worth including one that was conducted in Italy?

- Page 55: The discussion of stated preference limitations is superficial.

- Page 55: Don't production cost measures require that the least cost alternative be chosen?

- Page 57: The citation to the Carson, et al. study of the Exxon Valdez provides only one side's perspective as to the potential damages. Some note would seem appropriate.

- Page 71: I suggest that the authors give careful consideration as to the technical merits of the various studies authored by Simons as to the nature of the empirical results and the quality of the underlying data.

- Page 72: I suggest the handbook authors read the EPA SAB's report on valuing ecosystem services to see the limited role that concepts such as net environmental benefits analysis and habitat equivalency analysis should play in any valuation of ecosystem services. The SAB expresses considerable caution about the use of such methods.

- Appendices: I found these to be relatively insubstantial in comparison to the thoughtful discussion contained in the handbook itself. I was expecting something much more thorough and rigorous in the review of the literature and the significant theoretical and empirical issues. I did not find that they added much to the overall discussion.

I hope these comments are helpful.   Please do not hesitate to ask me to clarify any points that may be unclear.   I also welcome the chance to contribute to your overall assessment of the handbook as you feel appropriate and useful.

Thank you for the opportunity to participate in the review process.   I think the ultimate handbook would be a useful tool for benefits assessment practitioners.

Sincerely,

William   H.   Desvousges,
Ph.D. President

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Privileged and Confidential

Comments on
EPA Draft Handbook on the Benefits, Costs, and Impacts of Land Cleanup and Reuse
Ted Gayer

I was asked to focus my comments on the material on quasi-experimental research methods, which appears primarily in section 5.3. I have tried to incorporate the list of "issues for discussion" provided to me within my write-up below.

I have three general comments concerning the write-up on quasi-experiments. The first is that the text should convey that the quasi-experimental approach is not distinct from other empirical studies (such as the cross-sectional or panel data hedonic studies referred to in the *Handbook*.) Rather, what the experimental and quasi-experimental literature demonstrates is the vital importance of assessing the exogeneity of the variable of interest in *any* empirical study. For any given empirical study, if there is no credible evidence that can be provided to demonstrate the exogeneity of the variable of interest, then the results should be viewed with a great deal of skepticism. Any specific experimental or quasi-experimental study may suffer from poor data or from limited ability to generalize, but the key issue remains: an empirical study that ignores the source of variation is apt to suffer from omitted variable bias and is thus of limited usefulness. The traditional approach of addressing omitted variable bias with control variables (rather than demonstrating through the research design the exogeneity of the variable of interest) has been convincingly shown to be sub-standard.

The second, and related, point is that any empirical study can and should provide diagnostics demonstrating the likelihood of exogenous variation of the variable of interest. Rather than draw a sharp line between traditional empirical studies such as the typical cross-sectional or panel data hedonic and a quasi-experimental study (e.g., a regression discontinuity study), the point should be that any of these studies can and should provide evidence of whether the variable of interest is

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exogenous. This can be a simple comparison of means and distributions of covariates for the treated (toxic exposure) versus control (no toxic exposure), or it can mean comparisons at discontinuities, or it can mean providing evidence of instrument strength and a qualitative discussion of instrument exogeneity within an IV approach. The point is that this information will allow the interested reader (and policymaker) the ability to assess the strength of the validity of the empirical findings, rather than just treat all empirical findings – no matter of the research design employed – as equally credible evidence.

The third point is that the write-up seems too focused on the *results* of the Greenstone and Gallagher paper (and on attempting to refute these results by citing the Gamper-Rabindran and Timmins working paper), rather than the more pertinent issue of Greenstone and Gallagher, which is that attention must be paid in any empirical study of land cleanup to assuring a credible research design. The discussion within the *Handbook* of the other empirical hedonic papers does not show the same eagerness to assess the validity of findings and to promote the findings of some studies over others, so the write-up with respect to Greenstone and Gallagher suggests confirmation bias from EPA, in which findings of small or no economic benefits of cleanup are subject to higher scrutiny. This runs against the spirit of the *Handbook*, which otherwise seems directed toward laying out the various issues and uncertainties in the literature, rather than promoting specific findings.

I now offer some specific comments:

- At the bottom of page 43, the authors might want to emphasize that hedonic property models typically rely on estimating the distance gradient. Among other things, this makes it difficult

to translate the benefits of partial clean-ups of a site. This leaves the time-series (rather than the cross-sectional) variation as the main source of valuing partial cleanups.

- On page 44, I wouldn't say that "omitted variable bias and simultaneity" are "contentious issues." I think everyone agrees that correlation of the variable of interest with the error term leads to bias. There may be some contention between those who think that the standard approach of adding control variables is enough to address this issue and those who think this approach is lacking. I think the empirical literature (especially in labor economics) strongly supports the position of the latter. Either way, everyone should agree that any empirical study must provide credible evidence (as I discussed above) of the extent to which the variable of interest is exogenous. There is also some contention on the tradeoff between internal and external validity. The experimental and quasi-experimental literature puts acute attention on providing internally valid empirical estimates, but this focus can mean limited applications to other times, places, or policies. I sympathize with people who lean either way along this tradeoff. Indeed, I think the *Handbook* should mention that experiments and quasi-experiments are important in that they focus on the issue of providing unbiased estimates, but that they may be limited in their applicability (i.e., exogenous variation is not always easy to find using observational data).

- On page 44, the line "When these types of confounding factors are not controlled for …" suggests that the authors think the answer to omitted variable bias is to add controls.   But as I mentioned above, the empirical literature has demonstrated that this approach frequently fails to address the problem, as unobservable and unmeasurable correlates of the variable of interest persist.

- On page 44, the line "Fixed effects, difference-in-difference, and other approaches that use data that vary over time and space …" seems to suggest that these are considered quasi-

experimental approaches. This is not true. A quasi-experimental approach is one that replicates an experiment, meaning the variable of interest is exogenous (uncorrelated with the unobservables). Fixed effects and difference-in-difference models are not necessarily quasi-experimental. This same comment applies to the write-up of the instrumental variable approach on page 45.

- The write-ups for the fixed effects and difference-in-difference approach, the instrumental variable approach, the regression discontinuity approach, and the matching approach, should all emphasize the importance of exogeneity and should discuss the identifying assumptions of each. For example, the identifying assumption of the difference-in-difference approach for a hedonic study is that there must be no unobservable determinants of prices that vary by time across near and far houses. For the instrumental variable approach, the identifying assumptions are that the instrument is strongly correlated with the variable of interest and that it is not correlated with unobservable determinants. In other words, the *Handbook* should not give the impression that it's enough to do a difference-in-difference or instrumental variable (or any other) approach; rather, the importance of these approaches lies in their ability to isolate exogenous variation.

- On page 45, the write-up on Gamper-Rabindran and Timmins does not give enough information on which to assess the study. The authors should describe their research design in more detail. Also, to say that it has "a number of benefits over the regression discontinuity approach" seems incorrect for two reasons: 1) they, too, use a regression discontinuity approach, and 2) there are infinite possible regression discontinuity research studies, so one study cannot be used to dismiss all these potential studies.

- The first full paragraph on page 46 seems a little odd. It seems to say that quasi-experimental studies tend to focus on non-marginal changes and the results therefore need to be

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interpreted cautiously. I think this is a broader criticism of hedonics. That is, the policy question of interest typically is the benefits of non-marginal changes in contamination level, and empirical hedonic models of all varieties yield marginal willingness to pay estimates. It is the case that given the focus on discrete variation, quasi-experiments will tend to focus on infra-marginal changes in prices. But other hedonic studies also have difficulty capturing the willingness to pay for non-marginal changes.

- The last paragraph on page 46 misses the point of experimental and quasi-experimental studies. For example, the first line says "the credibility of the estimates depends on the ability of the analyst to identify valid control and treatment groups." This is a criticism of ANY empirical study. If the variable of interest is not exogenous (which is a better way of saying that the analyst hasn't identified "valid the control and treatment groups"), then the results will likely be biased. This is true for a traditional hedonic cross-sectional or panel data analysis. The point of the quasi-experimental literature is that any empirical study must pay attention to this issue and provide evidence that it is met. Similarly, the last line of this paragraph says "While quasi-experimental approaches offer the possibility to overcome tough statistical challenges, their application alone is not sufficient to guarantee unbiased estimates." Again, this is true of any empirical study and suggests a lack of understanding of the main point of the experimental and quasi-experimental literature.

- Let me re-state my previous point. I see the issue as follows: Omitted variable bias is a problem that leads to non-credible results. Most empirical studies largely ignore this problem, or they use methods (such as adding control variables) that have been shown to be ineffective. Quasi-experimental studies pay attention to this problem by employing research designs that isolate exogenous variation in the variable of interest. They also then provide evidence in support of this condition so the reader can assess the strength of the validity of

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the findings. It seems odd to then criticize these attempts as "depending on the ability to identify valid control and treatment groups" and "not sufficient to guarantee unbiased estimates," when these apply more so to other traditional empirical studies.

- My third general comment above summarizes my concerns with Box 5-2. This box seems way too defensive about the Greenstone and Gallagher paper, especially given that the tone of the rest of the *Handbook* suggests an interest in giving an overview of methods. I also don't understand the criticism that Greenstone and Gallagher "failed to control for unobserved time-invariant neighborhood characteristics." Their study did look at changes in prices, so time-invariant effects should drop out. Also, for a regression discontinuity study, time variant effects are only a problem if they change differentially on each side close to the cut-off, which shouldn't be the case here.

- The second paragraph on page 48 would be better described in terms of the tradeoff I mentioned earlier. Local, refined data are better than more aggregate data, but the question is typically one of sacrificing internal validity. One cannot make a blanket statement that implies any study using disaggregated data is better than any study using aggregate data, irrespective of research design.

- At the bottom of page 48, I would change "that land contamination lowers property values" to "a positive relationship between distance from contamination and property values."

- I think the first paragraph on page 52 should better reflect my first two general comments at the top. This paragraph also seems to define a quasi-experimental study as one that is equivalent to the Greenstone and Gallagher regression discontinuity paper. It would be better if this paragraph said that any empirical study must pay attention to demonstrating exogenous variation of the variable of interest, that this can be accomplished with a

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regression discontinuity set-up or other approaches, and that the strength of the findings for any empirical study are contingent on the evidence presented on the exogeneity.

- This one is outside my charge to examine the quasi-experimental write-up, but I think this sentence on page 20 should be re-written: "Alternatively, analysts might consider wages as benefits if their analysis focuses on a local or regional scale but an entity outside the region of analysis, such as the federal government, funds the new positions." In this case, the wages still entail a cost (unless there is structural unemployment). It's true that the locality isn't bearing the cost, but this doesn't seem relevant. Any policy entails distributional issues, so it seems odd to tally benefits that accrue because someone else is paying for it.

EPA Draft Handbook:
Evaluating the Benefits, Costs, and Impacts of Land Cleanup and Reuse

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PART I: SUMMARY

This draft handbook provides methodological background for analysts tasked with evaluating the benefits, costs, and impacts of land cleanup and reuse. Methods for retrospective evaluations and prospective evaluations are both covered. While the handbook provides some conceptual background, the emphasis is on describing the commonly used empirical implementation strategies and data requirements. Readers are expected to be familiar with the basics of hedonic theory and estimation, contingent valuation, choice experiments, and economic impact analysis. The chapters describing empirical methods typically contain one or more recommendations for how to proceed with future evaluations and suggest topics for future research.

I have several suggestions for improving the handbook. Perhaps most importantly, the current draft overlooks a recent literature that has clarified the tradeoffs associated with using the new quasi-experimental models of amenity capitalization (e.g. Greenstone and Gallagher 2008) instead of the conventional hedonic models (e.g. Kiel and Williams 2007). The findings from this literature have several implications for the discussion of property value models in chapter 5.

In the remainder of this document, I respond to the charge questions and provide additional comments on specific aspects of the study. Please contact me with any questions. I would be glad to elaborate on any of my comments.

PART II: RESPONSES TO CHARGE QUESTIONS

1. *Has the Handbook adequately described the conceptual framework, empirical implementation strategies, and data requirements for the key methods—revealed preference, stated preference, cost estimation, and economic impacts? Have important differences across the methods and their implications for interpreting results been discussed?*

<u>Response</u>

The set of methods covered in the handbook seems appropriate. The description of conceptual modeling, empirical implementation strategies, and data requirements is not intended to be comprehensive. It focuses on issues raised in recent research. This design seems adequate for readers who know the basic methods but need to be briefed on which modeling issues matter the most for evaluating the benefits and costs of land cleanup and reuse. I think it would be useful to explain this strategy to readers in the introduction. I would also make two further suggestions:

- For each of the key methods covered, it would be useful to provide a reference or two to external documents that provide background on the underlying conceptual framework and a more comprehensive discussion of empirical modeling issues and data requirements. For example, in the case of property value models, I would suggest Palmquist's (2005) chapter in the handbook of environmental economics and the review of hedonic and equilibrium sorting models by Kuminoff, Smith, and Timmins (2010).

  Palmquist, Raymond B. 2005. "Property Value Models," in *Handbook of Environmental Economics, Volume 2*. Karl-Göran Mäler and Jeffery Vincent eds. Amsterdam: North Holland Press.

  Kuminoff, Nicolai V., V. Kerry Smith, and Christopher Timmins. 2010. "The New Economics of Equilibrium Sorting and Its Transformational Role for Policy Evaluation." *NBER Working Paper # 16349*.

- The space devoted to empirical modeling issues differs quite a bit from method to method. This reflects the recent empirical literature which has focused on property value models, with less attention given to stated preference methods. However, given their potential for prospective evaluations, it might be worth anticipating some of the unique empirical modeling issues that might arise with stated preference methods in the context of land cleanup and reuse. Of course one would want to consider anchoring and the bias-variance tradeoff associated with the choice between single-bounded and multi-bounded studies. But are there further issues that might be unique to hazardous waste cleanup? For example, it seems like one would have to be very careful in explaining the cleanup plan and its probable time-path to completion.

Finally, in response to the second part of the charge question, I do think there are some important conceptual differences in the methods and their implications for how we interpret results that

have not been discussed. Since these issues relate to the difference between retrospective analysis and prospective analysis, I will postpone my comments until question 3 below.

2. *Are there important omissions from the literature, recent and otherwise, that have been overlooked?*

Response

Yes. A set of recent papers has clarified the tradeoffs associated with using the new quasi-experimental models of amenity capitalization (e.g. Greenstone and Gallagher 2008) instead of the conventional hedonic models (e.g. Kiel and Williams 2007). The current draft of the handbook cites the 2006 NCEE workshop summarized by Smith (2007a) and Smith's (2007b) *Reflections* article as the latest work on this topic. Both documents motivated subsequent research that has been summarized in several papers that are recently published, forthcoming, or currently under review[1]:

Abbott, Joshua H. and H. Allen Klaiber. 2010. "An Embarrassment of Riches: Confronting Omitted Variable Bias and Multi-Scale Capitalization in Hedonic Price Models." Forthcoming in *Review of Economics and Statistics.*

Klaiber, H. Allen, and V. Kerry Smith. 2009. "Evaluating Rubin's Causal Model for Measuring the Capitalization of Environmental Amenities". *NBER Working Paper 14957*.

Kuminoff, Nicolai V., and Abdul S. Jarrah. 2010. "A New Approach to Computing Hedonic Equilibria and Investigating the Properties of Locational Sorting Models." *Journal of Urban Economics* 67(3): 322-335.

Kuminoff, Nicolai V., Christopher F. Parmeter, and Jaren C. Pope. 2010. "Which Hedonic Models Can We Trust to Recover the Marginal Willingness to Pay for Environmental Amenities?" *Journal of Environmental Economics and Management* 60(3): 145-160.

Kuminoff, Nicolai V. and Jaren C. Pope. 2010. "Hedonic Equilibria, Land Value Capitalization, and the Willingness to Pay for Public Goods." *Arizona State University Working Paper,* *http://www.public.asu.edu/~nkuminof/KP10.pdf.*

The consensus from this research is that quasi-experimental capitalization studies do not measure willingness-to-pay. They measure the rate of change in property values that is associated with the change in an amenity. This "capitalization effect" will not equal *average willingness to pay* or *marginal willingness to pay* or *total willingness to pay*, unless consumer preferences satisfy some strong assumptions (discussed below).

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[1] These papers are in addition to the study by Gamper-Rabindran and Timmins (2010) that is already described in considerable detail in the handbook.

The key issue is time. Recall that the conventional hedonic model based on Rosen (1974) describes market equilibrium at a single point in time. Preferences, income, technology, and the levels of endogenous amenities are all fixed. This static description of equilibrium is what allows us to invoke the properties of Rosen's model to translate the hedonic price function into measures of willingness-to-pay in a conventional hedonic model. In contrast, the quasi-experimental capitalization studies track how changes in amenities are capitalized into property values over long periods of time. Greenstone and Gallagher (2008) track changes over a 20-year period, for example.

In order to guarantee that we can interpret the capitalization effect measured from a quasi-experimental study as a measure of willingness-to-pay, we must first add three new assumptions about the producers and consumers in Rosen's model:

i. Distributions of preferences, income, and technology in the "treatment" and "control" populations are constant over the duration of the study period.

ii. Preferences and technology are defined such that the gradient of the price function is fixed over the duration of the study period.

iii. The marginal willingness to pay for the amenity does not depend on the level of the amenity.

These assumptions are strong. For example, they imply that the demand curve for the amenity is perfectly elastic over the range of the quality change (e.g. cleanup of an NPL site). If the three assumptions do not hold, then we can expect there to be a wedge between quasi-experimental estimates for capitalization effects and the true willingness to pay.[2] It is difficult to predict the direction of the bias. Capitalization effects may lie above or below the relevant welfare measure. Kuminoff and Pope (2010) derive these results analytically and provide empirical evidence on the size of the difference between capitalization and willingness to pay for public school quality in five major metro areas: Los Angeles, Philadelphia, Portland, Fairfax, and Detroit. They find that, on average, the property value capitalization of changes in test scores understates hedonic willingness to pay by approximately 400%. The magnitude of the difference varies across metro areas.

Other studies have provided evidence consistent with these findings for different metropolitan areas and different amenities. Kuminoff and Jarrah (2010) calibrate a hedonic model to San Joaquin County, California, and simulate an improvement in public school quality in selected school districts. They find that willingness-to-pay for the change is undercapitalized in some districts and overcapitalized in others. Kuminoff, Parmeter, and Pope (2010) find similar results in a Monte Carlo study of a more detailed hedonic model calibrated to Wake County, North

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[2] Kuminoff and Pope also demonstrate that if the hedonic price function is linear in parameters, an alternative requirement is that the treatment be perfectly randomized in the sense that it is orthogonal to levels and changes in all other variables in the model. However, this restriction does not seem likely to be satisfied in the context of land cleanup and reuse.

Carolina. They consider several different amenities including changes in commute times following the construction of a new beltline highway, changes in neighborhood demographic characteristics, and changes in distance to public open space as privately owned land is purchased through conservation easements. They find that the error introduced by misinterpreting quasi-experimental capitalization effects as measures of MWTP is the same order of magnitude as the bias from estimating a conventional hedonic model with important omitted variables. Klaiber and Smith (2009) compare quasi-experimental capitalization models and conventional hedonic models in terms of their accuracy in recovering "general equilibrium" measures of WTP for cleanup of hazardous waste sites and moving from wet to dry landscapes in Phoenix, AZ. They find that which model performs best depends on context and they suggest using calibrated models of urban areas as a way to explore how each approach is likely to perform in a specific application. Finally, Abbott and Klaiber (forthcoming) demonstrate that quasi-experimental studies that use fixed effects to control for omitted variables may improve the credibility of estimates for MWTP for a subset of the treated population at the cost of being able to develop a measure of MWTP that can be applied to the entire population that is relevant to the study. Their data is for Maricopa County, AZ and their application focuses on access to public open space.

I think it is important to cover this literature in the handbook. It has several implications for the discussion of property value models in section 5 and elsewhere in the handbook. For example,

- It is misleading to describe panel data studies such as Greenstone and Gallagher as "hedonic" studies that estimate "willingness to pay". It would be more accurate and consistent with the recent literature to describe them as "capitalization" studies that estimate "capitalization effects".

- The distinction between capitalization and willingness-to-pay should be clarified. For example, in the chapter of benefit estimation, page 44 introduces cross-section and panel-data property value models and says that "More accurate conclusions can…be drawn from using panel data spanning the pre- to post-cleanup period." I agree that using panel data can allow one to draw more accurate conclusions about capitalization effects. The issue is that accurate measures of capitalization effects may not be informative about willingness to pay. This does not mean capitalization effects are unimportant. Capitalization effects matter to homeowners, renters, and the beneficiaries of public programs funded by property tax revenue. But they are not welfare measures.

- Footnote #34's discussion of Parmeter and Pope's forthcoming chapter in the *Handbook of Experimental Economics and the Environment* is misleading. The problem is that, taken out of context, their discussion of the difference between average and marginal willingness to pay reflects a best-case scenario in which the restrictions outlined by Kuminoff and Pope (2010) are assumed to be satisfied. They discuss the problems with interpreting capitalization effects as welfare measures elsewhere in their review—particularly section 3.3.

- Table 5.1 lists several social benefits that can potentially be evaluated using the hedonic model. Of course, to calculate an exact measure of social benefits we need to do the 2nd stage hedonic estimation, whereas the studies emphasized in the handbook are all 1st-stage studies

that aim to measure the willingness to pay for a marginal change. The distinction between willingness to pay for marginal and non-marginal changes should be noted.

3. Does the document deal adequately with how to interpret the results from revealed preference studies (which are retrospective) and apply them in policy evaluations (which are prospective)? Examples include:

- *Size of the cleanup activity in relation to the size and composition of local markets*
- *Nature of the local economy—e.g. unemployment; measures of connections to other regions*
- *Definition of group who would be willing to pay for cleanup i.e. extent of the market*
- *Interrelationship between the results for benefits and impacts from different methods*
- *Relationship between hedonic (such as Kiel and Williams) and capitalization studies (such as Greenstone and Gallagher) of effects of cleanup and reuse*
- *Likely usefulness of meta analysis of past work versus other approaches to benefits transfer; adequacy of discussion of benefits transfer*
- *Importance of general equilibrium effects for policy analysis*
- *Interpretation of benefit estimates from property value studies when the change in contamination is non-marginal (e.g., NPL site cleanup)*
- *Relevance of topics like habitat equivalency and restoration scaling*
- *Discussion of distributional effects and gentrification*
- *Should there be coverage of model calibration as alternative to estimation?*
- *Should the Handbook discuss the need for continuous experimentation and ex post evaluation as proposed recently by Greenstone [2009] in this context?*

Response

The distinction between prospective evaluations and retrospective evaluations is important. It would be appropriate to preview this distinction in the introduction and discuss it carefully in the body of the handbook. While the present draft does not discuss the implications of this distinction directly, it is implied that analysts will use the handbook for guidance on both types of evaluations. This makes it especially important to explain the challenges with prospective evaluations and outline areas for future research on this topic.

I will organize my specific comments around groups of the examples provided:

A. *Interrelationship between the results for benefits and impacts from different methods*

Capitalization studies based on panel data are ideal for retrospective analysis. The difficulty, as noted above, is that changes in property values do not generally measure the benefits ob-

tained by the affected population. Nonetheless, capitalization effects are important to home-owners, renters, and the beneficiaries of public programs funded by property tax revenue.

Prospective analysis is more challenging. Ideally, one would like to develop a general equilibrium prediction for benefits that includes all the categories of social benefits listed in table 5.1. This type of endeavor is typically prohibited by time and data limitations. Instead, we are limited to partial equilibrium analysis. Different methods provide different measures:

> i. A stated preference model of the policy site can give us a theoretically consistent measure of WTP that captures all of the partial equilibrium effects in table 5.1. This is a key advantage of stated preference methods.

> ii. A hedonic model of the policy site based on recent sales data can provide a theoretically consistent measure of MWTP in terms of distance from the site. The difficulty is that omitted variables are likely to bias the point estimate for MWTP. If it is possible to sign the bias based on econometric theory and intuition for the spatial pattern of key omitted variables, then I would conjecture that this estimate might be used to construct an upper or lower bound on a partial equilibrium measure of WTP. Bounding strategies would be an interesting topic for future research.

> iii. A retrospective capitalization study can provide an econometrically consistent measure of the capitalization effect from a past change in exposure to hazardous sites. Again, I would conjecture that it might be possible to use such a measure to place bounds on WTP at the study site. However, to transfer this result to the policy site, one must consider all of the issues associated with conducting a benefit transfer.

B. *Definition of group who would be willing to pay for cleanup*

In both prospective and retrospective analysis, the total measure of social benefits hinges on how we define the market and the treated population. Are benefits of cleanup constant across the houses in a census tract? Or do they vary by distance? What is the cutoff distance at which benefits go to zero? These questions have not received as much attention in recent studies as the issue of omitted variable bias, but they may be very important for benefit measurement. Importantly, there is no guarantee that the answers to these questions will be the same at different sites used in prospective and retrospective analysis, raising an additional complication for benefit transfer. Even at the same site, the cutoff distance may vary with the site designation (e.g. listed, construction complete).

C. Likely usefulness of meta analysis of past work versus other approaches to benefits transfer; adequacy of discussion of benefits transfer

The discussion of benefit transfer is very brief. The results of Kiel and Williams (2007) and Gamper-Rabindran and Timmins (2010) suggest that the property value effects will differ from site to site. This complicates the task of using retrospective analysis to make prospective recommendations. Aside from the rather obvious point that function transfer seems likely to do better than value transfer, I don't have much intuition for how different benefit transfer methods would perform. I think model validation is an important topic for future research. In the context of benefit transfer, one might use tests of convergent validity to evaluate the quality of predictions from different benefit transfer methods.

D. Should the Handbook discuss the need for continuous experimentation and ex post evaluation as proposed recently by Greenstone [2009] in this context?

Greenstone's proposal is interesting. It certainly applies to retrospective analysis. It is not clear that it would help with prospective analysis. More importantly, his book chapter is primarily a recommendation for policymakers, not guidance for economic analysts who take the current policy regime as exogenous. Thus, Greenstone's paper seems tangential to the purpose of this handbook. I don't think it needs to be discussed in much detail. A footnote in the paragraph on instrumental variables would be sufficient to direct interested readers to this work.

E. Should there be coverage of model calibration as alternative to estimation?

Model calibration is an interesting idea. To my knowledge, the only study to discuss model calibration in the context of hazardous waste is Klaiber and Smith's (2009) calibrated hedonic model. Their model has helped us to understand the distinction between capitalization effects and welfare measures. It would make sense to discuss their calibration exercise in that context. However, I don't think we currently know enough about the strengths and weakness of calibration as an alternative to estimation in the NPL context to devote a sub-section to this issue—except perhaps as a topic for future research.

F. General Equilibrium

- *Importance of general equilibrium effects for policy analysis*
- *Size of the cleanup activity in relation to the size and composition of local markets*
- *Nature of the local economy—e.g. unemployment; measures of connections to other regions*
- *Relevance of topics like habitat equivalency and restoration scaling*
- *Discussion of distributional effects and gentrification*

Most of the general equilibrium effects cited in the paper seem plausible, but it is not clear to me that they are of first-order importance. If the site is small relative to the size of the local market, I can imagine that general equilibrium effects would be dwarfed by the direct effect on property values. Investigating the importance of general equilibrium effects would be a worthwhile topic for future research.

G. *Relationship between Capitalization Effects and Hedonic Willingness to Pay*

- *Relationship between hedonic (such as Kiel and Williams) and capitalization studies (such as Greenstone and Gallagher) of effects of cleanup and reuse*
- *Interpretation of benefit estimates from property value studies when the change in contamination is non-marginal (e.g., NPL site cleanup)*

See my response to question #2.

4. Are the research questions posed by the document forward-looking and on target? Which do you think are most important? Please identify any additional research questions important to the evaluation of benefits, costs, and impacts of land cleanup and reuse.

Response

The document poses several interesting research questions and also underscores research questions previously raised by the 2006 NCEE-LRO workshop. Because these questions are dispersed throughout the text, it is hard to keep track of all of them. I would suggest collecting the research questions in a new concluding section.

I also think that some of the most important questions for future research are raised implicitly and that the handbook would benefit from discussing them explicitly.

A. **Model validation**. There is very little evidence on the accuracy of our empirical estimates for social benefits and costs of hazardous waste cleanup. It would be useful to investigate strategies for engaging in model validation. How can we test the predictions from our models to generate feedback on their performance? The need for validation applies generally to revealed preference, stated preference, cost estimation, and benefit transfer exercises. It also applies to the input-output and dynamic forecasting models discussed in the context of EIA.

B. **Bounds instead of point estimates**. Recent research on the tradeoffs associated with using quasi-experimental capitalization estimators versus conventional hedonic estimators

has focused on the goal of getting unbiased (or at least consistent) point estimates for model parameters. At this point, the literature suggests that neither approach is very likely to yield an unbiased measure of welfare. Faced with this realization, I think it makes sense to ask whether we can interpret the point estimates from property value models as unbiased bounds on the welfare measures we care about. In other words, can we sign the bias? For example, if NPL sites tend to be located in less desirable neighborhoods, then conventional hedonic estimates for the MWTP to increase distance from the site seem likely to be biased upward. This suggests we might be able to interpret our biased estimate as an upper bound on the true MWTP. Can we use this information to improve prospective analysis of site cleanups? Are there situations where we might be able to assign welfare theoretic bounds to capitalization effects?

C. **Importance of general equilibrium**. The handbook discusses several possible general equilibrium outcomes of site cleanup. These include reductions in crime, increases in productivity, urban agglomeration effects, habitat preservation, and reductions in unemployment. Can we document the magnitude of these effects for past cleanups, following the approach of Banzhaf and Walsh (2008) or other methods? Is the value of these effects likely to be of first-order importance?

D. **Combining the strengths of BCA and EIA**. The idea that we must choose between BCA and EIA seems odd. Wouldn't the ideal approach be a middle ground between BCA and EIA where we track the distributional welfare implications for relevant groups of affected individuals? Stated preference studies can track distributional implications by asking questions about income, race, age, employment, and other relevant demographics in the questionnaire. The new empirical equilibrium sorting models aim to do the same thing in the context of revealed preference analysis (see Kuminoff, Smith, and Timmins [2010] for a review). Recent studies have considered amenities such as air quality, open space, and school quality. Developing a model of residential sorting with NPL sites as a neighborhood amenity would be an interesting topic for future research. The need for model validation would apply here as well. In that context, a key advantage of sorting models is that they would generate clear and testable predictions for capitalization effects and mobility patterns in response to cleanup of a site, making it easy to evaluate the accuracy of their predictions.

5. *Comment on the accuracy and usefulness of the discussions on jobs and wages, land productivity benefits, and use of compliance costs as an approximation for social costs.*

Response

A. **Jobs and wages (Sec 3.3.1)**. I have a question about the accuracy of this section and a concern about its usefulness.

    a. I have a hard time understanding the "benefit-generating" property of hiring workers who are structurally unemployed. Page 19 suggests that measures of total direct labor costs "should be adjusted downward to account for the social benefits from reducing long-term unemployment, represented by the wage rate minus the opportunity costs of time for the structurally unemployed…". Analysts are encouraged to consider multiple values for the opportunity cost of labor, ranging from 0 to the new wage rate. Ok. Suppose the opportunity cost of labor is 0. Then we could pay unemployed workers to do *nothing* at zero net cost to society. Even better, we could pay them to do marginally productive activities like cleaning litter by the roadsides near their homes at positive net cost to society. Why don't we?

    To phrase my question differently…if the worker's opportunity cost of labor is less than the wage rate, and the worker is sufficiently skilled to earn the wage rate, then why aren't they choosing to work currently?

    b. P.20 says "As is true for all benefits, costs, and impacts, it is also important to measure jobs relative to a baseline of what would have happened without the cleanup and reuse project. If the reuse project would have simply occurred at the next best alternative development site, then wages would not be counted in a BCA." This seems hard. Have people found a way to do this credibly in the past? If not, I am not so sure about the usefulness of this discussion.

B. **Land productivity benefits (Sec 5.1.5.)**. I have a couple of concerns about the accuracy and usefulness of this section.

    a. P.31 suggests that "the net benefits of site cleanup and reuse can be calculated as the difference between the value of the property before and after the cleanup and redevelopment, less remediation and development costs." Redeveloped waterfront parks, high-rise hotels, and residential developments are cited as examples of increases in property values. My concern is that this definition of net benefits double-counts the value of structures. Including the value of these structures as part of *net* benefits implies the structures would not have been built elsewhere if the site had not been cleaned up. This is probably not true in most cases. I think

it would be more accurate to define net benefits based on the change in *land value* rather than the change in *property value.*

b. At the bottom of page 31 it seems unlikely to me that redevelopment of reme-diated sites would actually cause urban areas to contract.

c. In section 5.1.5.1. I agree that actual and potential liability may prevent properties from transacting. However, I would characterize a reduction in transactions as a non-monetary measure of the effects of contamination. I would not characterize it as *leading* to welfare losses, as described on page 34.

d. I agree that agglomeration (5.1.5.2), peer-group effects (5.1.5.3), and greenfield preservation (5.1.5.4) are potential outcomes of site cleanup and reuse. However, I suspect it would be very challenging to identify these effects in an econometric model. Moreover, I wonder whether the net benefits of their combined effect is likely to be small relative to the more direct benefits of reduced human exposure to contaminated sites.

C. **Compliance costs as an approximation for social costs (Sec 6.2.5)**. I understand the idea for using direct cleanup costs for small competitive firms as a measure of social costs. I am less sure of its applicability. The need to judge applicability raises three questions: (i) what share of site cleanups are performed by liable firms? (ii) what share of these firms are small enough within competitive industries to guarantee there is no "cost pass-through"? (iii) how would one get reliable data on costs from these firms?

6. *Is the document written clearly? Please specify sections in which the clarity can be improved.*

Response

I find that the document is written clearly, with the exception of the specific issues that I raise in my responses to other questions.

7. *Does the handbook provide practical advice and useful recommendations for policy analysts?*

Response

Yes, although I think it would help to collect these recommendations in a stand-alone section of the handbook.

8. *Please comment on any additions you feel would enhance the handbook.*

<u>Response</u>

- Recommendations for empirical work and open questions for future research are dispersed throughout the main chapters of the current text. It might be useful to collect both in a new concluding chapter. Alternatively, the recommendations could be previewed in the introduction and the research questions could be summarized in the conclusion. In either case, I think that collecting and summarizing both sets of information would improve clarity and help to ensure that readers do not miss important points.

- It would be useful to add a few graphics in chapter 2 to provide a statistical summary of how the various programs fit together. This would complement the historical background and help analysts get a quantitative sense of the scale of cleanup activities. For example, it would be useful to report

    o   Annual expenditures by program over time.
    o   # sites with cleanup expenditures, by program
    o   National map of locations for different types of sites
    o   # NPL sites by current phase of cleanup
    o   Acres of sites. How much land are we talking about?
    o   Distribution of counties by # of sites within the county

    This type of statistical summary might also help analysts think about where to look for instruments and discontinuities that could help with identification of property value models.

- For an analyst using the handbook, it would be valuable to have a set of references that provide examples of BCA and EIA applied to specific sites that are consistent with the recommendations of the handbook. Are there any such examples? If not, then it seems the role of the handbook is not to define "best practices" but to summarize the outstanding issues in the literature and propose new directions for future research. Discussion of this point would be helpful in the introduction. For example, the criteria in table 5-2 make good sense, but it is hard for me to think of examples that unambiguously satisfy all of those criteria.

- Aside from the NPL threshold studied by Greenstone and Gallagher, are there other features of hazardous waste regulations that have the potential to create discontinuities that could serve as instruments? Are there other sources of randomization in the policy that have yet to be exploited? Any insights along these lines could prove valuable.

PART III: ADDITIONAL MINOR COMMENTS

1. P.12. and P.64. The stats on Superfund expenditures on page 12 are for a single year (1999). Is this still up to date? Is 1999 a representative year? How accurate were the predictions described on page 64?

2. P.23 says "Contamination that does not migrate off-site does not constitute a market failure if information on the damages to health and the environment exists and is known to the public." It seems to me that the validity of this statement might vary from site to site. For example, there may be an existence value associated with on-site amenities. Even if information is freely available, we often lack institutions for market trading cleanup between individuals off-site and landowners of toxic sites. Furthermore, we have bargaining costs. There is also the possibility that contamination may migrate off-site in the future if there is an extreme weather event. My point is that we are far from the Coasian ideal when it comes to land contamination.

3. Discussion of estimation is focused on point estimation of benefits and costs. What about the need to quantify the uncertainty about these estimates? Aren't standard errors important? Weak instruments may also be an issue with the quasi-experimental methods.

4. Footnote 32 cites Palmquist's 1991 book chapter as a reference on hedonic methods. It is a bit outdated. His 2005 chapter in the Handbook of Environmental Economics is more current. I would suggest adding it.

5. P.47. I think that the last sentence of the second paragraph of box 5.2 should say "time-variant" rather than "time-invariant".

6. P.51. I do not understand the conceptual basis for using changes in property transaction rates to evaluate the benefits of land cleanup.

7. P.70. While I agree there is a possibility of stigma associated with a cleaned site, I am not sure I agree that stigma should be treat as a cost that is generated by land cleanup activities. Isn't it simply a reflection of imperfect information about the efficacy of cleanup?

Appendix B: Minor Re-wording

1. P. 47 Last sentence of the second paragraph of box 5.2 "time-variant" rather than "time-invariant".

2. P.22 Substitution of "plagued" or "hindered" for "dogged".

3. P. 44 "delve" vs. "explore".

4. P. 49 "lackadaisical" vs. "inconsistent".

5. P. 17 Winners and losers clarified relative to Kaldor Hicks.

6. P. 18 Social benefits not defined in Table 3.1.

7. P. 22 Last paragraph, externality or risk—need to clarify.

8. P. 23 Second paragraph more specifics too vague.

9. P. 27 Fourth paragraph—don't place "dollar value" measure tradeoff in dollar or monetary terms.

10. P. 29 Table 5-1 adds profit, cost function to ecosystem function row and cost and profit to market products row.

11. P. 35 5.1.5.3—is this over stepping what can be said here?

12. P. 37 Section 5.2 ignores nonuse values.

13. P. 38 Define— risk of what?

14. P. 38 Next to last line—"valued benefits" replace with monetized benefits.

15. P. 43 5.3.1—second paragraph last sentence not clear.

16. P. 45 Risk was part of HRS wasn't it?

17. P. 46 Footnote #34 needs to be corrected.

18. P. 51 Define property transaction rates.