Involving the Public: When Are Surveys and Stakeholder Interviews Effective?[1]

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Abstract

Scholars and practitioners alike advocate involving stakeholders in environmental decision making, although there is uncertainty regarding the effectiveness of public involvement tools and the degree of public involvement in the decision making process. Some researchers have gone a step further to promote the use of public surveys and stakeholder interviews as preferred means to include public concerns in environmental decision making. However, there is little evidence as to whether public involvement tools are effective at representing public preferences, especially when there is a shortage of technical information to inform public opinion. This study examines the effectiveness of surveys and stakeholder interviews for assessing the District of Columbia's environmental problems in a comparative risk assessment. The findings suggest that these public involvement tools are less effective when there is a shortage of technical data. Instead, more deliberative forms of public involvement may generate greater convergence of opinion regarding environmental problems.

When formulating policies to address environmental problems, all issues cannot be addressed nor should they be. Productive resources are scarce[2] and a variety of social objectives, such as environmental protection, must be addressed (Graham, 1994). Comparative risk assessment (CRA) is one tool that attempts to synthesize public values, expert opinions, and technical expertise into a single ranking system so that decision makers can prioritize their environmental agendas. Traditional CRAs compare and ultimately rank environmental threats by weighing relative probabilities and magnitudes of harm to human health, ecosystem health, and quality of life (Davies, 1996; Feldman, Hanahan, & Perhac, 1999). In comparing risks, CRAs generally consider both technical assessments and public preferences (Davies, 1996; Feldman et al., 1999). By including public preferences, important information may be obtained that is otherwise overlooked in a technical analysis alone (Beierle, 1999; Isaacson, 1986), therefore leading to more political support for the decision making process and the resulting policy decisions (Beierle & Konisky, 2000; Feldman et al., 1999; Perhac, 1998).

However, involving stakeholders in government decision making is often challenging, especially when a large number of interested parties are concerned. As the number of interested parties increases, there are greater opportunities for disagreement between the public and technical experts over the degree of risk associated with environmental problems (Rosenbaum, 1998).

For these reasons, scholars have often advocated using public surveys (MacRae & Whittington, 1997; Milbrath, 1981; Schaeffer, 1990) and stakeholder interviews (Gray, Wiedemann, Schutz, Hallman, Feldman, & Turner, 1996) to include public concerns in decision making, thereby avoiding a lengthy deliberation processes. However, to date there is little information about whether surveys and stakeholder interviews are effective at representing public preferences, especially for environmental problems involving extensive technical information. There is even less

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certainty about what conditions make these methods more effective. For example, most United States cities do not collect extensive environmental data (M. Katz, United States Environmental Protection Agency, Office of Policy, Planning, and Evaluation, Regional and State Planning Division, personal interview October 7, 1997; Lash, 1994). In the absence of such data, there is reason to question whether less deliberative forms of public involvement will be effective. This study addresses these issues by considering how well surveys and stakeholder interviews serve as public involvement tools where there exists a shortage of technical information. The analysis draws on data gathered from a case study of the District of Columbia's (DC) environmental risks to assess the merits of less deliberative public involvement tools in CRA.[3]

Public Involvement, Environmental Decision Making, and Comparative Risk Assessments

Public involvement in environmental decision making is important for several reasons. Involving the public in environmental decisions often results in the identification of concerns that analysts and public managers miss (Beierle, 1999; Fiorino, 1990; Isaacson, 1986). By promoting stakeholder involvement, public managers may also draw on citizens' expertise, producing a better-informed risk ranking. This process also increases accountability in the decision making process because stakeholders who are informed of and participate in CRAs are more likely to agree with the final decision or, at a minimum, the decision making process. As a result, public perceptions of the decision making process may improve (La Porte & Metlay, 1996), and increase public trust (La Porte & Metlay, 1996).[4]

Although the literature suggests that public involvement may be beneficial both to citizens and CRA development, in practice there is disagreement regarding the desirable degree of and procedure for participation, as well as the role the public plays in the decision making process (Almond & Verba, 1961; Fiorino, 1989; Pollak, 1985; Renn, Stegelmann, Albrecht, Kotte, & Peters, 1984; Renn, Webler, Rakel, Dienel, & Johnson, 1993; Rosener, 1978; Schrader-Frechette, 1985). Such disagreement exists because involving citizens requires that they have access to information and time to educate themselves about the relevant issues, which may prolong the amount of time required to assess an environmental problem. Moreover, the public's perception and expert opinion may differ when it comes to the seriousness of and priority for addressing environmental problems (Rosenbaum, 1998). These diverging views may require additional resources to address, therefore prolonging the length of time before a final ranking can be made.

To address these issues, several scholars have recommended using expert stakeholder interviews in identifying risk (Gray et al., 1996; Viellenave, Fontana, & Gorody, 2001). Systematic interviews with expert stakeholders are advantageous because they often provide detailed information about individuals' environmental risk perceptions. Interviews also allow for a two-way communication and therefore create opportunities for the interviewer to restate and clarify the subject's responses to avoid miscommunication (Morgan, Fischhoff, Lave, & Fischbeck, 1995; Minard, 1997). Compared to more interactive stakeholder involvement methods, such as extensive deliberation, systematic interviews with expert stakeholders are less resource-intensive and therefore have been used in environmental decision making (Morgenstern, Shih, & Sessions, 2000; Minard, 1997).

Other scholars have recommended using survey techniques (MacRae & Whittington, 1997; Milbrath, 1981; Schaeffer, 1990). Surveys are advantageous because they can represent the views of individuals who do not participate in or who are underrepresented in traditional public involvement procedures such as public hearings (Milbrath, 1981). Because surveys solicit opinions on views that may be otherwise unheard (Milbrath, 1981; National Research Council [NRC], 1996), they are considered more democratic approaches than other public involvement tools (MacRae & Whittington, 1997). Moreover, surveys often require fewer resources than more interactive public involvement approaches (NRC, 1996; Davies & Darnall, 1996). For these reasons, surveys have been advocated as appropriate means of including public concerns in environmental decision making (MacRae & Whittington, 1997; Milbrath, 1981; Minard, 1997; NRC, 1996; Schaeffer, 1990) and therefore have been widely used in numerous CRAs (Feldman, Hanahan, & Perhac, 1996).

Methods

To understand more about the value of survey and interview techniques in CRAs, we conducted a study of the District of Columbia's environmental risks. In doing so, we first surveyed District residents to identify the city's domain of environmental risks. We relied on publicly defined risks to frame the CRA because the analysis would better address the public's concerns (Minard, 1996). As a result, any eventual decision that was based on the study's findings would more likely have public support (Beierle & Konisky, 2000).

In the survey, DC residents were asked what they believed was the single most important environmental risk facing the District. After coding, the responses yielded seven types of environmental risk: air pollution, drinking water contamination, hazardous waste pollution, lead contamination, park conditions, solid waste pollution and surface water pollution.[5] Following the United States Environmental Protection Agency's (EPA) recommended CRA methodology, each of these seven risks was evaluated based on their respective effect to human health, ecological health, and quality of life (US Environmental Protection Agency [USEPA], 1996a). Adhering to the same methodology, risks were then ranked based on the opinions of the technical and scientific community, environmental experts, and the lay public (USEPA, 1996a).

Technical and Scientific Opinion

Technical and scientific concerns were incorporated into the CRA by doing an extensive literature search. From the onset, we assumed that the technical literature would be limited. The lack of literature was important because we sought to assess how effective surveys and stakeholder interviews would be as public involvement tools in the absence of technical information. However, some information was available and it remained important to understand how technical and scientific experts had assessed DC's environmental conditions.

In reviewing the literature, we searched EPA reports, DC government documents, nonprofit studies, and peer-reviewed articles for information about the seven publicly defined environmental risks. These risks were evaluated based on whether they exceeded government standards for acceptable risk to human health, ecology, and quality of life. Such standards were determined by the EPA, the United States Centers for Disease Control (CDC), and the District of Columbia. Using EPA's suggested CRA methodology (USEPA, 1996a), risks were ranked (high, medium, low) based on their potential harm. Risks that exceeded EPA, CDC, or DC government standards at least once per year for every year since 1992 and the time of this study received an "H" (high) ranking.[6] Environmental risks received an "M" (medium) ranking if, at the time of the study, they met government standards but had not done so consistently since 1992. Risks were designated "L" (low) if they met government standards and had done so since 1992.

Environmental Expert Opinion

Opinions of environmental experts were included by performing a series of personal interviews, as recommended by Minard (1997) and the NRC (1996). Environmental experts were defined as members of the environmental community who had a firsthand knowledge of the District's environmental status either through employment or community activism. These included DC grassroots activists and local and federal government officials. Environmental experts were identified first by reviewing published reports on the District's environmental condition. These individuals were interviewed in person or via telephone. During the interviews, experts were asked to identify other environmental specialists in the community who were also aware of the District's environmental risks. By relying on the literature to identify environmental experts and by snowball sampling, we interviewed twenty-three stakeholders over a period of two months.

Each interviewee was asked six open-ended questions that focused on what they believed were the most important environmental risks in the District. Respondents were prompted for more than one answer and were asked to prioritize their risks in order of importance. Each response was content-coded into the seven publicly defined environmental problems[7] and weighted based on the respondents' perceived degree of priority. High-priority risks received three points, medium-priority risks received two points, and low-priority risks received one point. The weights for all the respondents' risks were then summed within each risk category and a relative percentage was calculated.

Applying EPA's suggested CRA methodology, responses were ranked as high, medium, or low (USEPA, 1996a). Risks for which at least 30% of the stakeholders believed they were a priority received an "H" (high) ranking. For risks that between 10% and 29.9% of the stakeholders believed they were a priority risk received an "M" (medium) ranking and risks that were recognized by fewer than 10% of the respondents received an "L" (low) ranking. These thresholds were determined based on the natural breaks in the distribution of stakeholder responses. However, to account for uncertainty in our risk rankings, we conducted a sensitivity analysis to determine how the rankings would change for risks ranked "high" if the thresholds were relaxed from 30% to 20% and "medium" rankings were constrained to between 10 and 19.9%. Similarly, we evaluated how the risk rankings would change if risks ranked "high" were recognized by 40% of the expert stakeholders and "medium" rankings were recognized by between 10% and 39.9% stakeholders.

General Public Opinion

A telephone survey of city residents was used to rank the general public's perceived environmental risks. The survey solicited responses to the open-ended question: "What do you believe is the single most important environmental risk facing the District of Columbia today?" The survey was administered to 345 District residents who were 18 years of age or older. Responses were poststratified and weighted by age, gender, and race to ensure that the sample appropriately represented the District's population. With a survey this size, the sampling error was estimated to be less than 5%.

Like the expert stakeholder interviews, risks for which at least 30% of the general public believed they were a priority received an "H" (high) ranking. For risks that between 10% and 29.9% of the general public identified as high priority received an "M" (medium) ranking and risks that were recognized by fewer than 10% of the public received an "L" (low) ranking. As was the case with the expert stakeholder interviews, we performed a sensitivity analysis to determine how the rankings would change for risks ranked "high" if we changed our threshold from 30% to 20% or 40% and risks ranked "medium" would change if thresholds varied from between 10 to 29.9%, 10 to 19.9%, or 10 to 39.9%.

Results

Technical and Scientific Opinion

As anticipated, results of the technical and scientific data analysis showed that most of the District's environmental risks had not been studied and their associated environmental condition was uncertain. Consequently, relying on technical and scientific literature alone to rank the District's risks was almost impossible. The best-defined environmental risks related to public health. Ranking ecological health and quality-of-life risks was not deemed feasible because of data insufficiency.

Public Health Risks—Public health rankings were assessed for air pollution (ozone), drinking water contamination, lead contamination, and surface water pollution. Air pollution received an "H" ranking because on average, the District had exceeded EPA's health standards for ozone at least once per year since 1992 and was at the time of the study under compliance alert (R. Day, District of Columbia Air Resources Division, personal interview, August 26, 1996; District of Columbia, 1996). Similarly, drinking water contamination received an "H" ranking because for three years prior to the study, the District issued numerous "boil water alerts" per year to warn residents of unsafe coliform bacteria that had contaminated the drinking water system (US Centers for Disease Control [USCDC], 1994; USEPA, 1996a; Olson, 1995). Moreover, at the time of the study, the city was exceeding EPA compliance thresholds (USEPAa, 1996; USEPA, 1996b).

Lead contamination also received an "H" ranking because it had exceeded EPA public health standards in previous years and was prevalent in District soils, homes, and surface waters (USEPA, 1996a). At the time of study, 18% of the District's children exceeded the CDC standards for serum-borne lead (USEPA, 1996a). Finally, surface water pollution received an "H" ranking because the Anacostia River was out of compliance with EPA public health standards for at least two years before the study and during the time of the study due to its high concentrates of heavy metals, hydrocarbons, and PCBs (Interstate Commission on the Potomac River Basin, 1993; USEPA, 1996a). In addition, the EPA had previously issued repeated health advisories against consuming fish that were harvested from either the Anacostia or Potomac Rivers (USEPA, 1996a).

Ecological and Quality-of-Life Risks—Lack of conclusive environmental risk data was most prevalent for ecological and quality-of-life risks. Surface water pollution was the only category of ecological risks that could be evaluated. The city's surface water risk received an "H" ranking because fish populations were enduring serious harm from heavy metal, hydrocarbon, and PCB contamination (USEPA, 1996a; District of Columbia, 1994; Velinsky & Cummins, 1994). Contamination was highest in bottom-feeding fish as was evidenced by disproportionate quantities of malformations and tumors (District of Columbia, 1994).

Similarly, an assessment of the District's quality-of-life risks could be done only for drinking water risk. During the time of our data collection, 213,800 residents were consuming bottled water (USCDC, 1994) in large part because the city's drinking water system was contaminated with coliform bacteria. We assessed quality of life risks by evaluating how much District residents were paying for bottled water. Using the purchase price for bottled water and consumption quantity, we crudely determined how much residents paid for bottled water annually. The price of domestic bottled water was determined by assessing the cost of bottled water at a local grocery store. Generic bottled water cost as low as $0.70 per gallon, whereas brand-name water was found to cost as much as $1.75 per gallon. Assuming that average daily consumption was between one-half gallon and two gallons, District residents may spend between $128 and $1,278 per year on bottled water. Aggregated over the 213,800 residents that purchase bottled water, it is reasonable to assume that between $26 million and $273 million was spent annually on bottled water.[8] Whether these costs warrant an "H," "M," or "L" ranking, however, is uncertain as we surmised too little about the relative risk of the District's other six quality of life factors. Also, these calculations do not account for the quality-of-life effects to those residents who continued to consume the District's contaminated drinking water.

There were no data to assess the city's other ecological and quality-of-life risks, as shown in Table 1. Lack of data was attributed to the EPA's focus on human health risks rather than on ecological health and quality-of-life risks. State and local governments generally do not monitor such environmental conditions. In order to assess these ecological risks, information would be needed for the extent and degree of impact to biological life. Similarly, assessing quality-of-life risks would require data on the number of District residents who were affected, the cost of personal abatement expenditures, and consideration of how the risk had impacted the lives of District citizens.

Table 1. Technical and Scientific Rankings of District of Columbia Environmental Risks

	Scientific Ranking		
Risk	Health Effects	Ecological Effects	Quality of Life
Air pollution (ozone)	H	—	—
Drinking water contamination	H	—	H?
Hazardous waste pollution	—	—	—
Lead contamination	H	—	—
Park condition	—	—	—
Solid waste pollution	—	—	—
Surface water pollution	H	H?	—

H = High; M = Medium; L = Low
? = Data are speculative.
— = No data to assess.

Table 2. Expert Stakeholder Rankings of District of Columbia's Environmental Risks

				Risk Ranking		
Risk	Number of Responses	Total Weighted Point Score	Respondents Citing Risk as a "High Priority"	High Risk ≥40%	High Risk ≥30%*	High Risk ≥20%
Air Pollution (ozone)	15	28	23.1%	M	M	H
Drinking water contamination	14	32	26.4%	M	M	H
Hazardous waste pollution	1	3	2.5%	L	L	L
Lead contamination	3	6	5.0%	L	L	L
Park condition	3	3	2.5%	L	L	L
Solid waste pollution	3	3	2.5%	L	L	L
Surface water pollution	17	42	34.7%	M	H	H
Other**	2	4	3.3%	—	—	—

H = High; M = Medium Risk; L = Low
* = Preferred risk ranking based on the distribution of stakeholder responses.
** = Responses related to quality of life and brownfields, which were beyond the scope of this analysis.

Environmental Expert Opinion

Table 2 illustrates that despite the lack of technical and scientific information, DC's environmental experts had well-developed opinions about the District's environmental risks. Approximately 35% of the experts believed that surface water pollution was the highest relative environmental risk. This risk therefore received an "H" ranking. Other environmental risks registered less importance with environmental experts. Twenty-three percent of them believed that air pollution was the highest environmental priority and 26% believed drinking water was the District's most important environmental problem. Because fewer than 30% of the experts identified these two risks as a priority, the risks received a medium ranking. Hazardous waste pollution, lead contamination, park conditions, and solid waste pollution were rated as low risks because fewer than 10% of the experts identified them as a priority.

Although risk thresholds were determined based on the natural breaks in the distribution of stakeholder responses, we varied the thresholds to assess their sensitivity. When thresholds were relaxed so that at least 20% of expert stakeholders were necessary to classify an environmental problem as a high-priority risk, in addition to surface water pollution, air pollution and drinking water contamination became "high" priorities. Similarly, when we increased the risk thresholds to require that risks of "high" priority be recognized by at least 40% of the expert stakeholders, none of the risks retained their "high"-priority status.

General Public Opinion

In the survey, District residents differed from those of environmental experts, as shown in Table 3. Approximately 65% of the general public believed that the District's most important environmental risk was its drinking water system. Because more than 30% of the residents identified this risk, this item received a high ranking. The other environmental risks generated significantly less importance to District residents. Eleven percent identified air pollution as an environmental priority. Finally, fewer residents believed that solid waste pollution (7%) and surface water pollution (4%) were an environmental priority. Because fewer than 10% of the residents we surveyed identified these risks, they received a low ranking. The results of the sensitivity analysis showed no change in the risk rankings, which increased confidence in our designated thresholds.

Table 4 combines each of the above risk rankings. Two overall conclusions emerged. First there was an extreme shortage of technical data describing the District's environmental condition. Environmental decision making within DC's

Table 3. General Public's Rankings of District Environmental Risks

Risk	Respondents Citing Risk as a "High Priority"	Risk Ranking*
Air Pollution (ozone)	11% (13)	M
Drinking water contamination	65% (224)	H
Hazardous waste pollution	2% (7)	L
Lead contamination	1% (3)	L
Park condition	1% (3)	L
Solid waste pollution	7% (24)	L
Surface water pollution	4% (14)	L
Other	8% (28)	—

H = High; M = Medium; L = Low
*Results of the sensitivity analysis showed in no change in the risk rankings.

Table 4. Combined Rankings of District of Columbia Environmental Risks

	Technical and Scientific Ranking			Environmental Expert Ranking			
Risk	Health Effects	Ecological Effects	Quality of Life	High Risk ≥40%	High Risk ≥30%*	High Risk ≥20%	General Public's Ranking
Air Pollution (ozone)	H	—	—	M	M	H	M
Drinking water contamination	H	—	H?	M	M	H	H
Hazardous waste pollution	—	—	—	L	L	L	L
Lead contamination	H	—	—	L	L	L	L
Park condition	—	—	—	L	L	L	L
Solid waste pollution	—	—	—	L	L	L	L
Surface water pollution	H	H?	—	M	H	H	L

H = High; M = Medium; L = Low
* = Preferred risk ranking based on the distribution of stakeholder responses.
? = Data are speculative.
— = No data to assess.

government therefore is based on little or no scientific information. It is thus arguable that the city's environmental program budgets are likely to be based more on political concerns than on consideration of environmental risk.

Second, risk rankings differed across the scientific and technical communities, expert stakeholders, and the general public. Technical and scientific experts ranked lead exposure as a high environmental priority because lead poisoning causes severe developmental effects for children and contributes to osteoporosis in women. Yet both the stakeholders and the survey respondents ranked lead contamination as a low environmental risk. Similarly, the scientific literature and the environmental experts viewed the District's surface water pollution as a high environmental risk, while the general public largely did not consider it a significant environmental priority.

Conclusion

Incorporating expert and public opinion through stakeholder interviews and surveys is widely accepted in the environmental literature as methods that sufficiently account for the public's environmental concerns. The results of this study suggest that in CRAs and other types of analytical endeavors where political priorities are being determined based on very limited technical information, stakeholder interviews and surveys may be limited in their ability to approximate variation in public concerns. It is plausible that if the District's environmental risks were more clearly defined and if there were numerous sources of data that described the city's environmental conditions, interviews and surveys would have been sufficient. Yet, most United States cities gather only limited environmental data (M. Katz, United States Environmental Protection Agency, Office of Policy, Planning, and Evaluation, Regional and State Planning Division, personal interview October 7, 1997; Lash, 1994), suggesting more deliberative forms of stakeholder involvement may be warranted.

The results of this study also emphasize that the scientific community, environmental experts and the general public consider environmental risks differently. These differences may be due to inadequate communication among stakeholder groups (MacLean, 1986). In some cases, the public may have more direct knowledge about the risks of an environmental problem than is suggested in the technical literature (Beierle, 1999; Fiorino, 1990; Isaacson, 1986). For example, residents who live near the city's Anacostia River might have had critical information about how surface water contamination affects quality of life. Yet, quality-of-life issues are generally not discussed in the technical literature. In other cases, the differences between the scientific data and public perceptions may result from the scientific process not allocating sufficient weight to issues that the public believes are important (Morgan et al., 1995). For example, technical experts tend to focus on a very narrow range of consequences, but ordinary people have a much richer sense of risk because they consider not only the quantitative assessment of injuries, illness, or fatalities, but also "voluntariness" of exposure, trust in authorities responsible for managing the risk, and risk to future generations (Armour, 1993; Margolis, 1996). In still other cases, some survey respondents may not have the education needed to understand complicated issues of environmental risk (Morgan et al., 1995). This point is illustrated by the 12% of the survey respondents who could not identify any environmental risks in the District of Columbia. These residents did not have a clear understanding of the District's environmental risks.

Interestingly, we found agreement among the scientific literature, the expert stakeholders, and the general public with regard to the importance of safe drinking water. The city's frequent public health alerts resulted in it being evaluated as a high-priority risk for all stakeholder groups. The general public agreed with the scientific assessment, and, depending on the threshold used, expert stakeholders also ranked drinking water as a high environmental risk. These findings are important because in the months prior to the interviews and survey, much technical information was published in the news media regarding the city's contaminated drinking water system. As a result, the technical community, expert stakeholders, and the general public shared similar information, which likely caused associated risk rankings to converge. This example illustrates the importance of information sharing and issue salience when assessing environmental problems among multiple communities.

Creating opportunities for communication among the three interest groups may reduce the possibility that some communities gain access to information that others do not, and therefore increases trust among stakeholders (Armour, 1993; Metlay, 1996). Information sharing also increases political support for any programs that result from the decision making process (Beierle & Konisky, 2000). In contrast, surveys limit opportunities for citizen engagement (King, Feltey, & Susel, 1998) and therefore are less likely to generate the public support needed to put forward a risk-management program (Morgan et al., 1995).

Although surveys and stakeholder interviews may be advantageous because they expedite the decision making process, shortcomings exist. These findings support prior research concerning the limitations of surveys as public involvement tools. While surveys may provide a statistically representative snapshot of public opinion (Arnstein, 1969), alternative forms of public involvement that encourage dialogue may be preferable if the ultimate goal is to achieve a shared vision or policy (M. Katz, United States Environmental Protection Agency, Office of Policy, Planning, and Evaluation, Regional and State Planning Division, personal interview October 7, 1997; Perhac, 1998). Indeed, a more useful venue for surveys and stakeholder interviews in environmental decision making may be in determining the efficacy of a risk communication program or whether there is sufficient political support for a new environmental program.

Assessing environmental problems continues to be a challenge. There is still much to learn about which methods of involving the public in decision making are most appropriate to a particular situation. Our results suggest that when there are shortages of available technical information, it is important that the most collaborative forms of stakeholder involvement be used so that decision making may be best informed.

Notes

1 We are grateful for J. Clarence (Terry) Davies, Duncan MacRae, Paul Portney, John Villani, Marilyn Katz, Richard N.L. Andrews, and the participants in the Association of Public Policy Analysis and Management Conference for their comments on earlier versions of this work.

2 Scarcity includes the limitations on the quantity and quality of productive inputs such as human talent, raw materials, media time, human attention spans, and political courage (Graham, 1994).
3 See Davies and Darnall (1996) to review the original case study.
4 La Porte and Metlay (1996) define trust as "the belief that those with whom you interact will take your interests into account, even in situations where you are not in a position to recognize, evaluate, or thwart a potentially negative course of action by 'those trusted'."
5 It is important to note that human health and quality of life effects are not necessarily independent of each other. In an attempt to keep the risks independent, quality of life impacts associated with a health impact were included in the human health assessment, but not in quality of life effects. For example, an individual who suffers from asthma may have his or her respiratory system further compromised by the poor air quality. This risk was identified as a human health risk rather than a quality of life risk. Instead, "quality of life" risks applied to thousands of individuals who may experience no health effects from the city's air quality, but whose lives are affected by poor air quality. For example, when the ozone exceeds EPAs acceptable thresholds, DC officials issue warnings to remain indoors. These warnings constrain the quality of life for many area residents. Quality-of-life risks also include qualitative variables such as fairness or peace of mind, as well as more quantitative factors such infrastructure costs or benefits, personal investments or gain and foregone earnings (Minard, 1996).
6 Data were therefore collected for five years (1992–1996).
7 All but two of the responses of environmental experts fit into the seven environmental risk categories. These experts believed that quality of life and brownfields were environmental priorities. These issues, while important, were beyond the scope of this analysis and accounted for in an "other" category.
8 This estimate is simple and does not consider resident expenditures on home filtration and purification systems, home or office bulk delivery services, transportation to and from the purchase point, time costs of purchasing water, bottled water purchases by nonresident commuters, and so on.

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References

Almond, G. A., & Verba, S. (1961). *The civic culture: Political attitudes and democracy in five nations*. Princeton, NJ: Princeton University Press.

Armour, A. M. (1993). Risk assessment in environmental policymaking. *Policy Studies Review*, *12*(3/4), 178–196.

Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of American Institute of Planners*, *35*, 216–224.

Beierle, T. J. (1999). Using social goals to evaluate public participation in environmental decisions. *Policy Studies Journal*, *3*(4), 75–103.

Beierle, T .J., & Konisky, D. M. (2000). Values, conflict, and trust in participatory environmental planning. *Journal of Policy Analysis and Management*, *19*(4), 587–602.

Davies, J. C. (Ed.). (1996). *Comparing environmental risks*. Washington, DC: Resources for the Future.

Davies, J. C., & Darnall, N. (1996). *Environmental priorities for the District of Columbia: A report to the Summit Fund*. Discussion Paper 97-04. Washington, DC: Resources for the Future.

District of Columbia. (1996). *Ambient air quality monitoring network description: A brief overview of ambient air quality in DC, 1980–1993*. Washington, DC: District of Columbia, Air Resources Management Division.

———. (1994). *The District of Columbia water quality assessment*. Washington, DC: District of Columbia, Environmental Regulatory Administration, 1994 Report to the USEPA and the US Congress, pursuant to section 305(b) Clean Water Act (P.L. No. 97-117).

Feldman, D. L., Hanahan, R. A., & Perhac, R. (1996). *Environmental priority-setting in U.S. states and communities: A comparative analysis*. Knoxville: Waste Management Research and Education Institute, University of Tennessee, Knoxville.

Feldman, D. L., Hanahan R. A., & Perhac, R. (1999). Environmental priority-setting through comparative risk assessment. *Environmental Management*, *23*(4), 483–493.

Fiorino, D. J. (1989). Technical and democratic values in risk analysis. *Risk Analysis*, *9*(3), 293–299.

Fiorino, D. J. (1990). Citizen participation and environmental risk: A survey of institutional mechanisms. *Science, Technology, and Human Values*, *15*(2), 226–243.

Graham, J. D. (1994). Hammers don't cut wood: Why we need pollution prevention *and* comparative risk assessment. In A. M. Finkel & D. Goldring (Eds.). *Worst things first? The debate over risk-based national environmental priorities* (pp. 229–236). Washington, DC: Resources for the Future.

Gray, P. C. R., Wiedemann, P. M., Schulz, H., Hallman, W. K., Feldman, D., & Turner, R. (1996). The nature and challenges of environmental decision making: Case studies for policy improvement. Knoxville, TN: National Center for Environmental Decision-making Research, NCEDR/96-03.

Interstate Commission on the Potomac River Basin (ICPRB). (1993). ICPRB study assesses Anacostia sediment pollution, *Potomac Basin Reporter*, *49*(1).

Isaacson, P. (1986). Pollution regulation and public sensibility. *Environmental Impact Assessment Review*, *6*, 229–232.

King, C. S., Feltey, K. M., & Susel, B. O. (1998). The question of participation: Toward authentic public participation in public administration. *Public Administration Review*, *58*(4), 317–326.

Lash, J. (1994). Integrating science, values, and democracy through comparative risk assessment. In A. M. Finkel & D. Goldring (Eds.). *Worst things first? The debate over risk-based national environmental priorities* (pp. 69–86). Washington, DC: Resources for the Future.

La Porte, T. R., & Metlay, D. S. (1996). Hazards and institutional trustworthiness: Facing a deficit of trust. *Public Administration Review*, *56*(4), 341–347.

MacLean, D. (1986). *Values at risk*. Totowa, NJ: Rowman and Allanheld.

MacRae, D., & Whittington, D. (1997). *Expert advice for policy choice*. Washington, DC: Georgetown University Press.

Margolis, H. (1996). *Dealing with risk: Why the public and the experts disagree on environmental issues*. Chicago: University of Chicago Press.

Milbrath, L. W. (1981). Citizen surveys as citizen participation mechanisms. *Journal of Applied Behavioral Science*, *117*, 478–496.

Minard, Jr., R. A. (1996). Comparative risk assessment and the states: History, politics, and results. In J. C. Davies (Ed.). *Comparing environmental risks* (pp. 23–61). Washington, DC: Resources for the Future.

Minard Jr., R. A. (1997). Introduction. In *Public involvement in comparative risk projects: Principles and best practices*. Boulder, CO: Western Center for Environmental Decision-Making.

Morgan, M. G., Fischhoff, B., Lave, L., & Fischbeck, P. (1995). A proposal for ranking risk within federal agencies. In J. C. Davies (Ed.). *Comparing environmental risks* (pp. 111–147). Washington, DC: Resources for the Future.

Morgenstern, R. D., Shih, J. S., & Sessions, S. L. (2000). Comparative risk assessment: An international comparison of methodologies and results. *Journal of Hazardous Materials*, *78*, 19–39.

National Research Council. (1996). *Understanding risks: Informing decisions in a democratic society*. Washington, DC: National Academy Press.

Olson, E. D. (1995). *The troubled DC drinking water supply: A preliminary review of problems*. Washington, DC: Natural Resources Defense Council.

Perhac, Jr., R. M. (1998). Comparative risk assessment: Where does the public fit in? *Science, Technology, and Human Values*, *23*(2), 221–233.

Pollak, M. (1985). Public participation. In H. Otway & M. Peltu (Eds.). *Regulating industrial risk* (pp. 76–94). London: Butterworths.

Renn, O., Stegelmann, H. U., Albrecht, G., Kotte, U., & Peters, H. P. (1984). An empirical investigation of citizens' preferences among four emergency scenarios. *Technological Forecasting and Social Change*, 26(1), 11–46.

Renn, O., Webler, T., Rakel, H., Dienel, P., & Johnson, B. (1993). Public participation in decision making: A three-step procedure. *Policy Sciences*, *26*, 189–214.

Rosenbaum, W. A. (1998). *Environmental politics and policy* (4th ed.). Washington, DC: Congressional Quarterly.

Rosener, J. R. (1978). Matching method to purpose: The challenges of planning citizen participation activities. In S. Langton (Ed.). *Citizen participation in America* (pp. 109–121). Lexington: Lexington Books.

Schaeffer, N. C. (1990). Principles of justice in judgments about child support. *Social Forces*, *69*(1), 157–179.

Schrader-Frechette, K. S. (1985). *Risk analysis and scientific method: Methodological and ethical problems with evaluation societal risks*. Boston: D. Reidel.

U.S. Centers for Disease Control. (1994). Assessment of inadequately filtered public drinking water—Washington, DC, December 1993. *Morbidity and Mortality Weekly*, *43*(36), 661–663, 669.

U.S. Environmental Protection Agency. (1996a). *A scientific foundation for setting an environmental agenda, an environmental characterization of the District of Columbia*. Philadelphia: Author, Region 3.

———. (1996b). Water Quality Hotline, August 6.

Velinsky, D. J., & Cummins, J. D. (1994). *Distribution of chemical contaminants in wild fish species in the Washington DC Area*. Washington, DC: District of Columbia, Final Report for District of Columbia, Department of Consumer and Regulatory Affairs, Water Quality Control Branch, Report No. 94-1.

Viellenave, J. H., Fontana, J. V., & Gorody, A. W. (2001). *Environmental risk assessment methods useful for coalbed methane development: Cost-effective ways to manage risk*. Paper presented at 9th Annual International Petroleum Environmental Conference, October 22–25, Albuquerque, New Mexico.