Iowa Comparative Risk Project

Final Report

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IOWA COMPARATIVE RISK PROJECT FINAL REPORT

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I. What is Comparative Risk Assessment?

Comparative risk assessment (CRA) is an approach that prioritizes environmental risks in the areas of public health, ecosystems, and quality of life. Its purpose is to offer guidance to environmental decision-makers challenged with large shopping lists of risks, both real and perceived, and without the necessary resources to tackle all of them at once.

The CRA process begins with the gathering of information on the causes and consequences of a range of environmental problems. It is almost always the case that this information will be insufficient to establish indisputable scientific fact. The process openly acknowledges this uncertainty, and seeks to compensate for it with professional judgment

The Comparative Risk Assessment approach also includes wide public involvement as a complement to the judgments of expert technical committees. This is done in recognition that expert opinion, regardless of how carefully reasoned and crafted, does not always translate into successful policy without public support. William Reilly, former Administrator of the U.S. Environmental Protection Agency, has stated: "we need to improve the translation of scientific knowledge into the vernacular of politics and public opinion, to make rational risk assessment a part of every citizen's common sense."

The hope for every CRA study is that, in the end, the cream that rises to the surface is 1) a generally agreed upon set of environmental issues to be addressed, 2) a select set of ranking criteria, and 3) a qualitative assessment that compares the risks posed by each issue. The final product should possesses the best elements mustered with imperfect knowledge – it is based on best expert judgment; endorsed by public opinion; and provides a framework for environmental decision-making.

II. Structure and Process

The Iowa Comparative Risk Assessment study was conducted from September 1995 through December 1998. It was funded through the U.S. EPA in collaboration with the Iowa Department of Natural Resources (IDNR). The consultant team (see Figure 1, page 2) included principal investigators Dr. William M. Stigliani, Director of the Center for Energy and Environmental Education (CEEE) at the University of Northern Iowa; Dr. Jerald L. Schnoor, Co-Director of the Center for Global and Regional Environmental Research at the University of Iowa; and David L. Dahlquist, of David L. Dahlquist Associates, West Des Moines, Iowa.

As highlighted in Figure 1, the three assessment groups included the public; the four technical committees; and the Public Advisory Committee. Altogether, approximately 600 Iowans participated in the study.

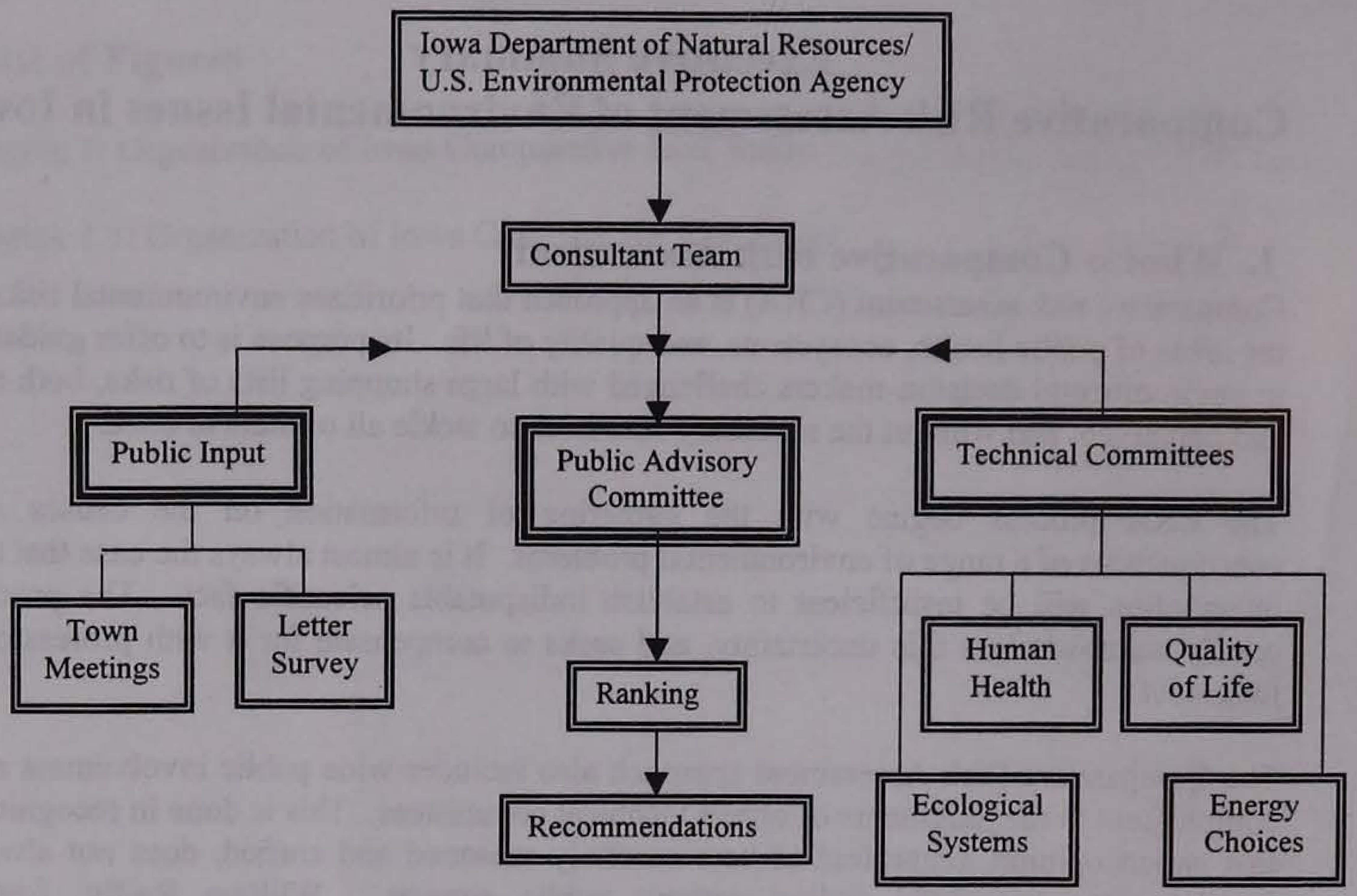

Figure 1
Organization of the Iowa Comparative Risk Study

Public Input

Town meetings. The consultant team facilitated two rounds of town meetings in ten Iowa communities during the spring of 1996 and 1997. The towns visited were Spencer, Missouri Valley, Corning, Dumont, Marshalltown, Corydon, Elkader, Cedar Rapids, Ainsworth, and Burlington. Extensive promotion was conducted prior to the meetings to encourage optimal attendance. On average, about 20 citizens participated in these meetings, corresponding to an overall attendance of about 200.

The participants voiced their concerns about local issues related to public health, ecological systems, quality of life, and energy choices. The purpose of the first phase of meetings was to identify the issues of concern, and the goal of the second phase was to rank the concerns.

Letter survey. An extensive letter survey was prepared by the consultant team. It was divided into six sections covering 25 issues related to public health, ecology, quality of life, and energy choices. The respondents answered questions about their general views of Iowa and its environment, the level of their commitment to environmental stewardship, the importance of specific environmental issues, and their perceptions of future environmental trends. In the autumn of 1996, a mailing was sent to about 950 randomly selected Iowa residents, of which 328 returned the completed survey instrument.

Technical Committees

Three technical committees were created to address the areas of human health, ecological systems, and quality of life. Committee members were recruited on the basis of expertise in given areas. They represented a diverse range of backgrounds and experience – state and county departments of health and natural resources, academia and research centers, civic organizations, the business community, energy providers, and farming.

The committees met as many as five times over the period from spring 1996 to spring 1997. Each committee was charged with developing a short list of issues deemed to pose environmental threats to Iowa. After the lists were formulated the members prioritized them into broad rankings of "severe," "high," "medium," and "low." Following extensive review, each committee published a stand-alone report as one of the final products of the study.

A unique feature of the Iowa study was the employment of a fourth Committee on Energy Choices. The addition of this extra technical component allowed for a rigorous analysis of how different energy choices affect the environmental issues determined by the other committees.

Public Advisory Committee (PAC)

The PAC, which met four times over the period from December 1995 to September 1998, served as a resource for input on overall policy recommendations. Its charge was to increase public input and integrate the diverse perspectives developed in the other components of the study. The committee comprised 30 members affiliated with local and state governments, members of the legislature, civic and environmental organizations, and representatives of agriculture, the electric utilities, and industry.

The specific tasks of the committee were:

- To advise the three technical committees in their deliberations, and to review the design and structure of the two instruments adopted for public polling.
- To provide a public forum for discussion of environmental risks, and review final drafts of the technical committee reports, and the assessment of public polling.
- To integrate the diverse information from the various components of the study, and contribute to a consensus-building process.
- To make final recommendations for setting priorities with regard to environmental problems.
- To recommend action plans for addressing selected problems.

III. Findings from Public Surveys and Technical Committees

The issues identified by the public and by the technical committees were condensed to a final list of 21 environmental concerns. These issues, and the rankings assigned to them, are given in Table 1. Ranking criteria differed among committees. For example, the

Committee on Quality of Life ranked each issue by sense of community, access to quality recreation facilities, economic well-being, and sustaining resources for future generations.

Table 1
Ranking Comparisons Among Three Technical Committees and Public Polling

Issue/Criterion	Quality of Life				Other Assessments		Public Assessments	
	Sen.Com.	Rec.Ac.	Econ.	Fut.Gen.	Health	Eco.Syst.	Letter	TownMtg.
Acid Rain				Low				
Air Pollution		Low	High		Medium	Low	Higher	Lower
Animal Production	Medium	High			High	Severe	Medium	Higher
Biological Alterations		Medium				High	Medium	Higher
Food Safety			High		Medium		Medium	
Global Climate Change				High				
Housing Safety					Medium		Lower	
Hydrological Alterations		Medium				High	Lower	
Improper Hazardous Waste Disposal			Low		Med./Low		Higher	Medium
Non-hazardous Solid Waste	Low				Low		Medium	Medium
Nuclear Waste				Medium			Higher	
Occupational Exposures			Medium					
Overuse of Non-renewable Energy				Medium			Medium	
Ozone Depletion				Medium				
Pesticides	Low	Medium	Medium		Medium	High	Higher	Medium
Private Septic Systems			Low		Low			Medium
Soil Erosion		High	Medium	High		Severe	Medium	Lower
Unacceptable Noise Levels	Low						Lower	
Unbalanced Real Estate Development	Medium	Medium		Medium		Low	Lower	Higher
Water Quality	High	High	High		High	Severe	Higher	Higher
Waste Incineration	Low				Low			

The Table suggests the following risk characterization of the issues:

- The issue of *water quality* stands alone as the highest risk over the widest set of criteria.
- *Animal production*, *soil erosion*, *pesticides*, *biological alterations*, and *food safety* are ranked medium or higher risks in three or more criteria.
- *Air pollution*, *unbalanced real estate development*, *improper hazardous waste disposal*, and *hydrological alterations* are issues with divergent rankings, varying between low and high risks across four or more criteria.

- Low to medium risk issues include *housing safety*, [1] *non-hazardous solid waste*, *occupational exposures*,[2] and *private septic tanks*.[3]

- *Acid rain*, *unacceptable noise levels*, and *waste incineration* were assigned the lowest risk ranking.

- A set of special issues was not evaluated by other criteria, but are of particular relevance to future generations. These include *global climate change*, *nuclear wastes*, *overuse of nonrenewable energy*, and *ozone depletion*. Each was ranked medium or high risk under the criterion "sustaining resources for future generations."

IV. Findings of the Public Advisory Committee

The Public Advisory Committee (PAC) reviewed the issues and the rankings of the public surveys and the technical committees. In its final deliberations, the PAC decided not to distinguish the issues as high, medium, or low risk, because the members felt that most of the issues were of concern and worthy of actions to mitigate their impacts. Rather, it based its analysis on the criterion of "immediacy," i.e., which of the issues were most deserving of actions now or in the near future. Twenty-one PAC members participated in the assessment of the 21 issues. The six issues with the largest number of votes based on the criterion of immediacy were:

- Water Quality
- Housing Safety
- Soil Erosion
- Animal Production
- Global Climate Change
- Overuse of Non-renewable Resources.

The PAC went one step further by identifying "action steps" that could be implemented to reduce the environmental threats related to each issue. Those steps, provided on an issue-by-issue basis in Chapter 3, fall broadly into the following categories:

- Monitoring;
- Reviewing already-existing information programs and action plans;
- Integrating and coordinating already-existing programs;
- Promoting prudent policies, legislative actions, and safe environmental standards;

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[1] Housing safety combines the issues of lead poisoning, household hazardous waste, indoor air, and radon, all of which were treated as individual issues by the Committee on Human Health. The assignment of medium risk was derived by averaging the ranking of these four issues. In fact, the committee ranked the individual issue of lead poisoning among the three highest risks out of a total of 15 issues.

[2] Occupational exposures do not include workers in hog confinements, for which the Committee on Human Health assigned a rank of high risk.

[3]Private septic tanks can be considered a subtopic under the broader concept of water quality, the issue assigned the highest risk.

- Enhancing public education and the availability of technical assistance;
- Testing and screening programs for early detection of problems;
- Thinking strategically about promoting actions that will be the most cost effective and the most environmentally beneficial (win/win situations);
- Including within environmental management strategies, concerns for the needs of future generations; and
- Exploring entrepreneurial opportunities for new markets for environmentally friendly technologies.

V. Follow-Up

The action steps put forth by the Public Advisory Committee offer practical measures for addressing the most immediate environmental concerns in Iowa. Follow-up activities should be devoted to refining and integrating the action steps into a coherent strategic plan for managing the state's most immediate environmental concerns. A great deal of beneficial environmental planning is already in place, and many of the actions called for by the PAC already are implemented in one form or another. Perhaps the most valuable service provided by this study is that it offers a coherent framework with well defined endpoints around which the disparate, on-going work can be coordinated.

In parallel to other initiatives, energy choices can play a major role in reducing the impacts of the issues identified by the PAC. Six examples are:

- **Energy choice:** Continue to minimize the use of nitrogen fertilizer through agricultural energy management programs.
  Issues mitigated: Water quality, global climate change, overuse of nonrenewable energy.

- **Energy choice:** Manage hog manure as a valuable resource rather than as a nuisance waste.
  Issues mitigated: Water quality, animal production, global climate change, overuse of nonrenewable energy.

- **Energy choice:** Plant switchgrass or poplar trees as energy crops on marginal lands.
  Issues mitigated: Water quality, soil erosion, global climate change, overuse of nonrenewable energy.

- **Energy choice:** Continue to increase energy efficiency in buildings.
  Issues mitigated: Global climate change, overuse of nonrenewable energy.

- **Energy choice:** Continue to promote renewable sources of energy in Iowa.
  Issues mitigated: Global climate change, overuse of nonrenewable energy.

- **Energy choice:** Strengthen existing programs and initiatives to improve transportation efficiency and promote less-polluting alternative fuels.
  Issues mitigated: Global climate change, overuse of nonrenewable energy.

Chapter 1
Overview of Comparative Risk Assessment

What is comparative risk assessment?

Comparative risk assessment (CRA) is an approach that prioritizes environmental risks in the areas of public health, ecosystems, and quality of life. Its purpose is to offer guidance to environmental decision-makers with large lists of risks, or perceived risks, and without the necessary resources to tackle all of them at once.

The CRA process begins with the gathering of information on the causes and consequences of a range of environmental problems. It is almost always the case that this information search will be insufficient to establish indisputable scientific fact. The process openly acknowledges this uncertainty, and seeks to compensate for it with professional judgment.

Consciously factored into the CRA process is an effort to include wide public involvement as a complement to the judgments of expert technical committees. This is done, in part, in recognition that expert opinion, regardless of how carefully reasoned and crafted, does not necessarily translate into successful public policy, particularly if the issues are beyond the understanding of the general public. In support of the process, William Reilly, Administrator of the U.S. Environmental Protection Agency (EPA) in the Bush Administration, has stated: "we need to improve the translation of scientific knowledge into the vernacular of politics and public opinion, to make rational risk assessment a part of every citizen's common sense."

Thus, in the last step of the CRA process, the final result is a general consensus on the prioritizing of the range of issues being considered. This prioritization is based on best expert judgment, endorsed by public opinion, and provides a framework for environmental decision-making.

The U.S. EPA developed the CRA methodology in 1986, and published it in the landmark study *Unfinished Business* in 1987. Since then, all of EPA's ten regional offices have completed CRAs relevant on the regional scale. These studies are now being used in strategic planning efforts in the regions by emphasizing greater technical support and funding in areas deemed to be of greater risk. Twenty-five states have completed, or are completing, their own CRA studies, mostly through EPA support.

EPA is encouraging CRAs on state and regional scales for two reasons. First, environmental concerns differ greatly from one area to another (risks in Nevada are different from the risks in Alabama). Second, the task of setting rational, cost-effective, and publicly supported national environmental policies is improved when major efforts have been made in states and regions to articulate their environmental concerns.

The Iowa Comparative Risk Assessment Study

The Iowa study was conducted from September, 1995 through December, 1998, and was funded through collaboration between the U.S. EPA and the Iowa Department of Natural Resources (IDNR). The principal investigators for the study were Dr. William M. Stigliani, Director of the Center for Energy and Environmental Education (CEEE) at the University of Northern Iowa; Dr. Jerald L. Schnoor, Co-Director of the Center for Global and Regional Environmental Research at the University of Iowa; and David L. Dahlquist, of David L. Dahlquist Associates, West Des Moines, Iowa.

The overall structure of the study is presented in Figure 1.1. Table 1.1 (see page 3) shows the time line for progress and completion of the various components. Altogether, approximately 600 Iowans participated in the process.

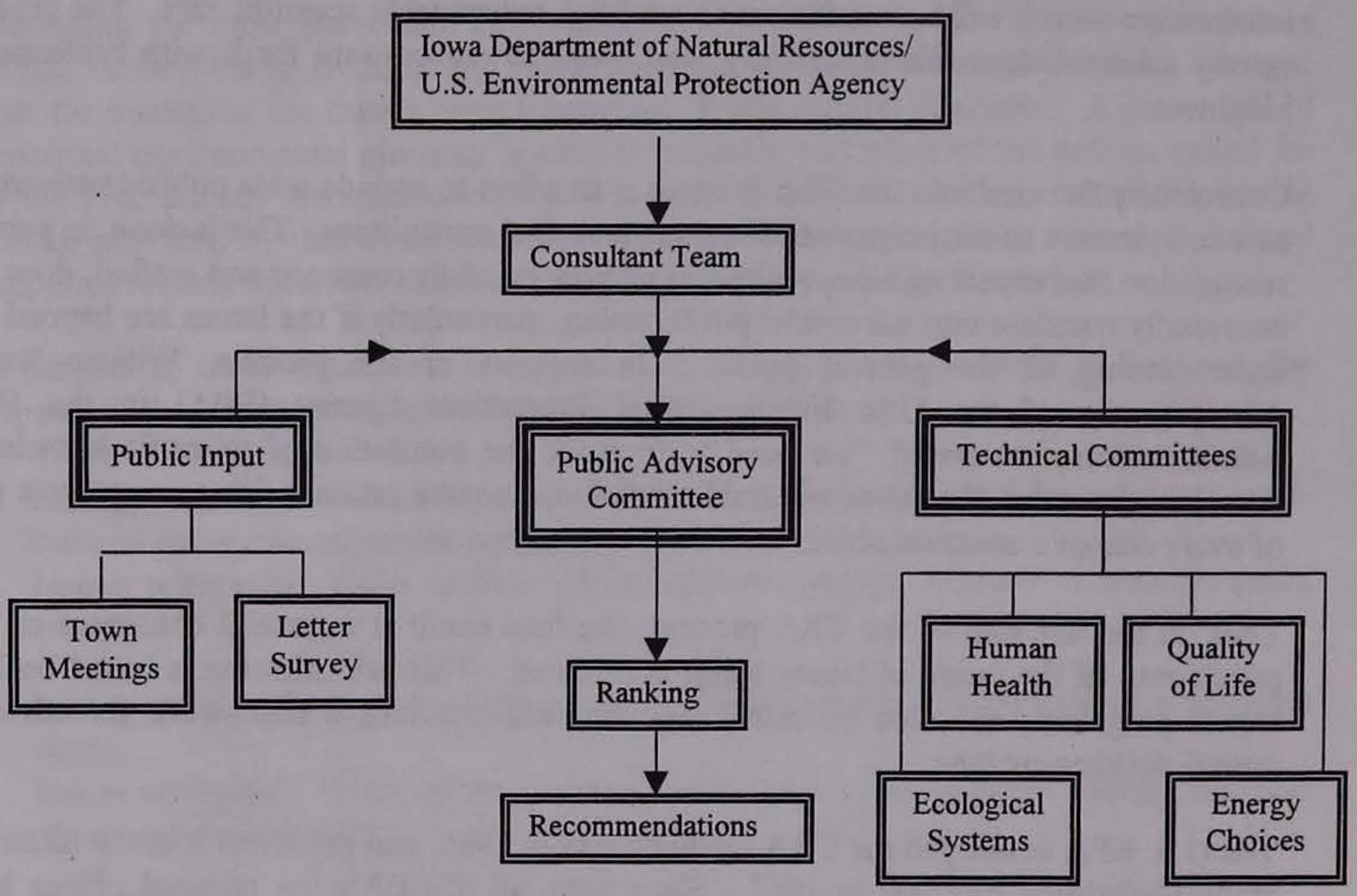

Figure 1.1
Organization of the Iowa Comparative Risk Study

Similar to other CRA studies, the Iowa study was served by three technical committees -- the Committees on Human Health, Ecological Systems, and Quality of Life. These committees were charged with developing a short list of issues (21 in the final analysis) deemed to be the most serious facing Iowans today and in the future. After the lists were formulated independently by each committee, the members prioritized them into broad rankings such as "high," "medium," and "low." After extensive review, each committee published a stand-alone report as one of the final products of the study (see Appendix 1).

Table 1.1
Time Line
Iowa Comparative Risk Study

Time / Activity	1995	1996				1997				1998			
	9-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12
Letter Survey			X	X	X	X							
Town Meetings		X	X		X	X	X						
Human Health		X	X	X	X	X7	X	X	X	X			
Ecological Systems			X	X	X		X	X	X				
Quality of Life		X	X		X		X	X					
Energy Choices			X				X	X	X				
Pub. Adv. Comm.	X				X				X			X	
Final Report													X

A unique feature of the Iowa study was the employment of a fourth technical Committee on Energy Choices. The addition of this extra technical component allowed for a rigorous analysis of how different energy choices would affect the environmental issues determined by the other committees. This effort is summarized in a final report (see Appendix 1).

Public Input

Two opportunities were created for public input. The first was a comprehensive letter survey mailed to approximately 1,000 Iowa residents representative of the Iowa public at-large. Approximately 35 percent returned completed questionnaires. The results of the survey were thoroughly analyzed and published in a final report (see Appendix 1).

The second instrument for assessing public opinion about environmental problems was through town meetings. Ten Iowa towns and cities participated in two rounds of meetings in spring of 1996 and 1997. A long list of environmental issues was discussed. The issues included those raised by the technical committees, and the citizens were encouraged to raise other issues not on the lists. During the second round of meetings, the issues were ranked, after which a final report was produced (see Appendix 1) and included as a component of the final deliberations of the Public Advisory Committee (PAC).

The PAC guided the study throughout the entire process. This committee was comprised of a group of 30 members representing state government, universities, industries, electric utilities, citizens and environmental advocacy groups. The PAC provided assistance and reviewed progress in every phase of the study, including the development of lists of environmental issues, criteria for ranking the issues, and final draft committee reports. They also had the task of formulating an integrated ranking of risks based on their review and appraisal of all components of the study. Their analysis is described in detail in Chapter 3 of this report.

The results and conclusions of the study reflect wide public participation, and provide a basis for taking further steps in the process of establishing a strategic environmental plan for the state.

Chapter 2
Findings of the Technical Committees and Public Perceptions of Risk

I. Report of the Technical Committee on Human Health

Mission and Accomplishments

The Technical Committee on Human Health was assembled to provide an objective, scientific point of view within the context of the Iowa Comparative Risk Assessment Study. The most important accomplishments of the Committee are:

- Selection of a set of 15 health-related environmental issues that were approved by the Public Advisory Committee.

- A uniform methodology for studying relative human health risks in Iowa from selected environmental issues.

- A consensus report based on the comparative evaluation of environmental issues that affect human health in Iowa.

Membership

Members of the Committee on Human Health were selected to provide expertise in areas of critical health concerns. Thus, they represented interests covering epidemiology, human toxicology, and human-health risk assessment. The six members included:

- Brad Cudal, M.D. (Chair); Environmental Epidemiologist, Iowa Department of Public Health

- Russell Currier, D.V.M., Iowa Department of Public Health

- Mark Linda, M.P.H., Disease Prevention Manager, Black Hawk County Department of Public Health

- Chad Roy, M.S.P.H., Graduate Research Assistant, The University of Iowa College of Medicine

- Peter Weyer, M.S., Director, The Center for Health Effects of Environmental Contamination

- Jane Gyo, M.S., Graduate Research Assistant, The University of Iowa College of Engineering

In addition, Tara Boodhoo, David Cornellder, and Stephen Soehnlen, a working group of graduate students from the University of Iowa, assisted in the collection and analysis of data.

Boundaries and Scope

The committee's study was restricted to the state of Iowa. The geographic boundaries, however, often did not coincide with available studies and data. Committee research was coordinated with data from the Iowa Department of Natural Resources, the Iowa Department of Public Health, and other state agencies.

The scope of "environmental risk" was defined by the list of 15 issues adopted by the Human Health Committee. The issues are given in Table 2.1 and precisely defined in Appendix 2.

Table 2.1
Environmental Issues[a] List Identified by the Committee on Human Health

• Agricultural and Animal Production • Food Safety • Global Issues • Household Hazardous Waste • Indoor Air • Lead Poisoning • Medical Waste • Non-hazardous Solid Waste	• Outdoor Air Quality • Pesticide Exposures • Private Septic Tanks • Radon Exposure • RCRA[b], CERCLA[c], and Federal Facilities • Underground Storage Tanks • Water Quality

[a]Issues are listed in alphabetical order.
[b]RCRA is acronym for the Resource Conservation and Recovery Act.
[c]CERCLA is acronym for the Comprehensive Environmental Response Compensation and Liability Act.

The issues were selected from lists provided by the U.S. EPA, as well as from specific, Iowa-related issues identified by the committee. Members had two opportunities for input into this list before it was officially adopted. For a few issues, such as food safety and nonhazardous solid waste, the committee was unable to conduct a complete and comprehensive assessment either because of insufficient data, or the inability to identify knowledgeable experts. In these cases, staff assigned to the committee, and under supervision of the committee chair, prepared summary reports on the state of current knowledge.

Analytical Criteria

Six criteria were judged to be most important in analyzing and comparing the human health effects of the risks under study. These included:

- ***Population Potentially Exposed.*** How many people are exposed to a particular stressor. (A stressor is defined as a chemical that, above a given threshold limit, induces chronic or acute adverse human health effects in the exposed population.)

- ***Severity of Effect to Exposure.*** Effect can range from mild, short-term effects (low severity) to mortality (high severity).

- ***Level of Exposure to Cause Health Effects.*** Does the chemical or biological stressor in question have an exposure level (or threshold level) below which no effects occur?

- ***Irreversibility of Health Effect.*** Can the effect on human health be reversed after the stressor ceases?

- ***Probability of an Event Occurring.*** Disease response of humans exposed to certain chemical stressors can be extremely severe, for example, lung cancer from the repeated inhalation of tobacco smoke. The probability of exposure, however, may be extremely low. In an overall risk assessment, severity of exposure would be weighted with probability of exposure.

- ***Degree of Scientific Certainty.*** A measure of how well the health effect and its cause are understood, including confidence in exposure data and the dose-response curve used in estimating the risk.

Method of Analysis

The committee generally adopted a method recommended by the U.S. Environmental Protection Agency (EPA), based on its experience with a number of national, regional, state, and local comparative risk analyses.

The concept of comparative risk is explained in the EPA's *A Guidebook to Risks and Setting Environmental Priorities* (EPA, 1993), as well as in state and other comparative risk reports. It is important to address all environmental problems affecting the state, and to provide guidance concerning those having the most significant effects today. Concerns ranked higher on the list tend to be areas in which existing regulations and practices do not adequately safeguard public health or, alternatively, areas in which existing information leaves such uncertainty that great prudence is called for. Ultimately, residual risk cannot be measured with a specific number or set of concrete indicators. Much of the human health data used is narrow or qualitative and required professional judgment for its interpretation.

The Human Heath Committee decided to work from exposure to effect rather than tracing effects (using mortality and morbidity data) back to exposures. Members were not asked to conduct original research. Instead, the analyses were to be based on existing data, supplemented by reports available from Iowa's state agencies. The committee also relied upon members' best professional judgment.

Analytical Process

The analyses conducted by the Human Health Committee are best characterized as qualitative risk assessments. The purpose of these analyses was to provide the Public Advisory Committee background material in their ranking of the risks. Given the limited scope of the program (in both time and resources) and the data limitations noted earlier, it is to be expected that the studies are generally qualitative and are not intended to be definitive scientific statements of risk.

Committee members drafted each of the chapters analyzing the individual concerns/risks. Draft reports were circulated to each committee member and also sent for external review. Reviewers were asked to judge the following aspects:

- technical competence;
- logic and clarity of analysis;
- accessibility to an interested public audience;
- usefulness as a background to risk ranking; and
- data or studies not included that would have influenced analysis or conclusions.

Uncertainty

Estimating the expected health effects in a population from an exposure is neither new nor unusual. Indeed, risk assessment has developed into a discipline studied and practiced by many. The above terms and reasoning used in the human health analysis, therefore, may be familiar. In considering all the studies, however, it is useful to keep the following precautions in mind:

- For many topics (e.g., hazardous air pollutants), sufficient data have not been collected because of the lack of availability.

- Geographic subpopulations are very difficult to study. Existing data are very difficult to access or use, given available resources.

- Where risk estimations are presented, the estimate may overstate actual risk because of the assumptions employed (e.g., an analysis based upon all persons in a county being exposed equally to a pollutant dispersed from a single point source).

- Conversely, risk estimates may understate actual risk because total body burdens (either of multiple exposures to one agent or simultaneous exposures to several agents) were not taken into account.

- The committee relied on qualitative judgment for risk determination, rather than traditional quantitative estimation.

Findings

Table 2.2 (see page 9) shows the comparative risk ranking by consensus of the Human Health Committee. Risks within each category are considered roughly equivalent and so

are listed in alphabetical order. The explanation for each category was distilled from the committee's discussions and was not developed ahead of time as the organizing factor for each category. Individual assessments provide an explicit and pertinent explanation for the ranking of each topic.

Table 2.2
Comparative Rankings of Environmental Issues Related to Human Health in Iowa

Category[a]	Environmental Issues Ranked[b]
High: widespread health effects, some serious; affects all demographic groups in the state	• Agricultural & Animal Production • Lead Poisoning • Water Quality
Medium: health concerns identified; current standards are uneven; no centralized regulatory or monitoring efforts to identify or minimize risks	• Food Safety • Indoor Air • Outdoor Air Quality • Pesticide Exposures • Radon Exposure • RCRA, CERCLA, and Federal Facilities
Low: health effects unknown, rare, or local instead of statewide	• Global Issues • Household Hazardous Wastes • Medical Waste • Non-hazardous Solid Waste • Private Septic Tanks • Underground Storage Tanks

[a]Description identifies common concerns among issues ranked within category.
[b]Listed within categories in alphabetical order; no ranking within categories is assigned.

High risks. These concerns can cause serious health effects that may be occurring at significant rates in the state. Agricultural and animal production show high rates of injury and illness among workers employed in this industry. With respect to lead risk, state data indicate rates of blood-lead levels in Iowa children exceeding the federal action level. Water quality data from the state shows levels in some municipalities and private wells exceeding the federal and state water quality standards.

Medium Risks. For these concerns, the committee identified specific adverse health effects that may be occurring in the state. The current standards are uneven in protecting the most sensitive exposure groups.

It is important to note that at the final Public Advisory Committee (PAC) meeting, the issue of "Housing Safety" was raised as an issue of great and immediate concern. The committee on Human Health considered the multiple issues comprising Housing Safety. As defined by the PAC housing safety encompasses the issues of "indoor lead," "indoor air quality," "radon exposure," and "household hazardous waste." Table 2.2 shows that

"lead poisoning" was ranked high risk, "household hazardous wastes" a low risk, and "indoor air" and "radon exposure" ranked medium risk. Averaging these four values results in an overall score of medium, although such averaging may not adequately reflect the severity of the risk from indoor lead poisoning.

Similarly, the PAC identified the issue of "improper hazardous waste disposal," which was not explicitly addressed by the Human Health Committee. Two related issues, however, were considered: (1) "RCRA, CERCLA, and federal facilities," was ranked medium risk; and, (2) "underground storage tanks" was ranked low risk.

Low Risks. This category includes risks for which effects are unknown, rare, or local instead of statewide.

II. Report of the Technical Committee on Ecological Systems

Mission and Accomplishments

The Technical Committee on Ecological Systems established the following three goals for its analysis:

- To use sustainable practices in maintaining the majority of the land as a productive agricultural landscape.

- To promote the functioning and integrity of natural areas that currently exist.

- To promote the restoration and reconstruction of pre-settlement ecosystems, particularly in areas inappropriate for agricultural production with an emphasis on ecological services, i.e. aesthetics, environmental protection, biodiversity, biological heritage, and economics.

The committee described and analyzed the impact of each environmental issue on Iowa's terrestrial and aquatic ecosystems. These systems were defined broadly to be: wetlands, aquatic, and riparian systems; remnant forests and prairies; and agricultural systems.

Noting the unique characteristics of Iowa's many regions, the committee created an original map that divided the state into seven ecoregions, each with different attributes This allowed for the issues (e.g., air pollution and soil erosion) to be addressed according to ecoregion.

Membership

Members of the Committee on Ecological Systems were selected to provide expertise in areas of critical ecological concerns. They represented a wide range of interests covering aquatic, terrestrial, and prairie ecology, as well as agricultural systems and toxicology. The members included:

- Sherry Baudler, Environmental Specialist, Iowa Department of Natural Resources

- Don Bonneau, Fisheries Research Supervisor, Iowa Department of Natural Resources
- Dennis Keeney, Director, Leopold Center for Sustainable Agriculture
- Terry Little, Wildlife Research Supervisor, Iowa Department of Natural Resources
- Bruce Menzel (Chair), Department of Animal Ecology, Iowa State University
- Jerry Schnoor, Co-Director, Center for Global and Regional Environmental Research, University of Iowa
- Daryl Smith, Leader, Roadside Management Project, Center for Energy and Environmental Education, University of Northern Iowa

The work of the committee benefited enormously from the assistance of the Western Center for Environmental Decision-Making (Boulder, CO). In particular, Kate Kramer and Sarah Tollison Fox provided countless hours of staff time collecting and organizing data, and offering expert counsel for the final ranking.

Boundaries and Scope

After careful study of a larger group of issues, the committee focused on ten deemed to be the most important threats to Iowa's ecological systems. These are presented in Table 2.3.

Table 2.3
Environmental Issues[a,b] List Identified by the Committee on Ecological Systems

• Air Pollution • Animal Production • Biological Alteration • Global Change • Hydrological Alterations	• Land and Soil Contamination • Pesticides • Physical Alterations • Soil Erosion • Water Quality

[a]Issues are listed in alphabetical order.
[b]See Appendix 2 for definitions of issues.

Before ranking the issues, the committee discussed three overriding aspects. First, increased human settlement in the mid-to-late 1800s led to extensive agriculture which eventually altered most ecological systems. Ecosystems existing today are fragmented and bear little resemblance to ecosystems of 200 years ago. The committee noted that the impacts on present-day ecosystems by environmental stressors are minor compared with the comprehensive changes that have occurred to ecosystems in the past. However, no member of the committee advocated returning Iowa to its original state. In fact, the first goal of the committee was to work with the existing agricultural system in Iowa.

Second, the committee noted that ranking impacts on ecosystems is difficult because they are interdependent, and the impacts of environmental stressors are often neither discreet nor quantifiable. The committee viewed the landscape holistically, realizing that drawing boundaries is not entirely possible. However, the committee ranked the issues in order to draw attention to them as important stressors, and to differentiate their impacts on diverse ecosystems across Iowa.

Third, finding it difficult to rank the issues numerically, the committee grouped them into clusters of *severe*, *high*, *low*, and *other* risks. The latter cluster was reserved for the issue of "global change." It was ranked as a separate category because (1) it is not known how ecosystems would respond to climate changes in time periods as short as 100 years, and (2) there are limited data for the impact of climate change on Iowa. Thus, the committee determined that although the issue is potentially of high concern, it is not possible to compare it with other risks.

Analytical Criteria

The committee based its analysis on five ranking criteria deemed to be most critical when assessing ecological problems. These include:

- ***Extent and Uniqueness.*** Size of area affected; uniqueness and connectivity of ecosystem.

- ***Severity of Impact.*** A measure of changes in function (productivity, nutrient cycling, water filtration, etc.) at the designated level of biological structure affected (i.e., population, community, ecosystem) with regard to potential or future impacts.

- ***Recoverability of Ecosystems.*** A measure of the ability of an ecosystem to recover from ecological damage if the stressor was removed.

- ***Duration/Frequency of Impact.*** A measure of the length of time that the stressor affects the receptor and a measure of the length of time between intervals of the stressor's presence.

- ***Confidence in Knowledge of Impacts.*** A measure of how well the problem is understood, in addition to the amount and quality of data including confidence in the impact and confidence in cause and effect.

Method of Analysis

The committee began the ecological analysis with an evaluation of baseline and trend data. Prairies, meandering streams, savannas, small areas of hardwood forests, wetlands, abundant wildlife, and aquatic life composed Iowa's landscape at the end of the 1700s. With the impact of Euro-American settlement in the mid-1800s, the lands and ecosystems of Iowa were irrevocably changed.

The committee emphasized two basic ecological principles, relating them to the ranking task. The first principle is the inter-related nature of species within ecosystems. Species

are dependent upon one another for survival. Species are part of habitats within ecosystems, which allow them to fulfill their role in a larger food web. The second principle is that organisms interact with their environment creating many interdependent ecosystems. In Iowa, absolute boundaries between ecosystems are not defined.

The committee stressed these principles because the structure of analysis and ranking required them to separate the impacts of the environmental issues/stressors on individual ecosystems. They agreed that separation was necessary for this document and exercise, but wanted to emphasize the importance of the holistic view of ecology in Iowa.

Analytical Process

Understanding the differences in ecosystem definitions is a necessary initial task in comparative ecological risk assessment. The committee decided to evaluate the state by ecoregions as well as by ecosystems. They believed differences in Iowa's topography, climate and soils could be evaluated to define seven different ecoregions. The premise was that each stressor could have a different impact on ecosystems in the unique ecoregions in Iowa. The final ranking process did not, however, involve an evaluation of the risks to each ecoregion. The similarities of the issues made an ecoregion ranking difficult. The committee implemented the following steps:

- identify goals;
- designate assessment endpoints;
- compile baseline ecological information;
- identify ecological stressors;
- define ecological risk criteria;
- designate measurement endpoints;
- analyze and evaluate information; and
- rank issues.

Uncertainty

The ranking process is somewhat uncertain due to the assumptions that must be made in comparing risks from different stressors. Species are part of habitats within a given ecosystem and are dependent upon one another for their survival. Moreover, ecosystems themselves are somewhat interdependent, making the borders between them unclear. The ranking process required the committee to separate the impacts of the environmental issues/stressors and to consider discreet ecosystems. This separation was necessary for the ranking exercise, but at the cost of losing the holistic view of Iowa's ecological systems.

Findings

Table 2.4 (see page 14) shows the rankings of the issues by the Committee on Ecological Systems. *Severe risk* was assigned to "animal production," "soil erosion" and "water quality." "Animal production" was actually listed in the report as a category under "water quality." However, when the ranking information was presented to the Public Advisory Committee, it was suggested that the issue should be treated as a distinct and

separate issue. It was also suggested that "pesticides," a major factor impacting water quality, should be treated as a stand-alone issue with high risk.

Table 2.4
Comparative Rankings of Environmental Issues Related to Ecological Systems in Iowa

Category[a]	Environmental Issues Ranked[b]
Severe: affects all parts of the state; causes serious environmental harm to aquatic ecosystems; damages and losses in many cases are irreversible, trends on-going, good supporting evidence.	• Animal Production • Soil Erosion • Water Quality
High: affects all parts of state; changes often irreversible; long duration of impacts; rate of damage somewhat slower than in past; good supporting evidence.	• Biological Alterations • Hydrological Alterations • Pesticides
Low: Most of damage has already occurred; effects are not statewide, and impacts are not severe.	• Air Pollution • Land and Soil Contamination • Physical Alterations
Other: Potentially serious impacts, but currently no way to evaluate.	• Global Change

[a]Description identifies common concerns among issues ranked within category.
[b]Listed within categories in alphabetical order; no ranking within categories is assigned.

III. Report of the Technical Committee on Quality of Life

Mission and Accomplishments

Environmental problems can impact entire communities, shaping how they use their resources and maintain their shared community values. These impacts are not always easily captured in assessments of human health and ecosystems, but are still important. For example, the value that Iowans place on having abundant, good-quality groundwater, or accessible and productive fishing and hunting areas, is important to both the state's economy and to its residents' sense of place.

A comparative risk project analyzes these less quantitative impacts under the category of "quality of life." While not capturing the entire universe of potential impacts, the analysis seeks to identify key aspects to consider with the goal of minimizing the negative effects on communities across Iowa. Coverage includes both economic and social effects related to specific environmental issues for both present and future generations.

The Technical Committee on Quality of Life provided a systematic appraisal of the impacts of environmental stresses on the socio-economic character and values of communities statewide. This analysis is reflected in the following committee outputs:

- A set of selected environmental issues linked to quality of life in Iowa.
- A specific set of community-level ranking criteria for assessing and comparing actual and potential impacts.
- A report that describes quality-of-life impacts associated with the defined set of environmental issues.

Membership

Members of the Committee on Quality of Life were selected to provide expertise in areas important to quality of life in Iowa. They represented interests covering farming, rural life, commercial development, social and economic factors and trends, and emerging issues of concern to future generations. The seven members included:

- Gary Guthrie, Farmer, Nevada, Iowa
- Katy Hansen, President, United Nations Association USA, Iowa Division
- Paul Lasley, Rural Life Poll, Department of Sociology, Iowa State University
- Myrt Levin, Iowa Business Council
- Janet Rives, Department of Economics, University of Northern Iowa
- Vernon Ryan, Department of Sociology, Iowa State University
- Susan Salterberg, National Sustainable Consumption Initiative, Center for Energy and Environmental Education, University of Northern Iowa

Boundaries and Scope

Although "quality of life" is an all encompassing concept with issues as far-ranging as alcohol abuse, public education, and crime, the committee agreed to limit its definition to valued living conditions that are particularly sensitive to changing environmental issues (stressors).

Another boundary condition was that the committee did not define its own issues. Rather, it selected 20 of them from the larger list compiled from four sources within the Iowa Risk Study: (1) the report of the Technical Committee on Human Health; (2) the report of the Technical Committee on Ecological Systems; and (3) the letter survey to the Iowa public; and (4) citizens' discussions at ten designated towns and cities in Iowa. These issues are presented in Table 2.5 (see page 16).

Table 2.5
Environmental Issues[a,b] List Identified by the Committee on Quality of Life

• Acid Rain • Air Pollution • Animal Production • Biological Alterations • Food Safety • Global Climate Change • Hydrological Alterations • Improper Hazardous Waste Disposal • Non-hazardous Solid Waste • Nuclear Wastes	• Occupational Exposures • Overuse of Non-renewable Energy • Ozone Depletion • Pesticides • Private Septic Systems • Soil Erosion • Unacceptable Noise Levels • Unbalanced Real Estate Development • Water Quality • Waste Incineration (municipal & medical)

[a]Issues are listed in alphabetical order.
[b]See Appendix 2 for definitions of issues.

Analytic Criteria

The first step in selecting the ranking criteria was the formulation of an operational definition of "quality of life." Following extensive deliberations, the committee crafted the following description:

> ***Quality of life analysis involves looking at the impacts of environmental issues on:***
>
> - ***sense of community;***
> - ***access to quality recreational facilities;***
> - ***economic well-being;***
> - ***sustaining resources for future generations***
>
> ***as they affect urban and rural communities in Iowa.***

The four components in this definition comprise the ranking criteria for measuring impacts of the selected environmental issues on quality of life. The meanings of these criteria are as follows:

Sense of Community. Includes trust, values, collective action, integrity of relationships and neighborhoods, local control of businesses, local land ownership and stewardship, job opportunities and alternative means of working (e.g., telecommunications).

Some examples of negative impacts on sense of community include: (1) urban sprawl and development changing the appearance and unique identity of a town; (2) loss of mutual respect, cooperation, ability, or willingness to solve problems together; (3) individual liberty exercised at the expense of the common good; (4) community authority exercised at the

expense of the common good; (5) loss of working landscape and the connection between people and the land.

Access to Quality Recreation Facilities. Concerns capacity of populations to have access to rest, relaxation, and aesthetic enjoyment.

Aspects that have negative impacts on the criterion include: (1) overuse of recreational areas due to insufficient space to accommodate users; (2) degraded quality of recreation experience (such as spoiled wilderness, turbid streams); (3) reduced visibility and impact from degradation of natural or agricultural landscapes.

Economic Well-Being. Includes economic sustainability, job opportunities and stability, economic fairness and justice.

Examples of negative impacts are: (1) higher out-of-pocket expenses to fix, replace, or buy items or services (such as higher waste disposal fees, cost of replacing a well, higher housing costs); (2) lower income or higher taxes due to the problem; net loss of jobs or value because of the problem; (3) health care costs and lost productivity; (4) unequal distribution of costs and benefits (costs and benefits may be related to economics, health, or any other quality of life criteria).

Sustaining Resources for Future Generations. Includes the preservation of cultural memories, and sustaining the ecological needs of our children's and grandchildren's generations.

Negative impacts concern shifting the costs (such as economic costs, health risks, ecological damage) of today's activities to people not yet able to vote or not yet born.

Method of Analysis

As its starting point, the committee used an approach recommended by the U.S. Environmental Protection Agency based on its experience with a number of national, regional, state, and local comparative risk analyses.

The meaning and measurement of quality of life as applied in this report evolved from several operational steps. First was the culling of 20 selected issues from the other Iowa risk reports, and listed in Table 2.5. Second, the committee classified the issues into each of the categories defined by the four selected criteria. Some issues were included in as many as three criteria (e.g., water quality and pesticides), while others only appeared under one criterion (e.g., global climate change and ozone depletion). The issues were ranked as high, medium, or low.

Analytical Process and Uncertainties

The analysis conducted by the Technical Committee on Quality of Life is "qualitative" risk assessment. The purpose of this report was to provide the Public Advisory Committee with background material in its ranking of overall risks in the areas of human health, ecological systems, and quality of life. Given the limitations of the study with regard to time, resources, and data availability, this report, as well as other reports of quality of life in general, is qualitative and not intended to provide quantitative scientific statements of risk.

In considering this study, it is important to keep the following caveats in mind:

- The analysis of uncontrolled social phenomena is not a precise undertaking. The report attempts to provide plausible interpretations of actual and potential responses to environmental impacts. It does not assert to be the definitive statement on all these issues.

- Where data were not available on the impacts of certain issues within Iowa, the committee attempted to identify similar impacts and observations in other areas of the country to approximate the impacts in this state.

- Not all potentially relevant issues were addressed.

Findings

Table 2.6 (see page 19) presents the final rankings. The Quality of Life Committee was the only one to identify how the issues ranked for each of the individual analytical criteria. It did so because of the wide scope of social and economic issues that needed to be addressed. The committee did not feel that an "overall ranking" obtained by averaging the ranks over the four criteria would be meaningful.

"Water quality" and "soil erosion" appear as particularly high risks across a range of criteria. Another important feature of this analysis is that "global climate change" is ranked as a high risk under the criterion of future generations. Not all stressors show immediate environmental effects. There are many examples where effects are time-delayed due to natural buffering processes. Global climate change is one such example.

Table 2.6
Comparative Rankings of Environmental Issues Related to Quality of Life in Iowa

Issue	Quality of Life Criteria			
	Sense of Community	Recreation Access	Economic Well-Being	Future Generations
Acid rain				Low
Air pollution		Low	High	
Animal production	Medium	High		
Biological alterations		Medium		
Food safety			High	
Global climate change				High
Hydrological alterations		Medium		
Improper hazardous waste disposal			Low	
Non-hazardous solid waste	Low			
Nuclear wastes				Medium
Occupational exposures			Medium	
Overuse of non-renewable energy				Medium
Ozone depletion				Medium
Pesticides	Low	Medium	Medium	
Private septic systems			Low	
Soil erosion		High	Medium	High
Unacceptable noise levels	Low			
Unbalanced real estate development	Medium	Medium		Medium
Water quality	High	High	High	
Waste incineration	Low			

IV. Public Input: Letter Survey on Choices for Iowa's Environment

The firm of David L. Dahlquist, Inc., was contracted to develop and administer a letter survey to the Iowa public. This initiative covered an important aspect of the comparative risk assessment process, i.e.; to poll the public for their views and perceptions about risks concerning a variety of environmental problems.

Methods

The 1996 Survey of Public Attitudes Toward the Environment in Iowa, developed by David L. Dahlquist Associates, Inc., was reviewed and approved by the Public Advisory Committee and members of the technical committees.

A pre-test of the questionnaire was conducted in August of 1996. Thirty individuals were randomly selected from those who had participated in the first phase of the town meetings (see Part V, page 23). A draft questionnaire was completed and suggestions were made for minor modifications, which were incorporated into the final version of the letter. The revised final survey was mailed to a sample of about 1,000 randomly chosen Iowans. The sampling criteria were: 1) residents over 18 years of age; 2) equal gender distribution; and 3) statewide geographic distribution.

To obtain a representative sample of the Iowa population, a database was acquired from TRW Market Services of Dallas, Texas. Their compiling procedures consisted of using credit grantor records; driver's license information; voter registration information; motor vehicle data; and data from questionnaires, publications, direct mail, real estate deed recordings, birth records, tax assessor files, telephone white pages, and other public records.

In January of 1996, TRW provided a sample of 2,500 names and addresses of Iowa residents meeting the three criteria noted above. From the original sample of 2,500 residents, 1,000 names were randomly selected. In the end, after accounting and compensating for mailings listed "incorrect address" and "unable to locate," the actual sample size receiving the survey was 940, of which 328 completed and returned the survey instrument. This corresponds to a response rate of 35 percent, which provided a statistical confidence level of 95 percent.

Survey Results

The letter survey was formulated at the beginning of the study. Issues were chosen from initial lists of the various committees and others provided by U.S. EPA. This list is not precisely the same as the final lists developed at later dates by the technical committees. Nevertheless, most of the issues addressed in the survey relate closely to those evaluated by the Public Advisory Committee (PAC) in its final deliberations.

Column 1 of Table 2.7 (see page 21) lists the 25 issues as they were initially evaluated in the public survey. Column 2 gives the percentage of respondents that ranked the issue as "one of the most serious" or "very serious." The third column lists the issues as worded in the final assessment by the Public Advisory Committee. This column correlates the issue, as worded in the original letter survey (column 1), to the issue as presented to the PAC.

To compare the rankings of the issues by the public survey to the rankings by the technical committees and the PAC, a ranking scale of "higher," "medium," and "lower" risks was assigned, based on the percentages given in column 2 of Table 2.7. If the score was 75 percent or more, the risk was assumed to be higher; for the range between 60 percent and

percent and 74 percent, the issue was ranked medium; if it was less than 60 percent, it was ranked lower. This scheme is somewhat arbitrary, but does provide a basis for comparing the risks addressed in the survey. The results are presented in Table 2.8 (see page 22).

Table 2.7
Issues and Rankings of Letter Survey
Relation of Issues to Final Issues Considered by the Public Advisory Committee

Issue Examined in Survey	Seriousness[a] (%)	Related Issue in PAC Assessment
Loss of plant and animal species	68.7	Biological alterations
Loss of wetlands	55.2	Biological/Hydrological alterations
Improper use of industrial chemicals	79.5	Improper hazardous waste disposal
Loss of forests	67.1	Biological alterations
Declining water quality in lakes/rivers	84.0	Water quality
Unacceptable outdoor air quality	78.7	Air pollution
Petroleum contamination/underground storage tanks	67.6	Improper hazardous waste disposal
Lack of solid waste disposal facilities	68.8	Non-hazardous solid waste
Improper use of agricultural chemicals and fertilizers	77.2	Pesticides
Inadequate treatment of livestock wastes	72.8	Animal production
Excessive soil erosion	65.7	Soil erosion
Unsafe food due to pesticides	74.0	Pesticides/Food safety
Overuse of non-renewable sources of energy	60.4	Overuse of non-renewable energy
Improper disposal of nuclear wastes	81.7	Nuclear wastes
Closing some state parks	33.4	(n/a)[b]
Exposure to lead	58.6	Housing safety
Improper use of household chemicals	56.5	Housing safety
Uncontrolled real estate development	49.9	Unbalanced real estate development
Unacceptable indoor air quality due to radon and asbestos	57.1	Housing safety
Improper disposal of toxic wastes	81.7	Improper hazardous waste disposal
Unacceptable drinking water quality	88.1	Water quality
Declining water quality	84.1	Water quality
Unacceptable noise levels	39.2	Unacceptable noise levels
Lack of recycling opportunities	36.2	(n/a)
Human public health diseases due to environmental conditions	77.7	(n/a)

[a]Corresponds to the percentage of survey respondents that ranked the issue as either "one of the most serious" or "very serious."

[b](n/a) signifies "not applicable."

Six issues-- "global climate change," "septic tanks," "waste incineration (municipal and medical)," "ozone depletion," "occupational hazards," and "acid rain,"-- were evaluated in the Public Advisory Committee analysis, but not specifically addressed or ranked in

the letter survey. In a broad sense, however, "septic tanks" is one facet of "water quality," which is ranked as a high risk in the survey. Similarly, "waste incineration" could be considered under "air pollution," which also ranked as a high risk in the survey.

Table 2.8
Comparative Rankings of Environmental Issues
Input from Public Survey

Risk Category	Environmental Issue
Higher: 75% or more of the respondents in the letter survey ranked issue as "one of the most serious" or "very serious."	• Air Pollution • Improper Hazardous Waste Disposal[a] • Nuclear Wastes • Pesticides[b] • Water Quality
Medium: 60% to 74% of the respondents in the letter survey ranked issue as "one of the most serious" or "very serious."	• Animal Production • Biological Alterations[c] • Food Safety • Non-hazardous Solid Waste • Overuse of Non-Renewable Energy • Soil Erosion
Lower: Less than 60% of the respondents in the letter survey ranked issue as "one of the most serious" or "very serious."	• Housing Safety[d] • Hydrological Alterations • Unacceptable Noise Level • Unbalanced Real Estate Development

[a]The rank for "Improper Hazardous Waste Disposal" is based on the average of the percentages for three issues in the survey -- "Improper Use of Industrial Chemicals" (79.5%), "Petroleum Contamination/ Underground Storage Tanks" (67.6%), and "Improper Disposal of Toxic Wastes" (81.7%).

[b]The rank for "Pesticides" was based on the average of the percentages for the two issues in the survey --, "Improper Use of Agricultural Chemicals and Fertilizers" (77.2%), and "Unsafe Food Due to Pesticides" (74%).

[c]The rank for "Biological Alterations" was based on the average of the percentages for three issues in the survey -- "Loss of Plant and Animal Species" (68.7%), "Loss of Wetlands" (55.2%), and "Loss of Forests" (67.1%).

[d]The rank for "Housing Safety" was based on the average of the percentages for three issues in the survey -- "Exposure to Lead" (58.6%), "Improper Use of Household Chemicals" (56.5%). And "Unacceptable Indoor Air Quality" (57.1%).

Six issues -- "global climate change," "septic tanks," "waste incineration (municipal and medical)," "ozone depletion," "occupational hazards," and "acid rain" -- were evaluated in the Public Advisory Committee analysis but not specifically addressed or ranked in the letter survey. In a broad sense, however, "septic tanks" is on facet of "water quality"

which is ranked as a high risk in the survey. Similarly, "waste incineration" could be considered under "air pollution" which also ranked as a high risk in the survey.

Climate change and ozone depletion, though not specifically addressed from the point of view of "seriousness," did appear in the survey, among other issues, under the question: *Ten years from now, how likely do you feel each problem may affect Iowa?* Table 2.9 shows the results for this survey question. About two-thirds of the respondents ranked both climate change (67.8 percent) and ozone depletion (66.2 percent) as "somewhat likely," "very likely," or "almost certain" to happen. These percentages are higher than the percentage for "improper disposal of nuclear wastes" (63 percent), an issue ranked as high seriousness (Table 2.8).

Also, 87 percent of respondents ranked "overuse of non-renewable sources of energy" somewhat, very, or certainly likely to happen, but did not rank this among the five most serious problems (Table 2.8). The same is true for "excessive soil erosion" (79.3 percent). On the other hand 78.5 percent of respondents ranked "unacceptable drinking water quality" as likely to happen, and also ranked it among the five most serious risks.

Table 2.9
Response to Question: Ten Years from Now How Likely Do You Feel Each Problem May Affect Iowa?
(ranked by percent)

Issue	Almost Certain	Very Likely	Somewhat Likely	Not Too Likely	Not at All	Don't Know
Global climate change	12.5	22.2	33.1	21.9	4.8	5.5
Excessive soil erosion	14.6	29.0	35.7	14.3	1.6	4.8
Overuse of nonrenewable sources of energy	21.1	33.8	32.1	6.5	1.0	5.5
Improper disposal of nuclear wastes	16.6	22.0	24.2	25.2	3.5	8.6
Depletion of ozone layer	14.1	18.2	33.9	21.1	6.1	6.7
Unacceptable drinking water quality	23.1	24.1	31.3	16.1	2.8	2.5

V. Public Input: Choices for Iowa's Environment – Ten Town Meetings

Planning

Apart from the letter survey, a second means for garnering public input was through town meetings in ten Iowa communities. Towns were selected as representative of Iowa's population and geographic diversity. Each town was visited twice. The first phase of the meetings occurred in spring of 1996, and the second phase was held in spring of 1997. The towns visited were: Spencer; Missouri Valley; Corning; Dumont; Marshalltown;

Corydon; Elkader; Cedar Rapids; Ainsworth; and Burlington. David Dahlquist and Marilyn Magnuson, of David L. Dahlquist Associates, Inc., facilitated the first round of meetings. Tamara Kuhn of Kuhn Communications facilitated the second phase.

An agenda common to all the meetings was designed and adapted to encourage maximum participation from the attendees at each meeting. During these meetings, participants identified local issues regarding public health, ecological systems, quality of life and energy choices in their communities. The participants were also asked to identify topics which were not problems in their communities.

There were common concerns expressed about environmental issues at all the meetings, such as water quality, changes in agricultural practices, consumerism/consumption in relation to waste reduction, disposing of toxic materials, and regulations. The goal for the first phase of meetings was to identify the issues of concern, and the goal of the second phase was to rank the concerns.

Promotion

The population base of each community was identified, and the editor of the local newspaper (or the newspaper serving that community) was contacted. The editor was asked 1) to identify citizens with environmental interests, 2) to specify, if possible, which risks were of particular concern in the community, and 3) to recommend the most accessible meeting place.

The facilitator contacted the citizens recommended by the editor for more information, and asked them to form a "committee." Each member agreed to contact and recruit at least two citizens to attend the meeting. This process was continued until at least 20 citizens had committed to attending. Other promotional efforts included:

- News releases to newspaper editors, county extension agents, farm bureaus, and other organizations and individuals upon request. IDNR issued statewide electronic news releases on the town meetings via Iowa Link and the Iowa Newspaper Association.

- Posters publicizing the event distributed by volunteers to local grocery stores, gas stations, schools, and restaurants.

- For the second phase meetings, letters of invitation to all citizens who had attended the first phase meetings, asking them to invite at least two other people.

In addition, numerous civic organizations were contacted and asked to assist in recruitment. These included the Izaak Walton League, Pheasants Forever, and county conservation boards.

Agenda

The agenda, similar for each meeting, was designed to inform, educate, and stimulate discussion of environmental risks. Introductions were made by both the facilitating team and the citizen participants who were also asked to discuss their motivation for attending the meeting. This helped all present to understand the variety of viewpoints expressed at the meeting.

The facilitators, with overhead visual aids, explained the purpose of the meeting, the procedures to be followed, the expected goals, and the value of the meeting to the overall framework of the comparative risk assessment process. In order to maintain continuity between the two phases of town meetings, the same definitions were maintained. Issues related to public health, quality of life and ecological systems were defined, and examples of each were presented. The role of energy choices in assessing environmental risk was also highlighted.

In the second phase, a ranking worksheet was presented that indicated the local issues identified by participants in the first phase. Participants were asked to rank each environmental risk individually as high, medium, or low. This step was followed by a discussion of the issues and the final group ranking.

Ranking Results

The issues evaluated in the town meetings were not entirely equivalent to the final issues presented to the Public Advisory Committee. This discrepancy arose because, like the letter survey, the issues were defined before the finalization of the issues by the technical committees. Nevertheless, many of the issues ranked at the town meetings correlate quite closely with the final issues list from the technical committees.

Table 2.10 lists twelve issues addressed at the town meetings (column one), an average score assigned to that issue by participants at the meeting (column two), and the issue from the final Public Advisory Committee list that is most related to the town meeting issue (column three). From this information, the rankings at the town meetings can be translated into rankings of the finalized issues. These results are shown in Table 2.11 (see page 26).

Table 2.10
Issues Ranked at Town Meetings Compared to Final Issues List

Issue at Town Meeting	Average Score[a]	Related Issue in PAC Assessment
Loss of family farms	2.6	Increase in corporate owned farms
Declining water quality	2.4	Water quality
Loss of habitat	2.3	Biological alterations
Inadequate treatment of livestock waste	2.2	Animal production
Loss of open space	2.1	Biological alterations/Unbalanced real estate development
Loss of timber and wetlands	2.1	Biological alterations
Random and uncontrolled real estate development	1.9	Unbalanced real estate development
Improper use of pesticides	1.8	Pesticides
Improper/inadequate garbage/sewage disposal	1.7	Non-hazardous solid waste/Septic tanks
Increase in cancer due to improper chemical use	1.7	Improper hazardous waste disposal
Increase in toxic air emissions	1.5	Air pollution
Excessive soil erosion	1.3	Soil erosion

[a] Average score is defined here as the numerical average of the ranking assigned at the ten town meetings. Participants ranked these issues as high, medium, or low. High was assigned the score of 3.0, medium the score of 2.0, and low the score of 1.0.

Table 2.11 shows "animal production" and "water quality" ranked as "higher" risks, just as they are in other components of the study. In contrast, the "lower" risk rank assigned to "soil erosion" differs greatly, since this issue has been consistently assigned a higher risk in the other analyses.

Table 2.11
Comparative Rankings of Environmental Issues
Input from Ten Town Meetings

Category	Environmental Issues Ranked
Higher: Risks for which average score among 10 town meetings was 2.2 or higher: based on 3.0 = highest risk, 2.0 = medium risk, and 1.0 = lowest risk.	• Animal Production • Biological Alterations • Unbalanced Real Estate Development • Water Quality
Medium: Risks for which average rank among 10 town meetings was between 1.7 and 2.1.	• Improper Hazardous Waste Disposal • Non-Hazardous Solid Waste • Pesticides • Private Septic Tanks
Lower: Risks for which average rank among 10 town meetings was 1.5 or lower.	• Air Pollution • Soil Erosion

VI. Overview and Comparison of Rankings by the Technical Committees and the Public

The previous analyses discussed in this chapter allow a comparison of the ranking of the issues across five different components of the study. Table 2.12 (see page 27) shows the complete set of scores for the 21 issues presented to the PAC at their final meeting. The risks are ranked as "high", "medium," or "low" except for the rankings of the Committee on Ecological Systems, who chose to rank a select set of issues as "severe," signifying a risk as even higher than "high" risk.

The Table suggests the following risk characterization of the issues:

- The issue of *water quality* stands alone as the highest risk over the widest set of criteria.
- *Animal production*, *soil erosion*, *pesticides*, *biological alterations*, and *food safety* are ranked medium or higher risks in three or more criteria.
- *Air pollution*, *unbalanced real estate development*, *improper hazardous waste disposal*, and *hydrological alterations* are issues with divergent rankings, varying between low and high risks across four or more criteria.

- Low to medium risk issues include *housing safety*,[1] *non-hazardous solid waste*, *occupational exposures*,[2] and *private septic tanks*.[3]

- *Acid rain*, *unacceptable noise levels*, and *waste incineration* were assigned the lowest risk ranking.

- A set of special issues were not evaluated by other criteria, but are of particular relevance to future generations. These include *global climate change*, *nuclear wastes*, *overuse of nonrenewable energy*, and *ozone depletion*. Each was ranked medium or high risk under the criterion "sustaining resources for future generations."

Table 2.12
Ranking Comparisons Among Three Technical Committees and Public Polling

Issue/Criterion	Quality of Life				Other Assessments		Public Assessments	
	Sen.Com.	Rec.Ac.	Econ.	Fut.Gen.	Health	Eco.Syst.	Letter	TownMtg.
Acid Rain				Low				
Air Pollution		Low	High		Medium	Low	Higher	Lower
Animal Production	Medium	High			High	Severe	Medium	Higher
Biological Alterations		Medium				High	Medium	Higher
Food Safety			High		Medium		Medium	
Global Climate Change				High				
Housing Safety					Medium		Lower	
Hydrological Alterations		Medium				High	Lower	
Improper Hazardous Waste Disposal			Low		Med./Low		Higher	Medium
Non-hazardous Solid Waste	Low				Low		Medium	Medium
Nuclear Waste				Medium			Higher	
Occupational Exposures			Medium					
Overuse of Non-renewable Energy				Medium			Medium	
Ozone Depletion				Medium				
Pesticides	Low	Medium	Medium		Medium	High	Higher	Medium
Private Septic Systems			Low		Low			Medium
Soil Erosion		High	Medium	High		Severe	Medium	Lower
Unacceptable Noise Levels	Low						Lower	
Unbalanced Real Estate Development	Medium	Medium		Medium		Low	Lower	Higher
Water Quality	High	High	High		High	Severe	Higher	Higher
Waste Incineration	Low				Low			

[1] Housing safety combines the issues of lead poisoning, household hazardous waste, indoor air, and radon, all of which were treated as individual issues by the Committee on Human Health. The assignment of medium risk was derived by averaging the ranking of these four issues. In fact, the committee ranked the individual issue of lead poisoning among the three highest risks out of a total of 15 issues.

[2] Occupational exposures do not include workers in hog confinements, for which the Committee on Human Health assigned a rank of high risk.

[3]Private septic tanks can be considered a subtopic under the broader concept of water quality, the issue assigned the highest risk.

Chapter 3
The Public Advisory Committee
Integrated Comparative Risk Assessment in Iowa

Role and Responsibility of the Public Advisory Committee

The Public Advisory Committee (PAC) served the Iowa Comparative Risk Study as a resource for input on overall policy recommendations. Its charge was to increase public input and integrate the diverse perspectives developed in the other components of the study. The committee was comprised of 30 members, serving on a voluntary basis. Their affiliations included local and state government, members of the legislature, civic and environmental organizations, and representatives of agriculture, the electric utilities, and industry. Names and addresses are provided in Appendix 3.

The specific tasks of the committee were:

- To advise the three technical committees in their deliberations, and to review the design and structure of the two instruments adopted for public polling.

- To provide a public forum for discussion of environmental risks, and review final drafts of the technical committee reports, and the assessments of public polling.

- To integrate the diverse information from the various components of the study, and contribute to a consensus-building process.

- To make final recommendations for setting priorities with regard to environmental problems.

- To recommend action plans for addressing selected problems.

The PAC met four times during the course of the project, in December 1995, October 1996, November 1997, and September 1998.

Methods of Engagement

The first meeting was introductory, during which the process of comparative risk assessment was described, the structural components of the study laid out, and the committee's role defined. Consensus was reached on the duties and responsibilities of the PAC members. They provided information and advice regarding recruitment of members for the technical committees, and emphasized the need for achieving balanced representation on those committees.

The next two meetings were devoted to reviewing early drafts of the technical committee reports. The PAC also reviewed and commented on the structure and content of the letter survey and the agenda proposed for the town meetings. During the meetings, PAC members were briefed on the progress of the technical committees.

During the third meeting, PAC members were offered the option of conducting a preliminary integrated ranking of the issues, based on information they had reviewed to date. The committee decided it was too early to develop such a ranking. They preferred to address that task after all data from the other components of the study were finalized.

Final Deliberations - The Issues List

The work over three years set the stage for the final meeting of the PAC on September 30, 1998. The PAC was briefed by representatives from the four technical committees: Russ Currier (Human Health); Bruce Menzel (Ecological Systems); Katy Hansen (Quality of Life); John Torbert (Energy Choices).

The next task for the PAC was to review and rank the issues. For this task, a Comparative Risk Project Assessment Form was distributed, containing a list of the following 21 issues for consideration:

Acid Rain
Air Pollution
Animal Production
Biological Alterations
Food Safety
Global Climate Change
Housing Safety
Hydrological Alterations
Improper Hazardous Waste Disposal
Non-Hazardous Solid Waste
Nuclear Wastes
Occupational Exposures
Overuse of Non-Renewable Energy
Ozone Depletion
Pesticides
Private Septic Tanks
Soil Erosion
Unacceptable Noise Levels
Unbalanced Real Estate Development
Water Quality
Waste Incineration (Municipal & Medical)

Twenty of these issues were adopted from the issues identified by the Technical Committees on Human Health, Ecological Systems, and Quality of Life. Not included in the above list are four issues identified by the Committee on Human Health: "lead poisoning" (from indoor household paint), "household hazardous waste," "indoor air," and "radon." The PAC chose to cluster these issues under the broader issue of "housing safety."

Individual Rankings. After finalization of the issues list, PAC members reviewed the 21 issues and ranked those needing immediate attention. The ranking was done in writing by anonymous ballot. The members also provided brief descriptions about their choices.

The PAC felt uneasy about ranking only the "high" risks, leaving the remaining issues unranked, and giving the impression that they were unimportant. One member suggested that the PAC criterion for high risk be based upon the *immediacy* of the issue and the health and safety risks. The member suggested that a disclaimer be included in the final report to address the possibility that, at any given point in time, any of the remaining issues may be moved into the high priority category because of an increased sense of immediacy or new findings that increased the health or safety risk.

The following summarizes the information provided by PAC members in their ranking ballots. The number in parentheses refers to the number of committee members that ranked the issue as needing immediate attention. This is followed by a summary of the comments PAC members submitted on the hand-written ballots.

Issue 1: Acid Rain (0)
No comments.

Issue 2: Air Pollution (5)
Comment 1: Rank based on perceived immediacy of the issue, and the health and safety risks.

Comment 2: Outdoor air (especially open burning) is high risk to humans with asthma/ upper respiratory problems.

Comment 3: Air pollution has become more of an immediate problem with the latest measurements in the Quad Cities area. It is better to attack the problems early rather than waiting until they reach non-attainment with respect to air pollution standards.

Comment 4: This member chose 10 issues for the "high" category, and ranked them within this category from 1 to 10. Air pollution was ranked as the 6th highest. The member stated that only the typical air pollutants are currently regulated. Toxic air pollutants and their movement on a regional and national basis must be addressed.

Comment 5: There is much data in this area to show an increase in respiratory diseases and death. Also note that we have several cities in Iowa that are out of compliance with new Clean Air Act standards.

Issue 3: Animal Production (9)
Comment 1: Includes social and waste issues.

Comment 2: Implement cost-effective ways to minimize effects of odor and waste.

Comment 3: This member chose 10 issues for the "high" category, and ranked them within this category from 1 to 10. Animal production was ranked as the 4th highest. The member stated that animal production, while providing significant economic benefit to Iowa, must be regulated consistent with its potential environmental impact. Animal production needs attention from several parts, including environmentally.

Comment 4: The concentration of animal production across Iowa has posed an enormous threat to all aspects of life in Iowa.

Issue 4: Biological Alterations (3)
Comment 1: Biological Alterations are potentially irreversible.

Comment 2: This member chose 10 issues for the "high" category, and ranked them within this category from 1 to 10. Biological Alterations was ranked as the 7th highest. Iowa's landscape has been drastically altered in the past 100 years. We need to learn from past lessons that depending on one or two crops will lead to disaster.

Issue 5: Food Safety (6)[a]
Comment 1: Needs more information.

Comment 2: Ranked high not because of original food product *per se*, but due to high rate of illness from handling and preparation.

Comment 3: This member chose 10 issues for the "high" category, and ranked them within this category from 1 to 10. Food Safety was ranked as the 10th highest. A leading producer of food, Iowa needs to be in the lead on this topic for its own benefit, and to lead others, therefore reaping benefits.

Comment 4: People's perceptions of poor food quality damage our agricultural economy. Second, food-borne illness and human health need more study.

[a] Includes a vote of one PAC member who singled out this issue as "needing more information."

Issue 6: Global Climate Change (9)[a]
Comment 1: Needs more information.

Comment 2: Climate change is potentially irreversible.

Comment 3: Global climate change has a huge potential risk to Iowa.

Comment 4: This member chose 10 issues for the "high" category, and ranked them within this category from 1 to 10. Climate Change was ranked as the 9th highest. Iowa must learn what impacts Iowa industry and agriculture have on this problem and prepare to reduce them. Preparation for future actions is what makes this important.

Comment 5: Perhaps our most comprehensive issue.

Comment 6: This is the single most important environmental threat to Iowa and the whole world. We cannot rely on others to solve the problem.

[a]Includes a vote of one PAC member who singled out this issue as "needing more information."

Issue 7: Housing Safety (14)
Comment 1: Housing safety is an immediate concern, because of the number of Iowans it currently, and potentially affects in daily life.

Comment 2: Tackling this issue requires a major educational campaign.

Comment 3: More information and education are needed to address this concern.

Comment 4: Housing safety is a daily ongoing influence with a need for major improvement.

Comment 5: Note particularly lead poisoning – 14% incidence and long-term health and economic costs make this immediate.

Issue 8: Hydrological Alterations (5)
Comment 1: This member chose 10 issues for the "high" category, and ranked them within this category from 1 to 10. Hydrological Alterations was ranked as the third highest. Water quality related issues are tied to hydrological modifications. To improve water quality, modifications must be assessed and only the ones that do not impact the water source should be allowed.

Issue 9: Improper Hazardous Waste Disposal (4)
Comment 1: Need to reduce and replace hazardous material.

Comment 2: This member chose 10 issues for the "high" category, and ranked them within this category from 1 to 10. Improper Hazardous Waste Disposal was ranked as the 5th highest. Past and future waste disposal must be handled in an environmentally acceptable manner. While there may be less hazardous waste, the potential for environmental damage is extreme.

Comment 3: PAC member suggested that all waste issues be evaluated as one category [improper hazardous waste disposal, non-hazardous solid waste, nuclear waste (priority), waste incineration].

Issue 10: Non-hazardous Solid Waste (1)
Comment 1: See Comment 3, Issue 9.

Issue 11: Nuclear Waste (3)
Comment 1: A federal repository is needed and should be encouraged by the state.

Comment 2: See Comment 3, Issue 9.

Comment 3: One PAC member ranked this as a medium risk.

Comment 4: This member chose 10 issues for the "high" category, and ranked them within this category from 1 to 10. Nuclear Waste was ranked as the 8th highest. While nuclear waste appears to be under control – the potential environmental damage from a single event leaves Iowa vulnerable.

Comment 5: With the federal government considering shipping nuclear waste across Iowa by rail and truck this is an immediate concern, as well as is the waste produced at Duane Arnold.

Issue 12: Occupational Hazards (1)
Comment 1: Occupational hazards include toxic exposure and injury. Both have overall major impacts on human health.

Issue 13: Overuse of Non-renewable Energy (8)
Comment 1: Overuse of non-renewable energy and ozone depletion, while certainly two separate threats, could be regarded as foldable into one because one has a highly significant effect on the other.

Comment 2: Unbalanced real estate development (sprawl) can result in more use of nonrenewable energy – air pollution, etc. – seem to be related.

Comment 3: Overuse of nonrenewable energy is important from the perspective of my children. Planning for the future begins now, before it becomes a "serious" risk.

Comment 4: Ozone depletion and overuse of fossil fuels needs evaluation.

Comment 5: Iowa must look at our huge use of fossil fuels. This would be easily addressed by the use of more renewable sources that are available right here in Iowa.

Issue 14: Ozone Depletion (2)
Comment 1: See Comment 1, Issue 13.

Comment 2: Ozone depletion and overuse of fossil fuels need evaluation.

Comment 3: Direct ties to farmer skin melanomas.

Issue 15: Pesticides (5)
Comment 1: One PAC member ranked this as a medium risk.

Comment 2: Many ecological and health effects are not known. Their use affects agricultural and ecological issues in Iowa.

Comment 3: One PAC member viewed this issue as a water issue, and how run-off from fields affects ground and surface waters.

Issue 16: Septic Tanks (5)
Comment 1: Failing septic tanks discharge raw sewage into roadside ditches within city limits in more than 300 communities in Iowa.

Comment 2: Include under "water quality."

Issue 17: Soil Erosion (11)
Comment 1: Soil erosion is a threat to agriculture, which is the main indigenous resource in Iowa.

Comment 2: Soil erosion is the major long-term issue in Iowa sustainability.

Comment 3: This member chose 10 issues for the "high" category, and ranked them within this category from 1 to 10. Soil Erosion was ranked as the 2nd highest. Iowa's economy is based on agriculture. Loss of the primary resource to sustain this economy is unacceptable. Plus, the input of erosion-generated sediment to the water resource must be reversed.

Issue 18: Unacceptable Noise Levels (0)
No comments.

Issue 19: Unbalanced Real Estate Development (Physical Alterations) (5)
Comment 1: Unbalanced real estate development (sprawl) can result in more use of nonrenewable energy -- air pollution, etc. – seem to be related.

Comment 2: One PAC member ranked this issue as medium risk.

Comment 3: This issue causes landscape destruction, affecting quality of life.

Comment 4: State government action to protect agriculture with the loss of right to farm legislation and protection for cities to function as cities.

Issue 20: Water Quality (21)
Comment 1: Because of water safety and quality problems, there are over 100 designated public and private beaches in Iowa which have no programs/regulations to address known high exposures to the public.

Comment 2: Clean water is a basic need/right.

Comment 3: Water quality is an immediate concern due to the number of Iowans this currently and potentially affects in daily life. The potential for serious situations resulting from contamination, on short notice, needs to be addressed.

Comment 4: There is a major education need to inform the Iowa public about water quality issues.

Comment 5: Complete, comprehensive monitoring data are needed to establish the causes of water quality problems.

Comment 6: Water quality problems are daily ongoing influences with need for major improvement.

Comment 7: This member chose 10 issues for the "high" category, and ranked them within this category from 1 to 10. Water Quality was ranked as the highest overall problem. This issue includes drinking water, streams, lake and ground water. Clean water is needed for individuals, industry, cities and agriculture. Protection of water resources needs more attention.

Comment 8: Protection of drinking and surface water needs immediate attention. There should be stronger regulations of soil and agricultural application processes.

Comment 9: This issue, ranging from run-off to manure spills to sewage problems, is by far the biggest threat to life in Iowa,. We have severe problems in both ground and surface water quality that must be addressed.

Issue 21: Waste Incineration (Municipal and Medical) (3)
Comment 1: Waste incineration has not been a significant problem in Iowa as yet but would be, should policy makers and promoters of such practices succeed in increasing this activity.

Comment 2: Outdoor air (especially open burning) is a high risk to humans with asthma/ upper respiratory problems.

Group Discussion: Selection of Issues, and Recommendations for Action Steps
Issues. After PAC members submitted their evaluations of the issues deserving of the most immediate action, a tally of the issues was taken. The PAC members decided to focus on the six issues with the greatest number of votes. These issues are:

- Water Quality
- Housing Safety
- Soil Erosion
- Animal Production
- Global Climate Change
- Overuse of Non-renewable Resources

Action Steps. The final task of the committee was to formulate, for each of the six selected issues, action steps that can be taken in the near term as a management plan for reducing environmental risks. A summary of the discussion is provided in the following text. For sake of uniformity and clarity, the discussion focused on two questions: "Why is there a problem?" and "What needs to be done to fix it?"

I. Issue 20: Water Quality

I.A. Why is there a problem?

I.A.1. Affects human health (drinking water)

I.A.2. Impairs aquatic ecosystems (anoxia and siltation)

I.A.3. Diminishes quality of life (sense of community, recreation access, and economic well-being).

I.B. What needs to be done to fix it?

I.B.1. Increase water quality monitoring by establishment of a comprehensive surface and groundwater monitoring network. A monitoring program exists now, but its design is rudimentary.

I. Issue 20: Water Quality (cont.)

I.B.2. Review and consider recommendations in the *Water Quality Action Plan*, published by the Iowa Environmental Council.

I.B.3. Review and consider Iowa State University's water quality project that brings together various ongoing water quality programs in Iowa.

I.B.4. Consider including the issues of "Septic Tanks" and "Hydrological Alterations" as related topics in the action steps.

I.B.5. With respect to septic tanks in unsewered communities, consider the following two steps: (1) help improve wastewater systems through management by a stable group such as the county water board, etc.; and (2) require a mandated inspection of buildings served by septic tanks at the time of property transfer.

I.B.6. For rivers and lakes designated for recreation, make the water clean enough for fishing and swimming (Iowa has the lowest fish/swim criteria in the United States).

I.B.7. Conduct an information and education campaign about threats to drinking water quality from badly constructed wells contaminated by polluted surface waters.

I.B.8. Monitor groundwaters vulnerable to pollution, particularly in areas with agricultural drainage wells and sink holes.

I.B.9. Follow through on regulations directed at limiting water pollution from Brownfield sites and leaking underground storage tanks.

I.B.10. Continue to uphold water quality standards at municipal solid waste landfills.

II. Issue 7: Housing Safety

II.A. Why is there a problem?

II.A.1. Lead poisoning when children ingest paint chips from old leaded paint.

II.A.2. Asphyxiation by high indoor carbon monoxide at lethal levels.

II.A.3. Lung cancer from inhalation of radon daughter products.

II.A.4. Asthma and other lung diseases induced from airborne indoor particulates.

II.A.5. Toxification by handling and breathing hazardous household materials.

II. Issue 7: Housing Safety (cont.)
II.B. What needs to be done to fix it?

II.B.1. Increase information and education on issues related to "Housing Safety."

II.B.2. Increase childhood lead screening.

II.B.3. Offer technical and financial assistance for abatement of lead poisoning.

II.B.4. Increase screening for carbon monoxide levels in the home, with particular focus on emissions from combustion sources such as hot water heaters, boilers, and gas stoves. Monitor to determine whether air exchange in homes is sufficient to avoid large build up of carbon monoxide.

II.B.5. Encourage citizens to test radon levels in homes; provide information for steps needed to reduce radon concentrations.

II.B.6. Increase awareness of citizens vulnerable to asthma and allergies about potential in-house sources of pulmonary illnesses. Provide information about measures that can be taken to reduce in-home levels of particulate sources.

II.B.7. Provide citizens with information about what is toxic in the home.

II.B.8. Facilitate for home owners the means for depositing household hazardous materials in safe depository collection centers.

III. Issue 17: Soil Erosion

III.A. Why is there a problem?

III.A.1. Soil erosion adversely affects quality of life in the areas of recreation access, economic well-being, and future generations.

III.A.2. It affects ecological systems through siltation and inputs of fertilizer and pesticides (adsorbed on the surface of soil particles).

III.B. What needs to be done to fix it?

III.B.1. Control erosion on the basis of watershed management. Under this framework, water quality monitoring could be integrated with sources of erosion in the watershed, and the most significant sources can be assessed.

III.B.2. Allot resources aimed at mitigating soil erosion to the most significant sources.

III. Issue 17: Soil Erosion (cont.)

III.B.3. Conserve the soil resource for future generations with the goal of no net loss of Iowa soil due to farming activities.

III.B.4. Support a public education campaign about various practices that minimize erosion. These include no-till agriculture, integrated crop management, contour farming, and manure management for rebuilding and replenishing top soils.

II.B.5. Continue programs that develop alternative crops while preventing soil erosion, particularly with respect to former CRP lands.

IV. Issue 3: Animal Production

IV.A. Why is there a problem?

IV.A.1. Manure, particularly from large hog confinements, often causes an odor affecting the quality of life of citizens in neighboring areas.

IV.A.2. Manure, entering water bodies via accidental spills or agricultural runoff, can cause extensive damage to aquatic ecosystems, and diminish the public's access to high quality lakes and streams for recreational purposes.

IV.A.3. Workers in animal confinement operations may suffer from an array of infectious diseases, asthma and other respiratory ailments.

IV.B. What needs to be done to fix it?

IV.B.1. Rewrite zoning laws that encourage local ownership of animal production and enhance local government's ability to regulate these operations.

IV.B.2. Change manure management to a comprehensive system that treats manure as a high quality resource (i.e., fertilizer, energy source) rather than a nuisance waste. This will require a broad distribution system to avoid concentration of wastes in and around confinement lots.

IV.B.3. Improve methods of manure application to crops so that runoff to drainage tiles is reduced. Use manure to restore and enhance the quality of soil.

IV.B.4. Enact laws that protect workers in animal production facilities against exposure to diseases and respiratory ailments.

IV.B.5. Continue to educate hog producers about appropriate measures for manure management.

V. Issue 6: Global Climate Change

V.A. Why is there a problem?

V.A.1. Agriculture is very dependent on climate. Thus, Iowa's agricultural economy could be adversely affected.

V.A.2. Ecological systems are very dependent on climate and changes could occur too rapidly for them to adapt naturally

V.A.3. Some climate change models predict an increase in the occurrence of extreme events, including more droughts, floods, cold and hot spells, more hurricanes, etc.

V.B. What needs to be done to fix it?

V.B.1. Gather the latest information and documentation on climate change assessments.

V.B.2. Initiate a comprehensive public education campaign about the environmental implications of global climate change. Building on existing initiatives, support the numerous programs that are already doing so (e.g., Taking on the Challenge of Climate Change, 1999, sponsored by the Iowa United Nations Association).

V.B.3. Support current activities that are economically and environmentally beneficial that concurrently mitigate global climate change (e.g., energy efficiency measures, reductions in nitrogen-fertilizer application, wind-generated electricity).

V.B.4. Implement the action steps proposed in the greenhouse gas action.

VI. Issue 13: Overuse of Non-renewable Energy

VI.A. Why is there a problem?

VI.A.1. The combustion of fossil fuels is the major cause for the increase of greenhouse gases in the atmosphere. It is the major stressor with respect to climate change (see Issue 6).

VI.A.2. Overuse may deplete the supplies of fossil fuels available for future generations, particularly in regard to petroleum and natural gas.

VI.A.3. Combustion of fossil fuels is a major cause of air pollution.

VI.B. What needs to be done to fix it?

VI.B.1. Support programs for enhancing energy efficiency.

VI. Issue 13: Overuse of Non-renewable Energy (cont.)
VI.B.2. Increase the use of renewable energy sources in Iowa (development and distribution), and support ongoing projects.

VI.B.3. Explore entrepreneurial opportunities for new markets in development, manufacturing, and distributing new energy-saving technologies (e.g., Maytag's state-of-the-art clothes washer).

Comparison of PAC Rankings with Rankings by Other Components of Study

At the final meeting of the PAC, the rankings of the three technical committees, the letter survey, and the town meetings were presented in table form, similar to Table 2.12 (see page 27). Three of the six PAC issues, "water quality," "animal production," and "soil erosion," were ranked among the highest risks by the committees and the public. "Climate change" and "overuse of non-renewable resources" were classified in Table 2.12 as high and medium risks, respectively, based on the criterion of concern for future generations.

At first glance, there appears to be a large difference in the ranking of "housing safety" between the PAC and the overall rankings of the other components of the study. As shown in Table 2.12, it is assigned a rank of medium or lower risk, in contrast to the PAC assessment, which ranked it as a concern needing immediate action. This difference arises from the PAC members' decision to cluster four distinct issues under the umbrella of housing safety (indoor air, lead, radon, and household hazardous waste). The Committee on Human Health ranked the issue of "lead poisoning" among the three highest risks, but it ranked "indoor air" and "radon" medium risks, and "household hazardous waste" low risk. When the issues are weighed equally and the risks averaged, the overall risk is medium.

Chapter 4
Action Steps
and
The Role of Energy Choices

The Iowa Comparative Risk Study as a Basis for Environmental Strategic Planning

In chapter 3, the Public Advisory Committee (PAC) examined the most important problems associated with 21 environmental issues facing Iowa. In their final deliberations, the members selected the following six issues deserving immediate action:

- Water Quality
- Housing Safety
- Soil Erosion
- Animal Production
- Global Climate Change
- Overuse of Nonrenewable Energy

The PAC members went one step further by identifying "action steps" that could be implemented to reduce the environmental threats related to each issue. Those steps, provided on an issue-by-issue basis in Chapter 3, fall broadly into the following categories:

- Monitoring;
- Reviewing already-existing information programs, and action plans;
- Integrating and coordinating already-existing programs;
- Promoting prudent policies, legislative actions, and safe environmental standards;
- Enhancing public education and the availability of technical assistance;
- Testing and screening programs for early detection of problems;
- Thinking strategically about promoting actions that will be the most cost effective and the most environmentally beneficial (win/win situations);
- Including within environmental management strategies, concerns for the needs of future generations; and
- Exploring entrepreneurial opportunities for new markets for environmentally friendly technologies.

Follow-up to this report will be to explore how the action steps set forth by the PAC can be realized. Resources should be devoted to refining and integrating the action steps into a coherent strategic plan for managing the state's most threatening environmental risks. A great deal of beneficial environmental planning has already been done, and many of the actions called for by the PAC already exist in one form or another. However, a

valuable service from this study is a coherent framework with well defined endpoints around which the disparate on-going work can be coordinated into a master plan.

The Connection Between Energy, the Economy and the Environment

In one sense, compartmentalizing environmental problems into separate and distinct issues, though necessary for the comparative risk process, misses one of the most important facets of long-range strategic environmental planning. Namely, it treats the issues as if they were independent of each other, whereas in truth they are connected in complex ways that defy simple separation and division. Nowhere is that complexity more evident than in the relationship between energy, the economy, and the environment.

The Iowa Comparative Risk Study is unique from all previous EPA-sponsored risk studies. From the beginning, it set out to determine the inter-relationships between energy choices and the most serious risks, as distilled from three years of study by three technical committees, two public surveys, and the final deliberations of the Public Advisory Committee (PAC). A comprehensive analysis of the links between energy choices and environmental issues was published as an Iowa Department of Natural Resources report entitled *Iowa's Energy Choices*. The energy analysis was not meant to supersede the "action steps" prescribed by the PAC. Rather, it offers practical and perhaps novel means by which those action steps can be achieved with the greatest economic and environmental dividends.

The following examples are derived from data and information provided in the Energy Choices report. They illustrate how the issues on the PAC's short list are linked economically and environmentally to energy choices.

Issue 1: Water Quality

Definition

Water quality refers to the suitability of water for its intended use. Of prime importance to the quality of our water, both surface and groundwater, is the prevention of pollution. Water pollution can be divided into two major categories. Nonpoint source pollution is the contamination of surface water and groundwater from widespread areas that cannot be tracked to a single source. Soil erosion and chemical runoff, both linked primarily with agricultural practices, are two examples of nonpoint source pollution. Point source pollution is the contamination of Iowa's surface waters at an identifiable source, such as a sewage outlet or industrial waste discharge.

The Energy Link

The major contaminants to Iowa's water (after soil erosion) are nitrogen from agricultural operations and pesticide runoff from farm fields and urban lawns. From an energy standpoint:

- Fertilizer accounts for nearly 70 percent of the energy used in growing crops. In 1995 about 8.3 million tons of nitrogen fertilizer were applied to Iowa's fields.
  SOURCE: Leopold Letter Spring 1998.

- Iowa is making strides to reduce its use of fertilizers and pesticides. Through an agricultural energy management program sponsored by several government and agricultural organizations in the state, Iowa reduced its use of nitrogen fertilizers by 2.4 billion pounds from 1985 to 1995, without affecting yield levels. This resulted in the equivalent energy savings of 604 million gallons of diesel fuel, and a cost savings of $362 million for Iowa's farmers.
  SOURCE: George Hallberg, *1995 Nitrogen Use and Energy Savings*, May 14, 1996.

- Water treatment is costly and energy intensive. Each million gallons of water treatment requires 1,500 to 2,000 kWh of electricity, an amount that is expected to increase by 40% over the next 20 years.
  SOURCE: EPRI, Energy Efficiency in Water Treatment, Vol.1, No. 1, 1993

Another energy connection to water quality is in the waste water treatment process, which involves treating sewage before it reaches streams, rivers and lakes.

- According to the Electric Power Research Institute (EPRI), every one million gallons of wastewater treatment requires up to 3,000 kWh of electricity consumption.

- Given Iowa's total water consumption of 970,602 million gallons in 1996, wastewater treatment for that year consumed as much as 2.9 million MWh of electricity — enough electricity to provide power to more than 300,000 households for a year.

- Energy use at waster water treatment plants is expected to increase 40 percent on a national level over the next 20 years due to more stringent federal regulations.
  SOURCE: EPRI Energy Efficiency in Water Treatment, Vol. 1, No. 1, 1993.; Iowa Department of Natural Resources, Environmental Protection Division, Water Quality.

- Since 80 percent of a wastewater facility's total energy use occurs during pumping, energy efficiency measures can be implemented. Variable Frequency Drives (VFDs) enable pumps to operate at lower speeds and consume less energy during reduced demand. VFDs are predicted to save up to 50 percent in energy use.
  SOURCE: Department of Energy, Energy Efficiency and Renewable Energy Network web sites.

Environmental Implications

Nonpoint source pollution is one of the most critical environmental issues for Iowa in terms of sheer volume and potential economic and environmental repercussions. Poor water quality can cause damage and loss of life to aquatic habitat — in 1997, more than 600,000 fish were estimated by the DNR to be killed through contamination. Water pollution is also a threat to human health. High nitrate levels from fertilizer and waste materials can cause illness and even death in infants. Reducing the amount of chemical fertilizers, pesticides and soil erosion — thereby reducing energy use as well — will greatly improve Iowa's surface and groundwater.

Issue 2: Housing Safety

Definition

Housing safety, as defined by the PAC includes lead poisoning, household hazardous materials (HHMs), indoor air, and radon. Among these sub-issues, HHMs and indoor air are most directly related to energy choices. (HHMs) are substances categorized by the U.S. Environmental Protection Agency as: *corrosive*, if they destroy human tissues or corrode metal; *flammable*, if they are easily ignitable; *toxic*, if they are poisonous; or *reactive*, if they react violently when exposed to heat, sudden shock, pressure or other chemicals. Iowa law includes the following materials as HHMs:

- motor oils and filters
- gasoline and diesel additives
- degreasers
- waxes and polishes
- solvents
- paints (except latex-based) lacquers and thinners
- caustic household cleaners
- spot and stain removers (with petroleum base)
- pesticides

The Energy Link

One linkage between housing safety and energy is the question of indoor air quality. For maximum energy efficiency in space heating and cooling, a building needs to be well-insulated and free of air leaks and cracks in windows and doors. At the same time, all well-insulated buildings should have good air exchange to freshen the air and prevent the build up of toxic gases (carbon monoxide, radon, asbestos, etc.). Air-exchange technology is now quite advanced. Heat exchangers transfer heat efficiently from the outgoing warm air to the incoming cold air (and vice versa for summer air conditioning). Further, a properly maintained furnace is more efficient than a poorly maintained one. The risk of carbon monoxide poisoning and fire is also reduced.

The Environmental Link

Motor oil and gasoline, two petroleum-based products, are common HHMs. According to a 1992 report by the DNR Waste Management Assistance Division, motor oil and gasoline constitute a great danger to the environment because of their toxicity and flammability. In addition:

- One gallon of improperly disposed used oil can render one million gallons of water undrinkable, according to the National Oil Recyclers Association.
- Two gallons of used oil generates enough electricity to run the average household for a day.

When HHMs are not disposed of correctly, they can negatively impact groundwater, the primary source of drinking water in Iowa. They also can infiltrate surface waters, damaging fish habitats, wildlife and recreational quality. HHMs are potentially harmful to human health from exposure to fumes and explosions.

Nationally, HHMs comprise up to 1 percent of the municipal solid waste stream, representing the most hazardous segment of waste. Estimated statewide annual disposal of HHMs in Iowa is approximately 17,140 tons – or about 30 pounds per household. This doesn't include improper disposal practices such as pouring hazardous materials down drains, storm sewers, or directly into water ways.

Issue 3: Soil Erosion

Definition

Soil erosion is the process by which top- and subsoils are removed from the land. Agricultural activities, amount of vegetation cover, topography, soil types, wind, and precipitation all contribute to the rate of soil erosion.

The Energy Link

Agricultural activities are the greatest contributor to soil erosion in Iowa. Of the three main tillage practices -- conventional, reduced and no-till -- conventional till requires the greatest amount of energy use. In addition:

- Reduced-till and no-till practices can decrease soil erosion by up to 90 percent. When tilling is reduced, so is the amount of energy a farmer uses.
- Reduced till can also save one to two gallons of diesel fuel per acre planted. This amounts to 20 to 40 million gallons of diesel fuel saved annually in Iowa, reducing dollars spent on fuel by $15 to $20 million per year without yield loss.

  SOURCE: Iowa State University, Integrated Farm Management Demonstration Program, Comprehensive Report. August 1995.

As shown in Table 4.1 (see page 47), the different tillage practices influence how much soil erodes from Iowa's fields. (Note - no single method works for all situations).

The Environmental Link

Soil erosion is Iowa's most critical environmental concern. A 1982 study by the U.S. Department of Agriculture showed that Iowa had the worst soil erosion of any state — twice the national average. Eighty percent of Iowa's surface is tillable, and nearly all of this land has been tilled. Today, after approximately 150 years of farming, it is estimated that at least one-half of Iowa's topsoil has been lost to erosion.

SOURCE: Iowa Association of Naturalists, Iowa's Agricultural Practices and the Environment.

Soil erosion causes a reduction in Iowa's water quality, lower production in crop fields, eroded lands, sediment in lakes, streams and rivers, increased flooding, and loss of ecosystems and habitats. Also, soil erosion is the number one nonpoint-source of water pollution in Iowa.

Several state and federal organizations are working to educate Iowa's farmers about how to most effectively limit soil erosion without jeopardizing crop yields. Alternative farming methods that can help reduce soil erosion include:

- Contour farming -- planting on contours around a hill rather than in straight lines up and down a hill.
- Terraces -- breaking up a steep hill into a series of level areas broken up by shorter slopes rather than one long hill.
- Cover crops -- planting grasses, alfalfa and other grains with dense root structures on steep hills.
- Grassed waterways -- planting grass or hay along areas where concentrated water runoff occurs.
- Filter strips -- planting grass, shrubs or trees above waterways to trap sediment before it reaches a stream, river or lake.
- Energy crops -- switchgrass and poplar trees, two biomass crops burned to generate electricity or provide heating energy, are excellent choices for cover crops and filter strips.

SOURCE: Iowa Association of Naturalists, Iowa's Agricultural Practices and the Environment.

Table 4.1
The Influence of Different Tillage Practices on Soil Erosion

Term	Definition	Amount of Crop Residue	Types of Plowing Practices
Conventional Till	Soil is plowed, disced, planted and cultivated at least once before harvest.	Leaves less than 30% of crop residue to cover soil	Moldboard plow is most common, leaving only 15 % of crop residue
Reduced Till	Soil is undisturbed between harvest and planting season.	Leaves at least 30% of crop residue to protect soil	Ridge till and mulch till
No Till	Soil is planted, perhaps sprayed with a herbicide and harvested. No other soil disruptions occur.	100% crop residue remains	None

SOURCE: Iowa Association of Naturalists, Iowa's Agricultural Practices and the Environment.

Issue 4: Animal Production

Definition

Animal production is one of Iowa's major industries. It involves the production of swine, cattle, sheep, poultry and other specialty animals, almost all of which are used for food products.

The Energy Link

Energy use differs dramatically depending on the size of the farm operation, methods of raising animals, and types of livestock. By establishing an average of production methods, Iowa State University has quantified the energy used to produce animals as shown in Table 4.2. The energy use refers only to feeding animals, not to overall operations. As an example, a farmer with a medium- to large-sized finishing operation (5,000 head of swine) will use the energy equivalent of one gallon of gasoline for the feed necessary to raise one pig to market.

Table 4.2
Energy Intensity for Livestock Production Per Animal
(Based on Feed Only, Not Overall Operations)

Animal	Feeding Period	Fuel Gallons per Animal		
		Gasoline	Diesel	Propane
Swine	Raise one pig to market, including feeding of sow and boar.	0.40	0.30	0.50
Dairy	One cow milking 9,000 lbs. of milk/year.	1.00	0.75	1.20
Beef	Steer grown from 400 lbs. to 1,200 lbs.	1.80	1.30	2.15
	Heifers grown from 400 to 850 lbs.	1.35	1.00	1.60
Sheep	Lambs from birth to market.	0.60	0.45	0.70
	Feeder lambs 50 lbs. to market.	0.125	0.10	0.15
Poultry	Raise 100 boilers from birth to market.	0.74 (per 100 birds)	0.55 (per100 birds)	0.90 (per 100 birds)
	Raise 100 layers for one year.	7.50	5.40	9.00

Source: Iowa State University

Environmental Implications

Animal production raises environmental concerns due to the large levels of manure that can cause pollution problems. Iowa's hog operations alone produce more than 17 million tons of recoverable animal manure each year. This can potentially impact both surface and groundwater through seepage and spills. Another concern is the odors associated with production feed lots.

A solution to managing this manure is methane recovery, by which the organic gases produced during the decomposition of animal manure are captured. Warm temperatures and an enclosed manure storage system are necessary to maximize methane production. The recovered methane can be used to generate electricity or to produce heat. Both can

be used on farm to offset operating costs while minimizing odor and other environmental concerns. Efficiently capturing and using energy from hog manure could provide enough energy to heat 51,000 homes, or generate enough electricity for 43,000 homes. Use of these resources could save Iowans millions of dollars per year in energy dollars which typically leave the state. In addition, use of methane for energy production would offset the production of 455,000 tons of carbon dioxide, a greenhouse gas.

Source: Energy Bureau, Iowa DNR.

Another option with respect to animal manure is composting. Composted animal manure can be used to develop and maintain desirable biological, chemical and physical soil properties for agricultural uses. As already noted, the production of animal fertilizer requires a large amount of energy. Further, its use kills beneficial bacteria in the soil. Composted animal manure restores the biological activity to the soil.

Issue 5: Global Climate Change

Definition

Global climate change is the term given to the prospects of human-induced global warming from an enhanced greenhouse effect. Through the greenhouse effect, several atmospheric constituents, including water vapor, carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (CFCs) exert a warming influence that allows the earth to retain life giving warmth. An enhancement of this greenhouse effect, through the emission of ever-increasing quantities of greenhouse gases, many induce a change to what we know as our climate. This change may result in altered precipitation patterns that could disrupt agricultural production, increased incidence of diseases such as malaria which depend upon climatic conditions for their spread, increased sea levels which may threaten inhabited coastal regions, and increased frequency and severity of significant weather patterns.

Humans exert an increasing influence of the concentration of these greenhouse gases in the atmosphere through increasing population and expanding energy use. Fossil fuel combustion releases carbon dioxide, methane, and nitrous oxide to the atmosphere, accounting for nearly 80 percent of greenhouse gas emissions in the United States. Other significant contributions include nitrous oxide emissions from agricultural fertilizer application, and methane from livestock and flooded agriculture (rice production). Chlorofluorocarbons are emitted from refrigeration and industrial processes.

Source: U. S. Environmental Protection Agency "Inventory of U. S. Greenhouse Gas Emissions and Sinks: 1990-1996."

Other scientists believe temperature increases are a function of Earth cycles and cannot be markedly affected by changing human behavior. They also contend that natural systems are responsible for most greenhouse gas production. They believe the economic and environmental changes needed to reduce "human-caused" greenhouse gases will not prevent the changes in temperature that are predicted to occur naturally.

The Energy Link

Burning coal, oil and natural gas to heat and cool homes, power cars and light cities produces carbon dioxide (CO_2) and other greenhouse gases as by-products. Improved energy efficiency and the use of alternative fuels, such as wind, solar, switchgrass, methane, ethanol, and biodiesel, will help reduce greenhouse gas emissions.

For example:

- New homes and buildings that incorporate energy efficiency measures use, on average, 30 percent less energy than standard designs. Even a typical home built 15 years ago can be upgraded to reduce energy use by 20 percent.

- Today's automobiles average twice the number of miles per gallon than automobiles manufactured in 1973. The U.S. and other countries are now trying to produce automobiles that are three times more fuel efficient than today's models.

- Current wind power facilities in the U.S. provide enough electricity for one million Americans.

- In 1996, Iowa evaluated its emission levels as they relate to the possibility of global climate change. According to the Iowa Greenhouse Gas Action Plan, produced by the Center for Global and Regional Environmental Research at the University of Iowa, Iowa is the fifteenth highest producer of energy-related air emissions in the country, per capita. It relies on fossil fuels for 95 percent of its energy and emits 29 tons of carbon dioxide per person annually, a major contributor to greenhouse gases. Strategies in the plan to lower gas levels include tree planting and decreasing reliance on fossil fuels.

Environmental Implications

Although global climate change is a controversial issue, reducing emissions is primarily accomplished through a more efficient use of energy. Improved energy efficiency reduces fossil fuel dependence and increases financial profitability of organizations. It can also benefit the environment through improved air quality.

Climate change may impact human health in a variety of ways. Warmer temperatures could increase the risk of mortality from heat stress. Diseases that thrive in warmer climates, such as malaria, dengue and yellow fevers, encephalitis and cholera, may spread due to the expansion of the ranges of mosquitoes and other disease-carrying organisms. The rise in sea level may erode beaches and coastal wetlands, inundate low-lying areas, and increase the vulnerability of coastal areas to flooding from storm surges and intense rainfall. Intensification of the water cycle may produce more severe droughts and floods, affecting the quality and quantity of water.

SOURCES: 1998 Energy Plan Update (DNR, 1998), Greenhouse Gas Action Plan (DNR, 1996), Global Climate Change–Implications for Energy Policy in Iowa (DNR, 1989) Climate Change–State of Knowledge (Office of the President of the United States).

Issue 6: Overuse of Nonrenewable Energy

Definition

Nonrenewable energy refers to finite energy resources, such as fossil fuels. Examples include coal, petroleum and natural gas. In contrast, renewable energy is comprised of those energy resources that renew themselves and are virtually inexhaustible. Examples include solar, wind, geothermal, hydro and biomass (resources from plant material).

The Energy Link

As of 1994, fossil fuels represented 95 percent of Iowa's energy consumption. Three percent of the state's energy requirements were met by nuclear power, and only two percent were from renewable resources such as wind, solar, hydroelectric and biomass power.

The following facts further demonstrate Iowa's dependence on fossil fuels:

- As of 1995, coal accounted for 35 percent of Iowa's total energy consumption.
- Petroleum and natural gas accounted for 35 and 25 percent of Iowa's total energy consumption in 1995, respectively.
- Each Iowan used an average of 377 million Btus of energy in 1995, including 130 million Btus — or 7.2 tons — attributed to coal.

SOURCE: The Energy Information Administration of the U.S. Department of Energy.

Security issues are also a factor in America's over-reliance on fossil fuels. National security experts like R. James Woolsey, former CIA director, have stated that diversity of energy resources is important because of potential problems with foreign petroleum supplies on which the nation increasingly depends.

SOURCE: Des Moines *Register*, Sunday, April 26, 1998. "Fuel tax credit affects defense, too," by George Anthan.

The two strategies for decreasing nonrenewable energy use are to improve energy efficiency and to develop renewable resources.

Effective energy efficiency measures *minimize* the amount of energy needed to run a specific system or building, and *maximize* the level of productivity, comfort and quality of life. For example, if a school retrofits its lighting system, replacing T-12 lights and magnetic ballasts with T-8 lights and electronic ballasts, the quality and amount of light in the building remains constant, but the amount of energy required to power those lights will be reduced by 34%.

Developing renewable energy is a direct solution for decreasing reliance on fossil fuels. In 1998, Iowa's renewable energy capacity — including hydro, biomass, wind and solar — equaled 156 megawatts. This is equivalent to about 25 percent of the capacity at the Duane Arnold Nuclear Plant in Palo, Iowa.

Environmental Implications

Fossil fuel consumption contributes to a number of environmental problems including air pollution and acid rain. Renewable energy often is considered to be "cleaner" because of lower emissions levels, especially with wind, solar and hydro power. Fossil fuels remain prevalent because they are supported by a well-established infrastructure. Coal, oil, and natural gas are readily available, easily transported and relatively inexpensive. In contrast, renewable energy infrastructures are still being developed, and their availability for commercial and consumer use is still quite low.

Strategies for the Future: How Energy Choices Can Mitigate Impacts of the Environment and Improve the Economy

Iowa has major opportunities for reducing environmental risks through energy choices. Equally as important, these positive solutions can mean improved economic opportunities for the state. The Energy Choices Committee Report provides a detailed analysis of six specific solutions that hold the strongest potential in the state, and what their implications are for Iowa. These six options are:

- **Continue to minimize the use of nitrogen fertilizer through agricultural energy management programs.** This strategy will improve water quality and reduce the use of fossil fuels because of the high energy inputs necessary for creating and applying the fertilizer. It will also reduce emissions of greenhouse gases generated during its production, and from microbial degradation of residual nitrates in the environment.

- **Manage hog manure as a valuable resource rather than as a nuisance waste.** Enormous potential exists for using hog manure as a source for methane, which is a renewable energy resource. By extracting methane from manure, farms can generate energy and lessen the problems associated with conventional manure management, the worse aspects of which include stench and water degradation. Methane recovery also provides a potential revenue stream to offset waste management costs. In addition, hog manure takes less energy than synthesized fertilizers to produce, and emits less air pollutants. It provides a solution to many of the issues concerning animal production, and will help improve water quality through the reduction of waste streams.

- **Plant switchgrass or poplar trees as energy crops on marginal lands.** These biomass crops are direct solutions for reducing water quality problems and soil erosion. They also will help reduce the concerns associated with biological alterations, especially since switchgrass is a native Iowa prairie grass. Another benefit is the decreased level of air pollutants such as sulfur and nitrogen oxides, that occur from fossil fuel burning at power plants.

- **Continue to increase energy efficiency**. This is accomplished through such measures as adoption of improved technologies in lighting and appliances, and more energy efficient space heating and transport systems. Iowa can lessen its reliance on fossil fuels, the main causes of climate change, air pollution, and acid rain.

Efficiency measures also improve the economy by creating jobs, and by allocating money previously spent on energy toward other goods and services.

- **Continue to promote renewable sources of energy in Iowa.** Replacing fossil fuels is a key strategy for improving Iowa's environment. Because the state is a leader in agriculture, homegrown energy resources such as ethanol and switchgrass are a strong complement to the state's current economic activities. In addition, wind as a source for energy has excellent possibilities in Iowa because of strong wind levels. These resources will effectively reduce air pollution, acid rain, and the potential for climate change.

- **Strengthen existing programs and initiatives to improve transportation efficiency and promote less-polluting alternative fuels.** The transportation sector is a key contributor to environmental problems. By developing strategies that encourage drivers to reduce their fuel use and to use ethanol-blend fuel, which is less polluting than petroleum, the state can reduce air pollution, as well as the potential for global climate change and acid rain.

Conclusion

The intricate relationship between Iowa's energy use, economy and environment is evident from the trends and information described in this report. Improving Iowa's energy management strategies translates into strong opportunities for the state's long-term economic and environmental health. By determining solutions for how to balance energy use with economic concerns, Iowa can achieve a sustainable future.

Appendix 1
Bibliography of Reports of Technical Committees and Public Surveys Completed in Support of the Iowa Comparative Risk Assessment Study

Iowa Comparative Risk Assessment: Report of the Human Health Team, 105 pages., plus 50 page addendum.

Iowa Comparative Risk Project: Ecological Technical Assessment, 129 pages.

Iowa Comparative Risk Assessment: Report of the Technical Committee on Risks to Quality of Life, 56 pages.

Iowa's Energy Choices, 35 pages.

1996 Survey of Public Attitudes Toward the Environment in Iowa (David L. Dahlquist Associates, Inc.), 43 pages.

A Process for Ten Town Meetings, Phase I, Iowa Comparative Risk Assessment (David L. Dahlquist Associates, Inc.), 92 pages.

Choices for Iowa's Environment, Town Meetings – Phase II (Kuhn Communications), 56 pages.

Appendix 2
Descriptions of Environmental Issues
Iowa Comparative Risk Assessment Study
(Listed in Alphabetical Order)

1. Acid Rain. Acid rain is formed when sulfur dioxide and nitrogen oxides rise into the air. Once in the atmosphere, they convert to sulfuric acid and nitric acid through interaction with water. There, acids eventually fall back to the Earth in the form of precipitation. Acid rain is detrimental to ecological systems in several ways. It can lead to lake acidification, resulting in the extinction of acid-sensitive fish and other aquatic organisms. It can deplete the buffering capacities of soils, causing the mobilization of aluminum and other heavy metals. Aluminum mobilization has been identified as a source of forest dieback in heavily impacted regions of Europe.

2. ***Air Pollution. (Outdoor).*** Air pollution is defined as the presence of airborne pollutants found at concentrations high enough to induce an adverse effect on the health of humans and ecosystems. Substances may be natural or synthetic. In the human health assessment, the analysis focused on six "criteria" air pollutants, as defined by the U.S. EPA. These six were carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM_{10}), nitrogen oxides (NO, NO_2), lead (Pb), and ozone (O_3).

In the quality of life assessment, under the criterion "economic well-being", the definition of air pollution has been expanded to cover any pollutants that might retard economic development in a region. In addition to pollutants affecting health and ecological systems, pollutants that have strong, offensive odors are included. Examples are odors from sewage treatment plants, rendering plants, incineration of wastes. These odors, though not threatening human health or ecological systems, can detract from the quality of life of a region and be viewed as an undesirable place to live. This perception may discourage economic investment and growth in the given region.

3. ***Animal Production.*** This issue concerns the growing trend of large scale animal production in Iowa, with particular emphasis on swine production. Associated environmental problems include the potential impacts on streams, rivers, lakes, and groundwaters due to seepage or spills of concentrated animal manure, and odors that have impact on neighboring communities unassociated with the feed lots. Excess-application of manure may also contribute to water quality problems.

4. ***Biological Alterations.*** Biological alterations are changes in Iowa's ecosystems, especially native prairie, forest and wetlands, due to the introduction of new species, loss of native species or, changes in the way land is used. This issue focuses on ecosystems in Iowa including remnant prairie and forests, parks, riparian zones, wetlands, and lands converted to agricultural use; but not urbanized areas. Impacts include the introduction of exotic species and pest species such as smooth brome, zebra mussels, leafy spurge, multiflora rose, purple loosestrife, Eurasian water milfoil; loss of biodiversity; monoculture crops such as corn, and soybeans; and species extinction.

5. ***Food Safety.*** This issue refers to foodborne human disease outbreak defined as the occurrence of two or more cases of similar illness resulting from the ingestion of common food. This issue includes foods contaminated with bacterial pathogens, foods treated with hormones or antibiotics, and foods containing pesticide residues.

6a. ***Global Change (Climate Change).*** Global climate change is caused by the combustion of fossil fuels and emissions of various "greenhouse" gases, global deforestation, and changes in land use that change surface albedo. Changes in climate may influence regional as well as global climates. Impacts include higher or lower temperatures, increased or decreased precipitation levels, increased or decreased wind flows, increased or

6b. ***Global Change (Ozone Depletion).*** The chlorofluorocarbons, a class of synthetic chemicals, are depleting the stratospheric ozone layer. Ozone depletion is hazardous because it increases the exposure of humans and other biota on earth's surface to UV-B radiation, an agent responsible for skin cancer. Other effects are possible impairment of photosynthesis and plant metabolism in certain species, declines in forest productivity, and dysfunction in various oceanic phytoplankton

7. ***Household Hazardous Waste.*** This issue covers the human health risks associated with storage and subsequent exposure to hazardous wastes which are commonly found in the household. This issue excludes hazardous wastes that are generated as a result of industrial processes. It excludes non-hazardous solid wastes generated at home and by industry.

8. Housing Safety. This issue was identified by the Public Advisory Committee. It is not a new issue, but a clustering of several issues identified by the Committee on Human Health. It includes "lead poisoning," (issue 13, this appendix), "household hazardous waste," (issue 7), "indoor air pollution" (issue 11), and "radon exposure" (issue 22).

9. ***Hydrological Alterations (Ecological Systems).*** Hydrological alterations are events such as stream channelizaton, removal of riparian vegetation, and destabilization of stream banks that alter the aquatic habitat and/or flow of a stream or river, thus leading to a deterioration of the biological aspect of stream quality. The main causes of hydrological alterations are industrial and residential development and agricultural practices.

10. ***Improper Hazardous Waste Disposal.*** This issue refers to the many and varied types of hazardous wastes produced from private as well as commercial sources. The majority of the improperly disposed wastes in Iowa consists of worn out tires, old appliances, unwanted junk, automotive parts, as well as drums for which the contents are unknown. Sites containing such wastes are not only an eyesore, but can be breeding grounds for pests which themselves can be potential sources for disease, e.g., mosquitoes, roaches, rodents, etc. Particular hazards may include exposure from hazardous substances such as chemical and manufacturing wastes which can leach into ground water supplies. Toxification episodes such as have occurred at Love Canal, New York, and Times Beach, Missouri represent some of the worse case scenarios that can result from hazardous wastes. This issue is closely related to the issue "RCRA, CERCLA, and federal facilities" (see issue 23).

11. Indoor Air Pollution. This issue refers to toxic airborne pollutants, in homes or commercial buildings, occurring in heavy enough concentrations so as to cause illness or sickness to humans inhabiting the resident space. The human health assessment comprised an analysis of four such pollutants: carbon monoxide (CO), asbestos, environmental tobacco smoke, and radon.

12. Land and Soil Contamination. This issue results from accidental and toxic releases, and leaking landfill and hazardous waste sites. The introduction of contaminants into the soil from these sources can be harmful to the normal structure and functioning of Iowa's ecosystems. This issue is related to issues 10 and 23.

13. Lead Poisoning. This issue refers to elevated human exposure to lead through inhalation of lead dust or fumes, or ingestion of lead. In previous decades the major exposure pathway was inhalation of lead from leaded gasoline. Currently, the major exposure is to young children ingesting leaded paint chips. Lead as an additive to paint was discontinued in the mid-1970s, but in old houses in economically poor neighborhoods it is often the case that old leaded paint peels of the wall and onto the floor. The paint has a rather sweet taste, and toddlers pick up the chips and ingest them. Because these children are so small, even a rather small chip can cause lead poisoning.

14. ***Non-hazardous Solid Wastes.*** Nonhazardous solid waste includes materials such as durable goods (i.e. appliances), non durable goods (i.e. newspapers) containers and packaging, food scraps, yard waste, and miscellaneous inorganic wastes from residential, commercial, institutional and industrial sources.

15. ***Nuclear Wastes.*** Nuclear power is produced by splitting heavy atoms (fission) or joining light atoms (fusion). The waste that remains as a result of this process is nuclear waste. To date, scientists and engineers have not devised optimal means for safely disposing of nuclear wastes from military operations or from nuclear power plants. Any exposure to nuclear waste products poses a health risk. Risks are related to cumulative exposure, and the onset of disease (in this case cancer) may occur many years after initial exposure. Monitoring the atmosphere, the soil, and drinking water supplies for possible leaks from waste area repositories will need to be conducted continuously over a period of time transcending any time scales relevant to human experience to date. For example, it will take about 250,000 years for plutonium wastes to decline to negligible levels in the environment.

16. ***Occupational Exposures.*** This issue includes human diseases caused by exposure of workers to pathogens and toxic chemicals in their work places. A particularly important aspect for Iowa is the health risk posed to agricultural workers in the production of both crops and animals. The Technical Committee on Human Health ranked worker exposure from hog production to be in the highest risk category.

17. ***Outdoor Air Quality.*** See "Air Pollution," Issue 1.

18. ***Overuse of Non-renewable Energy Resources.*** This issue includes current and future use of fossil fuels, which are in limited supply globally. The higher the rate of use, the sooner they will be unavailable later on. Moreover, this issue leads directly into the issue of global change. The rate of use of fossil fuel may well define whether acid rain and climate change constitute significant risks.

19. ***Pesticide Exposures.*** This issue includes risks to human health and ecological systems posed by insecticides, herbicides, fungicides, ascaricides, larvacides, miticides, mollucides, pediculicides, rodenticides, scabicides, plus attractants (pheromones), defoliants, desiccants, plant growth regulators, and repellents. The analysis includes an exposure assessment of pesticides which involves multiple pathways in different environmental media. Affected environmental media include: (1) sources of potable drinking water (both surface and groundwater); (2) edible biota e.g., commercial fish stocks as well as sport fish; (3) wildlife; (4) long distance atmospheric transport of deposited and/or re-volatilized pesticides in the environment.

20. ***Private Septic Systems.*** This issue mostly applies to about 150 small Iowa communities without municipal sewage systems. Untreated domestic sewage discharges are common in these areas. There are health concerns, particularly when children come in contact with the discharged waste, which contains pathogens and viruses, and are breeding grounds for mosquitoes and other pests.

21. ***Physical Alterations.*** This issue refers to threats to Iowa's ecosystems resulting from land-use changes such as urbanization; surface transportation systems including ecological roadside management, roads and highways, dredging, and water transportation; and energy production including coal burning and biomass fuel promotion.

22. ***Radon Exposure.*** Radon gas can build up to elevated levels in houses built on rock with high natural uranium content, and where the ground is sandy and permeable to gases (radon is a "daughter" product of the nuclear decay of uranium). Once in the home, radon decays to other radioactive isotopes that can lodge in the lung and cause lung cancer. This is also an issue under indoor air pollution (see issue 8).

23. ***RCRA[4], CERCLA[5], and Federal Facilities.*** This issue refers to exposure to a vast array of toxic substances from abandoned hazardous waste sites. It is estimated that such sites may pose a threat to more than 100 communities in Iowa. Pollutants at these sites typically leach into groundwaters and migrate to wells used for drinking water, or to streams, rivers, and lakes, where they are taken up by aquatic biota.

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[4] RCRA is the acronym for the Resource Conservation and Recovery Act.

[5] CERCLA is the acronym for the Comprehensive Environmental Response Compensation and Liability Act.

24. ***Soil Erosion.*** Soil erosion is the process by which top- and sub-soils are removed from the land. Although erosion is a slow, natural process, agricultural activities have greatly increased the rate and scale of removal. Eighty percent of Iowa's land is tillable, and agricultural activities, combined with land cover, topography, soil types, and wind and precipitation patterns, result in soil erosion. Wind and aqueous runoff are the main causes of soil erosion. Aqueous runoff from agricultural lands results in less productive, eroded lands; loss of farm chemicals; reduction in water quality; deposit of sediments and chemicals in road ditches, lakes, streams and rivers; reduction of water-quality-based recreation; increased flooding; and loss of ecosystems and habitats.

25. ***Unacceptable Noise Level.*** This issue includes unwanted or excessive sound caused by numerous sources, such as motors, fans, and exhausts used in industrial processing, whistles and horns, high volumes of traffic (cars, heavy trucks, railroads, and air planes), construction and demolition works, and quarrying and mining activities.

26. ***Unbalanced Real Estate Development.*** This issue refers to purchase and development of real estate mainly in rural areas and smaller towns, whereby so-called "green" space is purchased and converted into industrial, commercial, or residential zones. Negative, community-scale impacts may occur when such developments are conducted without foresight about: (1) the integrity of landscapes and natural areas; (2) other alternative uses of the land in the future (since in general, developed areas cannot be converted back to natural or agricultural land); and (3) concerns of local citizens who have lived in these areas all or most of their lives.

27. ***Underground Storage Tanks.*** This issue includes the human health risks posed by Iowa's underground storage tanks (USTs). Data are available from the Iowa Department of Natural Resources's implemented registration program for underground storage tanks, and from a newly implemented risk-based corrective action plan that prioritizes UST sites based on estimated impacts to human health and the environment. The major contaminants included under this issue are petroleum fuels, including gasoline, kerosene and jet fuel, diesel fuel, and light and heavy fuel oils.

28. ***Water Quality.*** This issue includes both surface and groundwater pollution. Surface water refers to any water in lakes, rivers, and streams on the surface of the land. The contamination of these aqueous resources comes from runoff from agricultural land (siltation, nutrients, and pesticides), industrial discharges, landfills, hazardous waste sites, road salt, urban runoff (contaminated street dust), underground storage tanks, land-based sewage application, animal confinement, and accidental releases.

29. ***Waste Incineration (Municipal & Medical).*** This issue includes human health risks posed by the burning of large quantities of municipal solid waste (MSW), including medical wastes in Iowa. The assessment focuses on the airborne emissions of polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and trace metals from waste disposal processes. The assessment also considers all waste management options, including recycling, composting, and landfilling.

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Ms.	Sharon	Juon	Executive Director	Iowa Northland Regional Council of Governments 501 Sycamore -- Suite 333 Waterloo, Iowa 50703	319/235-0311
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Title	FirstName	LastName	JobTitle	Address	Phone #
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Mr.	Rick	Robinson	Environmental Affairs Director	Iowa Farm Bureau Federation 5400 University Avenue West Des Moines, Iowa 50266	515/225-5432
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Mr.	Mark	Douglas	President	Iowa Utility Association 321 E. Walnut Street Des Moines, Iowa 50309	515/282-2115
Mr.	Jack	Clark	Vice President	Iowa Utility Association 321 E. Walnut Street Des Moines, Iowa 50309	515/282-2115
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