Final Report of the New Jersey Comparative Risk Project

March 2003

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Bradley M. Campbell
401 East State Street
P.O. Box 402
Trenton, NJ 08625-0402

Dear Commissioner Campbell:

On behalf of the Steering Committee of the New Jersey Comparative Risk Project, we are very pleased to transmit our final report to you, summarizing a four-year effort to evaluate the comparative negative impacts of the state's many environmental problems.

We find that the environmental threats with the greatest impact statewide in New Jersey include land use change, indoor environmental problems, and invasive species, plus a set of more familiar pollutants already targeted by government action. Some of these threats are clearly within the domain of the New Jersey Department of Environmental Protection, and we hope that you will take appropriate management actions. Other threats, including land use change and the indoor environment, depend on coordinated action by multiple agencies of government. We encourage you to pursue such coordination vigorously.

The 178 detailed, systematic analyses of health, ecological and socioeconomic impacts of 88 environmental stressors provide unprecedented information about impacts not yet dealt with by existing environmental management efforts. While monitoring, data analysis and research can and should be used to fill in the inevitable data gaps and uncertainties, we hope that you will encourage your agency and other environmental managers in New Jersey to use these results in priority-setting and strategy development.

The New Jersey Comparative Risk Project was led by an active and broad-based Steering Committee (see attached list), supported by three expert Technical Work Groups and a project coordination team. A thorough peer review process and outreach efforts touching hundreds of citizens enhanced the project's technical credibility, transparency and legitimacy. Among the dozens of project participants, we would especially like to recognize the contributions of Martin Rosen, Branden Johnson, Gary Buchanan, Alan Stern and Suzanne Shannon of NJDEP, and Professor Clinton Andrews of Rutgers University.

Sincerely,

Daniel Rubenstein
Co-chair, Steering Committee
Professor and Chair
Department of Ecology & Evolutionary Biology
Princeton University

Sheryl Telford
Co-chair, Steering Committee
Business Team Manager
E.I. du Pont de Nemours & Co.

Steering Committee, New Jersey Comparative Risk Project

Co-Chair: Daniel I. Rubenstein, Princeton University
Co-Chair: Sheryl Telford, PSE&G (later E.I. du Pont de Nemours & Company)

Dorothy Bowers, Merck & Co. (Retired)

James Brownlee, New Jersey Department of Health & Senior Services

Joseph DellaFave, Ironbound Community Corporation

Gus Elsner, Infineum USA

Peter J. Furey, New Jersey Farm Bureau

Keith V. Hamilton, Mercer County Freeholders, and Avaya Corp.

Gary Lord/Laura Schwartz (sequential members), Isles, Inc.

Leslie McGeorge, New Jersey Department of Environmental Protection

Michael McGuinness, New Jersey Chapter of the National Association of Industrial and Office Properties

Linda Morgan, OENJ Cherokee Realty Holdings, LLC

Martin Robins, Edward J. Bloustein School of Planning & Public Policy, Rutgers, The State University of New Jersey

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Randy Solomon/Tim Evans (sequential members), New Jersey Future

Nancy Wittenberg, New Jersey Builders Association

Charles Yates, Farmers & Mechanics Bank (deceased)

Carolyn Whittaker/Junfeng (Jim) Zhang (sequential members), Environmental & Occupational Health Sciences Institute (EOHSI), UMDNJ

A Guide to This Report

This report is organized to emphasize the two primary products of the New Jersey Comparative Risk Project (NJCRP): (1) the rankings of environmental issues according to their relative negative impacts on human health, ecological quality, and socioeconomic conditions, and (2) the detailed analyses of those impacts for each issue.

The report begins with an Executive Summary, which includes the overall rankings for the three kinds of impacts.

The main part of the report has three sections:

- The Rankings section begins with a very brief background section on the NJCRP's origins, mission, and process; presents the separate statewide rankings of issues based on their health, ecological and socioeconomic impacts (including uncertainty in these rankings, trends, and catastrophic potential); and ends with a discussion of caveats about the overall rankings.
- The Analyses section provides a more detailed discussion of the process of the NJCRP, particularly for the expert workgroups that separately analyzed health, ecological and socioeconomic impacts; and presents alternative perspectives for ranking environmental issues (by uncertainty, trends, catastrophic potential, areas and populations at particular risk).
- The Steering Committee for the project—a diverse group of stakeholders from across New Jersey—used the rankings and analyses produced by the experts to develop their own set of Findings and Recommendations to the New Jersey Department of Environmental Protection (DEP).

The next part of the report contains the Summaries. These are one-page distillations of the information developed for each environmental issue. They define the issue; show its overall relative ranking; discuss potential impacts overall; report the health, ecological and/or socioeconomic impacts judged most likely to occur; and briefly report on what's being done about them.

The final section of the report contains the Appendices. These include (1) a list of NJCRP participants; (2) blank versions of the templates that the expert workgroups used to standardize their analyses; (3) the Human Health analyses; (4) the Ecological Quality analyses; (5) the Socioeconomic analyses; and (6) analyses of issues that were not included in the overall rankings.

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ACKNOWLEDGMENTS

A project of this complexity and magnitude could not be successfully completed without the significant and dedicated efforts of a committed group of individuals. This group recognized the value and potential of the comparative risk concept for improving environmental decision-making in New Jersey with the ultimate goal being the improvement of our state's environmental quality. They worked hard, remained committed, and contributed their most valuable assets—their intelligence and time. Consequently, I would like to offer my appreciation to the following:

Dr. Daniel Rubenstein, Princeton University, and Ms. Sheryl Telford, E.I. du Pont de Nemours Corporation, the project's Steering Committee Co-Chairs, who took much time out of their busy schedules to lead and refine this project and inspire its participants. Their attention to process and content, and their sensitivity to detail and politics, kept the project on a sound footing and gave it a clear direction. Their contributions on behalf of the citizens of New Jersey are gratefully applauded.

Dr. Clinton Andrews, Rutgers University, whose insights, products and humor helped keep the project practically focused as well as intellectually challenging throughout. He is owed an additional debt of gratitude for being the mainstay of the Socioeconomic Technical Work Group and ensuring that the necessary analyses were completed. Many thanks also to Clint's graduate students, especially John Posey, Dave Hassenzahl, Jun Bi, Jason Lien and Ana Baptista.

Dr. Alan Stern and Dr. Gary Buchanan, NJDEP Division of Science, Research and Technology (DSRT), for their outstanding work as Chairs of the Human Health and Ecological Quality Technical Work Groups, respectively. I thank them for their commitment to scientific excellence and their willingness to persevere and guide the many members of their committees, especially when committee members' energy inevitably began to wane.

Ms. Suzanne Shannon, my Executive Assistant, who endured many extended meetings, short deadlines and numerous thankless assignments. Her patience, dedication and suggestions were always appreciated and her contributions vital.

Dr. Ken Jones of the Green Mountain Institute for Environmental Democracy, Montpelier, Vermont, who shared his extensive understanding of the comparative risk paradigm to help inform key project decisions, and (with Jennifer Colby) accomplished wonders of synthesis in writing stressor summaries and initial versions of this report.

Ms. Terri Tucker exhibited enormous patience and resolve in dealing with numerous revisions of the content, formatting, and organization of this report, and in ensuring that both its printed and Web versions would enhance its usefulness to environmental managers and New Jersey citizens.

Finally, Dr. Branden Johnson, DSRT, who was my left hand, my right hand, my advisor, and my colleague, and who kept this colossus moving forward throughout the numerous years it took to bring this project to fruition. The successful completion of this endeavor would not have been possible without his many, many efforts and excellent judgment.

Marty Rosen
Project Manager, New Jersey Comparative Risk Project
Director, Division of Science, Research and Technology
New Jersey Department of Environmental Protection

EXECUTIVE SUMMARY

Executive Summary

Introduction

From 1988 to 1998, the U.S. Environmental Protection Agency (EPA) partially funded and gave technical assistance to comparative risk projects. As defined by the EPA, comparative risk assessment "uses sound science, policy, economic analysis and stakeholder participation to identify and address the areas of greatest environmental risks and provide a framework for prioritizing environmental problems." By the end of 2000, 24 states had completed comparative risk projects.

In April 1998, the New Jersey Department of Environmental Protection (DEP) launched the New Jersey Comparative Risk Project (NJCRP).

Its primary question was:

"What is the relative importance of environmental problems in New Jersey?"

The NJCRP Steering Committee, a diverse group of stakeholders, was charged with the following tasks:

- Determine how different environmental issues compare to one another in their negative impacts on human health, ecological quality, and socioeconomic conditions in New Jersey, based on current environmental management.
- Identify key gaps in existing knowledge that need filling to better compare environmental issues and develop strategies to deal with them that also account for any beneficial impacts (not included here).

To meet these objectives, the Steering Committee assembled three Technical Work Groups (TWGs). These included the Human Health (HH)TWG, the Ecological Quality (EQ) TWG and the Socioeconomic (SE) TWG, each composed of experts from government, business, academia and nonprofit organizations. The three TWGs together created impact analyses for 88 different environmental stressors (chemical, physical, or biological factors) affecting the environment. Each TWG also produced a ranking based on these analyses, designed to indicate the relative statewide risks posed by each stressor in New Jersey.

The 178 resulting analyses (not all stressors were relevant to each impact category, and some were aggregated) provide detailed information on each stressor's undesirable impacts, and are well worth additional study (see Appendices). They focused on current impacts and impacts over the next five years, which means that issues with long-term or uncertain impacts (such as climate change due to greenhouse gases) rank low. The fact that an issue ranks low does not mean that it is not worth action to reduce its impacts further. For example, it may be low due to the success of current environmental management or because it is inherently or currently low-risk; action may be warranted because easy means of additional risk reduction can be applied or because society wishes to prevent a potential problem from getting worse. A low rank does not necessarily signal lack of importance (see p. 20).

Findings

Based on the exhaustive analysis performed by the TWGs, the Steering Committee arrived at the following findings. Its members focused on issues ranking high for more than one TWG or that seemed relatively neglected or in need of further attention. The full rankings, which appear at the end of the Executive Summary, show that many of the high-ranking issues on individual TWG lists are already subject to major impact-reduction efforts by DEP. The fact that their high rank indicates significant impacts are not addressed by current programs may at the very least encourage state government to continue its efforts on these issues.

1. Land use change lies at the heart of many of New Jersey's environmental problems. Land use change, in the view of the experts, produced by a wide margin the largest negative ecological and socioeconomic impacts.

- Habitat loss and fragmentation are leading to species loss and permanent destruction within several of the state's ecosystems.
- An increase in the amount of impervious surfaces increases stormwater flows to New Jersey streams and rivers, leading to destruction of wetlands and increased flooding and reducing aquifer recharge.
- Sprawl skews employment patterns and affects property values, both to the detriment of older communities.
- Congestion may cause health and psychological impacts, although there is much uncertainty about the quantification of this threat.

2. Indoor pollution ranked among the highest threats in both the HH and SE rankings. This is a serious problem that deserves more attention from environmental and public health managers.

- Several stressors with high health impacts are primarily or entirely problems of indoor air: secondhand tobacco smoke, radon, indoor asthma inducers, carbon monoxide, and indoor microbial air pollution.
- Although there is insufficient evidence with which to quantify the risk associated with certain stressors, there is some evidence that indoor exposure to some chemicals may be a cause for concern. These include formaldehyde and several volatileorganic compounds.
- Indoor air quality is almost entirely unregulated, although the New Jersey Department of Health and Senior Services (DHSS) is to be commended for beginning discussions concerning an action plan.
- Other indoor pollution problems, such as skin contact with or ingestion of indoor pesticides or lead by children, also are serious and deserve more attention.

3. Invasive species pose a serious ecological threat to several New Jersey ecosystems.

- Insects such as the Asian longhorned beetle and the hemlock woolly adelgid have the potential to destroy hardwood and softwood forests. For example, over 90% of the state's hemlock forests have suffered varying degrees of defoliation.
- The zebra mussel will probably reach freshwaters in New Jersey sometime in the next five years. This thumbnail-sized mollusk has already destroyed freshwater ecosystems in more than a dozen states.
- Invasive plants such as the purple loosestrife, the Norway maple and garlic mustard threaten biodiversity and ecological integrity in several ecosystems, with wetlands a particular concern.

4. Progress has been made in the battle against outdoor air pollution. However, several air pollutants continue to pose both ecological and health risks, including ground-level ozone, sulfur oxides and nitrogen oxides.

Recommendations

These findings led the Steering Committee to offer the following recommendations:

1. The notion that land use changes can create significant environmental problems is not new to New Jersey policy-makers or citizens. But these problems continue to be large and increasing despite past efforts, and reducing negative impacts while retaining benefits of land use change will be challenging. Thus DEP should collaborate with state and local planning officials to design and implement strengthened efforts to reduce the environmental impacts of land use change. While the Steering Committee did not define the precise role of DEP in implementing the state plan, there is a consensus that DEP can contribute by bringing together people from multiple sectors.

2. It is time for DEP and other environmental managers to join DHSS to examine systematically indoor pollution's impacts and management options, and to take action against these problems. The current approach, with inconsistent (across pollutants) attempts at education and persuasion, is clearly not sufficient for the magnitude of the problem.

3. Continued vigilance should be employed against threats posed by invasive species and hazardous air pollutants.

4. A high priority should be placed on identifying and targeting sources that produce multiple stressors. Control of stressors that co-occur (i.e., come from the same sources) offers the potential for more effective environmental management. For example, many air pollutants may be jointly reduced by single actions such as more efficient energy use and use of emissions-cleaning technology.

5. State officials and the New Jersey congressional delegation should seek assistance from the federal government in dealing with sources that originate outside New Jersey borders as well as work with other states on regional problems. Criteria air pollutants (e.g., SOx, NOx) and greenhouse gases are the best known examples of this problem. Other examples include certain invasive species such as the zebra mussel.

6. Increased monitoring, data assessment and research (see Analyses section for examples) will aid in the understanding of risks and the formation of policy. Monitoring programs may help the state focus resources in geographic areas or in economic sectors that will provide the most benefit. In addition, there was a high degree of uncertainty regarding the impact of certain stressors, such as chromium, indoor microbes and pesticides. Additional research can reduce uncertainty and guide risk reduction strategies.

7. Local discussions of risks may yield important new environmental protection efforts. Local environmental planners and managers are encouraged to use the analyses created in this project to produce local comparative risk projects. A pilot local comparative risk project has begun as a collaboration between New Brunswick and Rutgers University.

8. NJCRP analyses and rankings should be used by DEP as part of its risk-based and performance-based management system.

9. The State should consider repeating NJCRP at regular intervals. Comparative risk projects are a strong and useful complement to topic-specific and program-specific analyses.

Caveats

The analyses of environmental impacts were the best possible reviews of available data and science, limited by data availability and quality. Use of identical templates for analysis within TWGs, and peer review, limited variability in analyses across authors. These analytic results are the most systematic across a wide range of stressors ever produced in New Jersey.

Consequently, the resulting rankings should be taken as reasonable reflection of the relative negative impacts imposed by these stressors. (The value of the analyses' estimates of absolute risk is less, due to data gaps, incommensurate kinds of impacts, changing conditions, and other confounding factors.)

A risk ranking is not a list of priorities. It is tempting to consider a list of higher risk issues as the priorities for action. The Steering Committee and other project participants discourage that translation, since the risk ranking does not take into account the limits of agency responsibility, the differing costs of risk reduction, or the appropriate role of public opinion in policy making. Moreover, very few stressors scored high in all three areas (human health, ecological, socioeconomic), thus underscoring the multi-dimensional nature of environmental risks. Any composite ranking would have elevated one dimension over another, which the Steering Committee felt was inappropriate.

The Steering Committee and Technical Work Groups agree that the risk rankings are only part of the product from the analysis. There is a great deal of information that supports the risk ranking. In many cases, this information is more useful than the ranking itself. For this reason, the project produced one-page summaries for each stressor which give an overview of the extent and type of risks that occur. For even more information, the Appendices include the full analyses of each stressor.

Table 1. Issues Rankings (by impact type)

Human Health

High
- Lead
- Ozone (ground level)
- Particulate matter
- Polychlorinated biphenyls (PCBs)
- Radon
- Secondhand tobacco smoke

Medium-High
- Carbon monoxide (Co) -indoor
- Dioxins/furans
- Indoor asthma inducers
- Pesticides-indoor
- Radium
- Volatile organic compounds (VOCs)-carcinogenic

Medium
- 1,3-butadiene
- Acrolein
- Arsenic
- Benzene
- Chromium
- Disinfection byproducts
- Endocrine disruptors
- Formaldehyde
- Legionella
- Mercury
- Nitrogen oxides (NOx)
- Pesticides-food
- Pesticides-outdoor
- Pesticides-water
- Ultraviolet radiation
- Waterborne pathogens-recreational water

Medium-Low
- Airborne pathogens
- Carbon monoxide (CO) -outdoor
- Cryptosporidium-recreational water
- Sulfur oxides (SOx)/sulfates
- Volatile organic compounds- non-carcinogenic (VOCs)

Low
- Cadmium
- Cryptosporidium-drinking water
- Extremely low frequency/Electro magnetic radiation
- Greenhouse gases
- Hanta virus
- Indoor microbial air pollution
- Lyme disease
- Methyl tertiary butyl ether (MTBE)
- Nickel
- Nitrogen pollution (water)
- Noise
- Pfiesteria
- Polycyclic aromatic hydrocarbons (PAHs)
- Radionuclides
- Waterborne pathogens-drinking water
- West Nile virus

Ecological

High
- Habitat fragmentation
- Habitat loss

Medium-High
- Hemlock woolly adelgid
- Increase in impervious surface
- Mercury
- Pesticides-historical use
- Ultraviolet radiation

Medium
- Cadmium
- Catastrophic radioactive release
- Deer
- Endocrine disruptors
- Geese
- Inadvertent animal mortality
- Invasive plants
- Lead
- Nitrogen pollution (water)
- Overharvesting (marine)
- Petroleum spills
- Phosphorus
- Phthalates
- Polychlorinated biphenyls (PCBs)
- Starlings

Medium-Low
- Acid precipitation
- Arsenic
- Brown tide
- Chromium
- Copper
- Dioxins/furans
- Dredging
- Greenhouse gases
- Nickel
- Noise
- Off-road vehicles
- Pesticides-present use
- Polycyclic aromatic hydrocarbons (PAHs)
- Tin
- Water overuse
- West Nile virus
- Zinc

Low
- Asian longhorned beetle
- Blue-green algae
- Channelization
- Dermo parasite in oysters
- EHD virus in deer
- Extremely low frequency magnetic radiation
- Floatables
- Genetically modified organisms (GMOs)
- Green/red tides
- Light pollution
- MSX parasite in oysters
- Ozone (ground level)
- Pets as predators
- Pfiesteria
- QPX parasite in shellfish
- Road salt
- Thermal pollution
- Volatile organic compounds (VOCs)
- Zebra mussels

Socioeconomic

High
- Land use change
- Lead

Medium-High
- Arsenic
- Deer
- Indoor asthma inducers
- Particulate matter
- Pesticides
- Petroleum spills
- Phosphorus
- Polychlorinated biphenyls (PCBs)
- Secondhand tobacco smoke
- Ultraviolet radiation

Medium
- Dioxins/furans
- Endocrine disruptors
- Inadvertent animal mortality
- Indoor microbial air pollution
- Invasive plants
- Noise
- Ozone (ground level)
- Polycyclic aromatic hydrocarbons (PAHs)
- Radon
- Sulfur oxides (SOx)
- Water overuse

Medium-Low
- 1,3-butadiene
- Acid precipitation
- Acrolein
- Catastrophic radioactive release
- Chromium
- Dermo and MSX parasites in oysters
- Extremely low frequency/Electro magnetic radiation
- Floatables
- Formaldehyde
- Greenhouse gases
- Hemlock woolly adelgid
- Light pollution
- Mercury
- Methyl tertiary butyl ether (MTBE)
- Volatile organic compounds (VOCs)
- Waterborne pathogens

Low
- Asian longhorned beetle
- Benzene
- Brown tide
- Cadmium
- Carbon monoxide (CO)
- Copper
- Cryptosporidium
- Disinfection byproducts
- Dredging
- EHD virus in deer
- Geese
- Genetically modified organisms (GMOs)
- Green/red tides
- Hanta virus
- Legionella
- Nickel
- Nitrogen oxides (NOx)
- Nitrogen pollution (water)
- Off-road vehicles
- Overharvesting (marine)
- Pets as predators
- Pfiesteria
- QPX parasite in shellfish
- Radium
- Road salt
- Starlings
- Thermal pollution
- Tin
- West Nile virus
- Zebra mussels
- Zinc