Delaware River Estuary: Application of a Regional Relative Risk Approach

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Acknowledgements

The DuPont Delaware River study is a collaborative effort between scientists and engineers at Arcadis, Integral Consulting, URS, and DuPont.

Team members include:

Integral Consulting - Judi Durda and Damian Preziosi

Arcadis - Tim Iannuzzi

URS – Greg Murphy and Todd Morrison

DuPont - Ralph Stahl, Amanda DeSantis, Bob Hoke, and Bart Ruiter

Science Advisory Team

These individuals provide peer review, comments and guidance on the Study and reports:

Dr. Jeffrey Ashley – Academy of Natural Sciences; Philadelphia University

Mr. Michael McCabe - McCabe and Associates; formerly USEPA Region 3 Administrator

Dr. Charlie Menzie – Exponent

Dr. Jonathan Sharp - University of Delaware

Special Thanks to:

Dr. Wayne Landis - Western Washington University

A Changing World

- **Society is concerned about what you make as well as how you make it**
  - What is your facility footprint
  - What is the societal value and environmental impact
- **Science is important, but science alone is not always sufficient for complete public acceptance**
- **Engage with Stakeholders and Government**
  - Develop relationships and partnerships broadly
  - Understand (not just listen to) their concerns
  - Take action throughout the life cycle of issues

Why Do This?

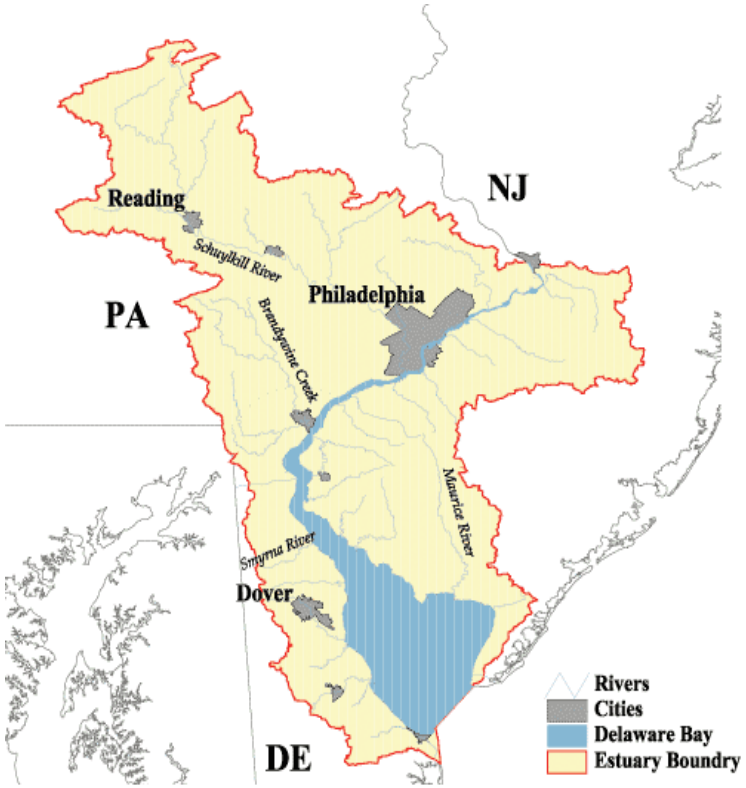
Because the Delaware River Estuary is:

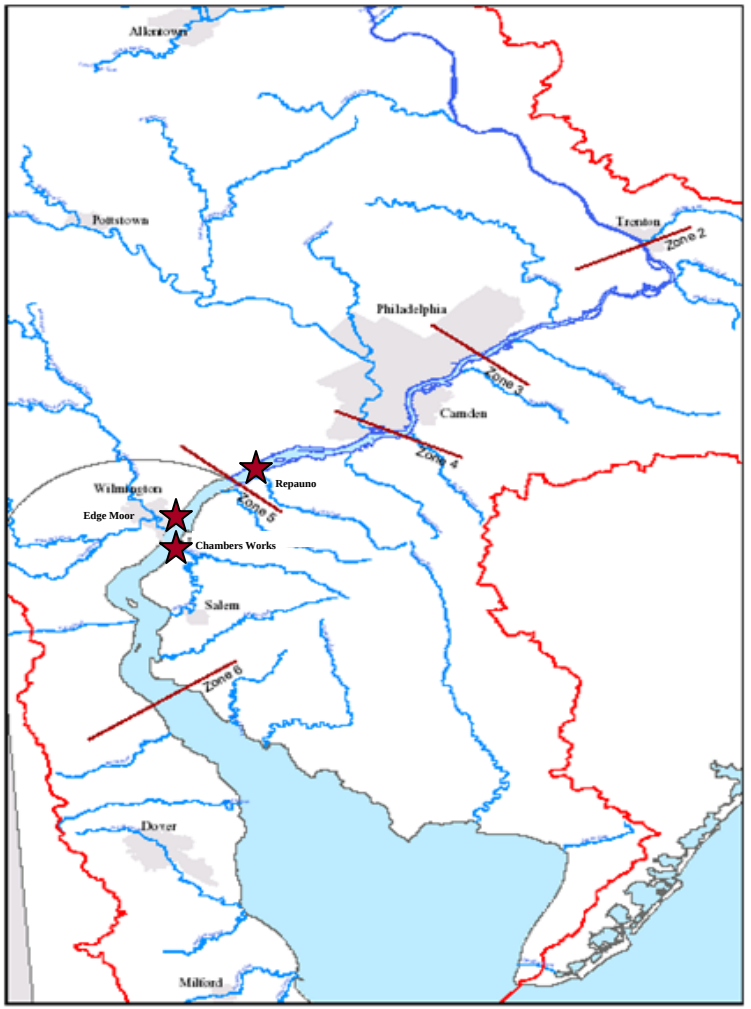
- An urban river impacted by multiple stressors
- Subject to management under a number of regulatory programs

Because realistic and effective restoration actions cannot be developed without understanding:

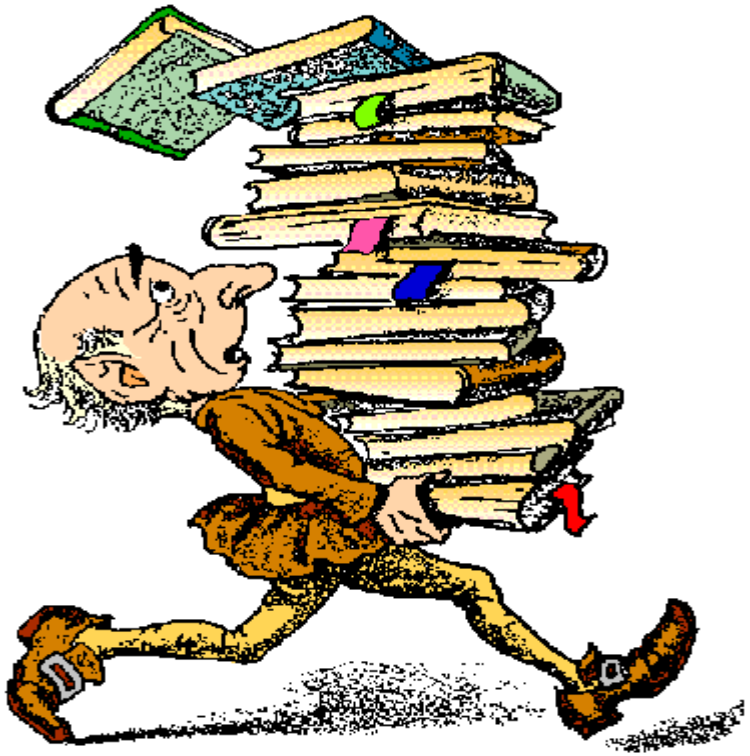
- What is impaired
- What is the cause(s)
- How cause and effect are linked

Study Area Boundary





We Have Diverse Source Issues and Users to Deal With



Objectives

Vision

Support actions in the watershed that are meaningful to stakeholders, have measurable environmental benefits, and occur through a consensus-based scientific framework

Understand our sites in context of river history

Identify and prioritize regional and facility specific data gaps

Ultimately, contribute to overall restoration of River

How to Accomplish

- **Compile Historical Information - Characterize Ecological Conditions, Habitats, etc.**
  - Bibliographic database
  - ARC GIS Database
- **Characterize Major Stressors - Chemical, Physical and Biological**
- **Estimate Relative Ecological Risks Using the Relative Risk Model**

Benefits of the Study

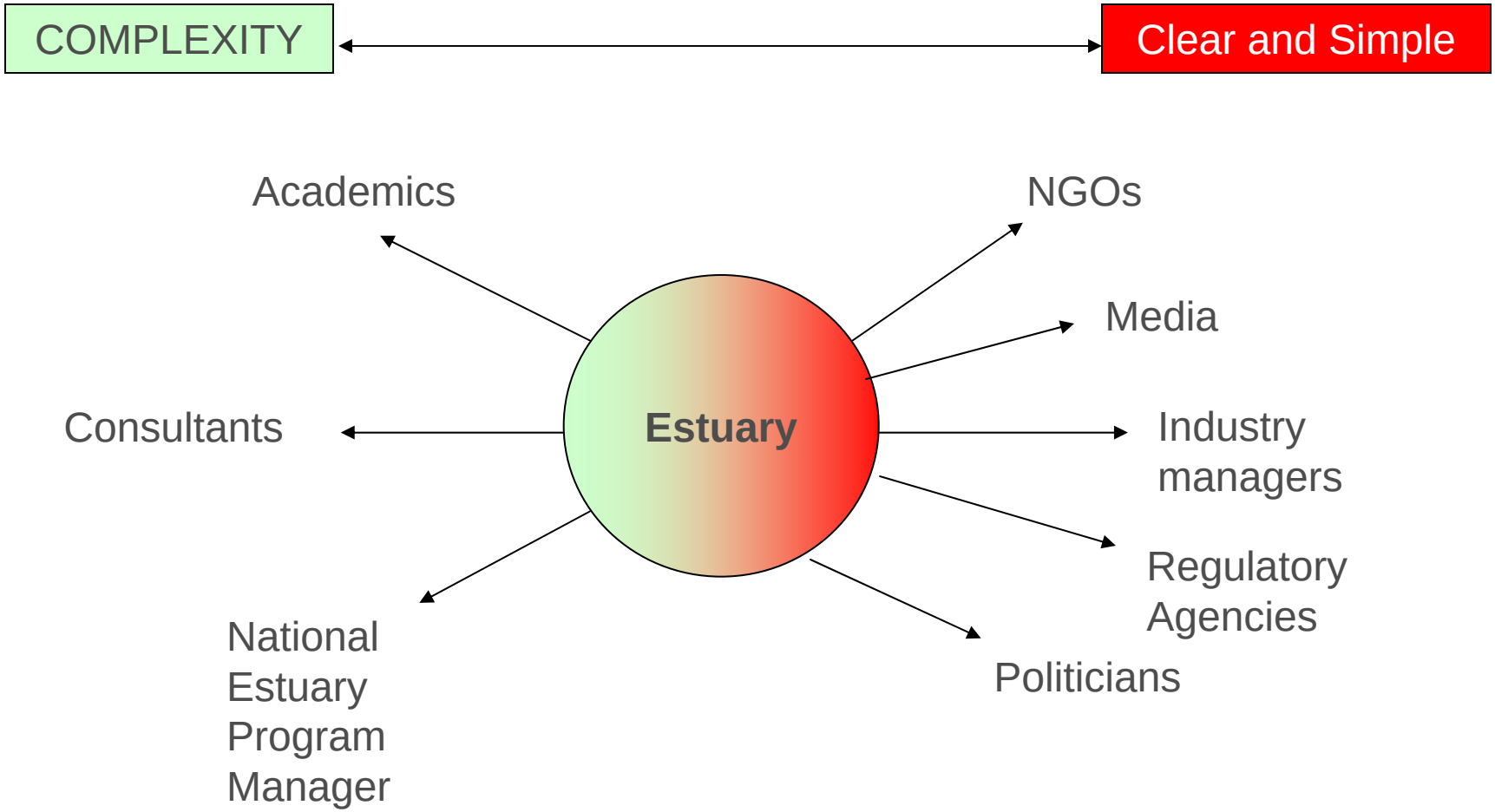
Augment existing initiatives by synthesizing the wealth of information collected to date

- Searchable database
- Hardwired to GIS
- Public-accessible information

Aid in decision-making

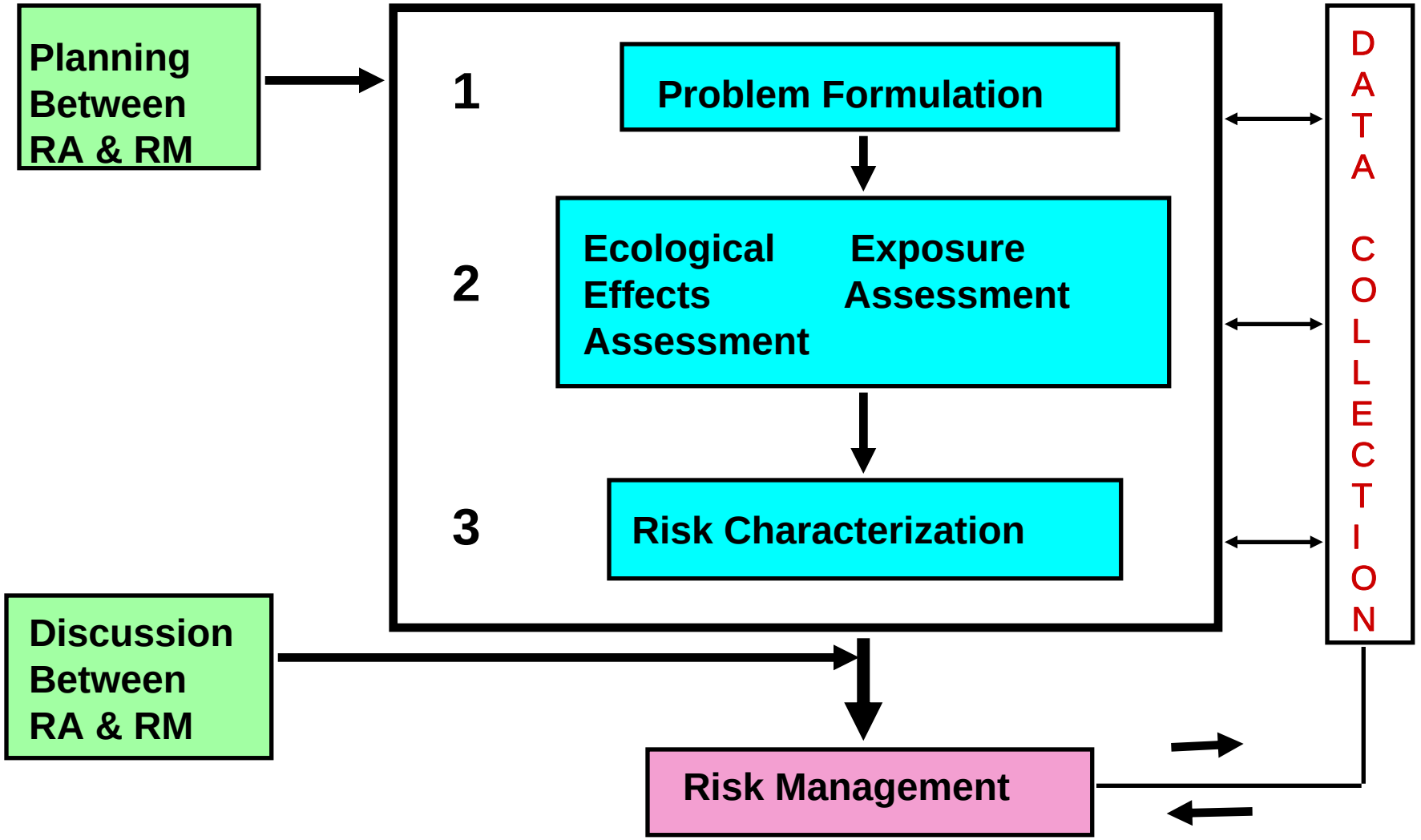
- Identify major stressors and potential data gaps
- Focus efforts
- Data to support regulatory agency and NGO initiatives
- Data to support DuPont facility specific efforts

Communication challenges
with multiple audiences



Adapted from Mike Gribble - ECETOC (2006)

Framework for Ecological Risk Assessment

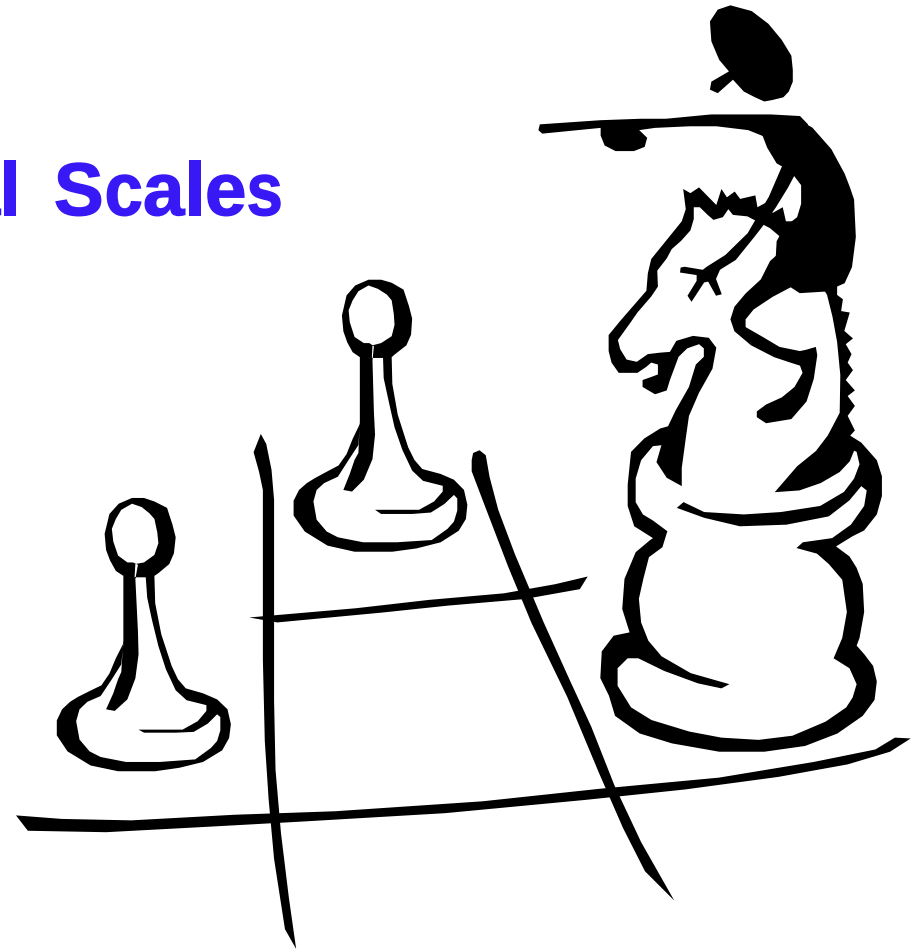


Challenges to ERA

Multiple Stressors

Spatial and Temporal Scales

Ecological Relevance



Applying the RRM – 10+ Years of Experience

Human and Ecological Risk Assessment, 13: 25–38, 2007

ISSN: 1080-7039 print / 1549-7680 online
DOI: 10.1080/10807030601107536

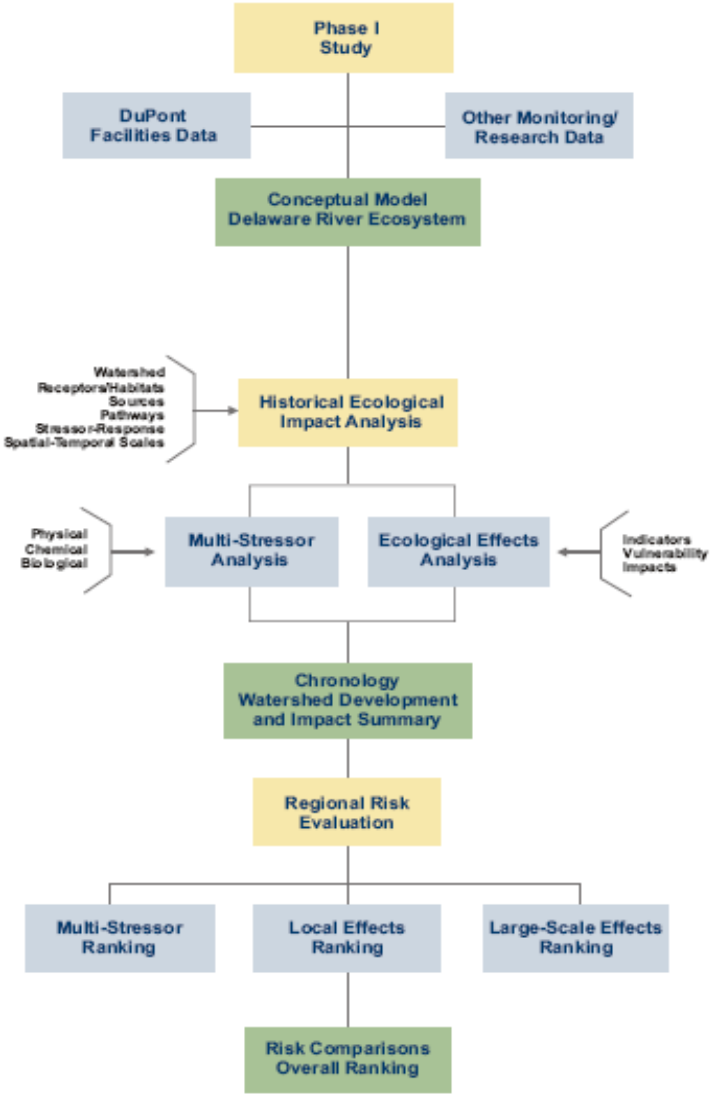
REFLECTION

Ten Years of the Relative Risk Model and Regional Scale Ecological Risk Assessment

Wayne G. Landis[1] and Janice K. Wiegers[2]
[1]Institute of Environmental Toxicology, Huxley College of the Environment, Western Washington University, Bellingham, Washington, USA;
[2]Alaska Department of Environmental Conservation, Fairbanks, Alaska

Overall Phase I Study Approach

- Historical ecology
- Stressor evaluation
- Regional risk assessment
- Relative rankings
- Prioritization



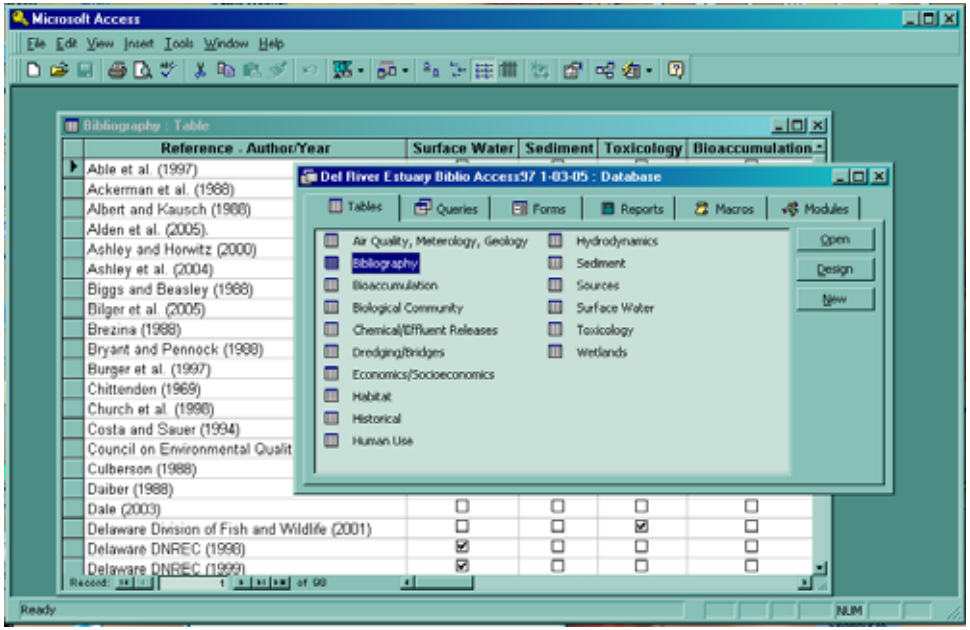
Extensive Data Compilation - Project Bibliography

Searchable bibliography of data/information sources

Citation and summary of contents for each source

PDFs of non copyright protected documents

Shared with regional stakeholders – publically available



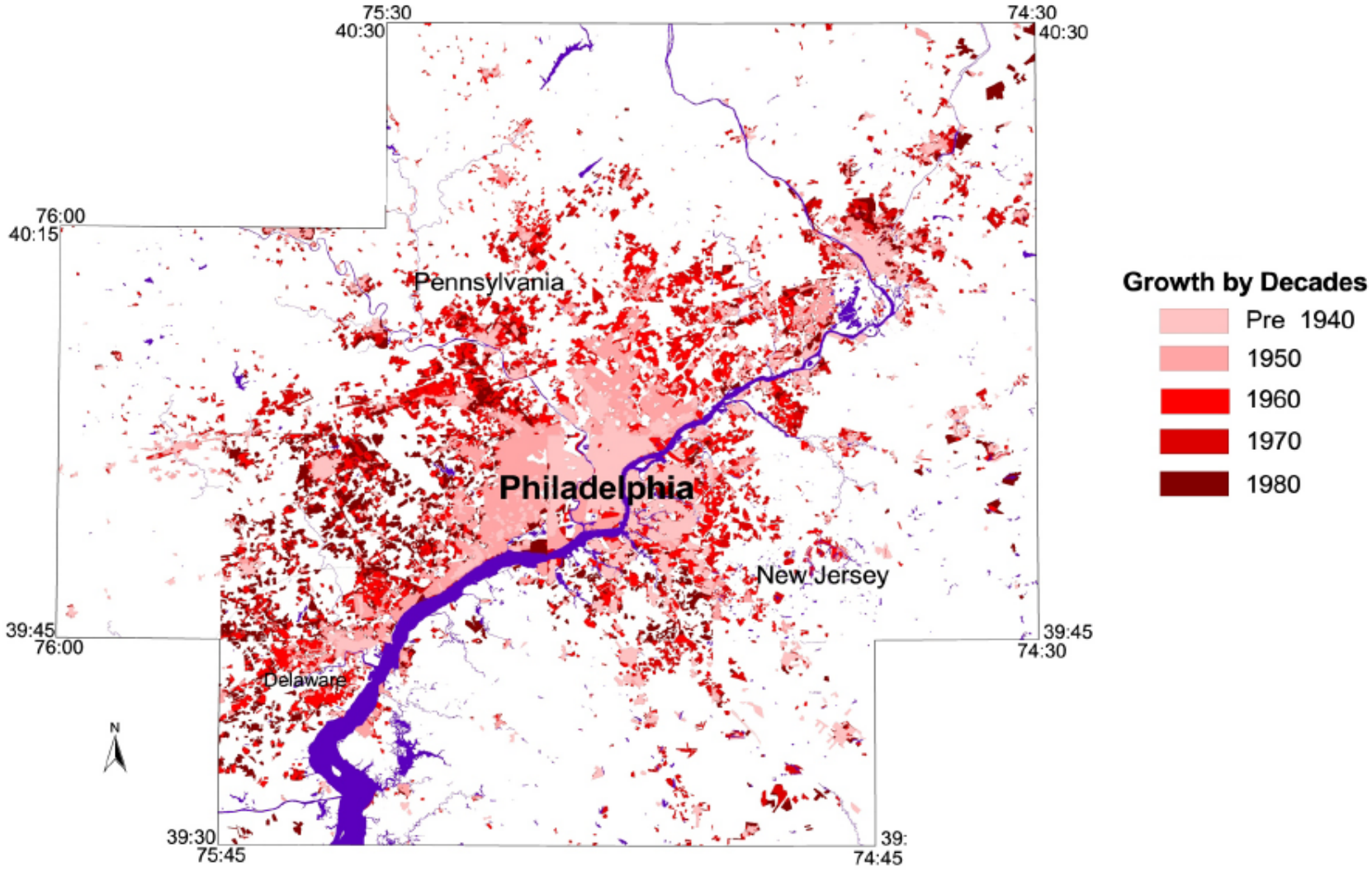
Extensive Data Compilation – GIS Database

First comprehensive database of chemical, biological, and physical data

- Obtained from federal and state regulatory agencies

Shared with regional stakeholders – publically available

Urbanization - Key Historical Stressor in the Delaware River Estuary - We Have A Multiple Stressor Issue



Combine Ecology and Stressor Information

Identified a diversity of habitats, receptors, stressors

Need to combine information in a meaningful way

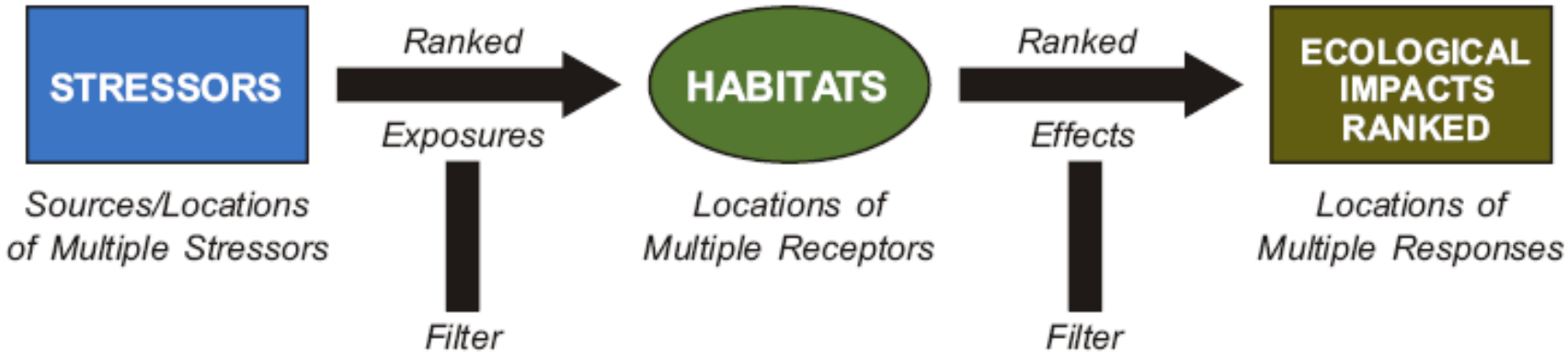
Chose the relative risk model (RRM) as tool (Landis et al., 2005)

- Adaptation of traditional ERA paradigm
- Accounts for multiple and diverse stressors

Key steps in RRM

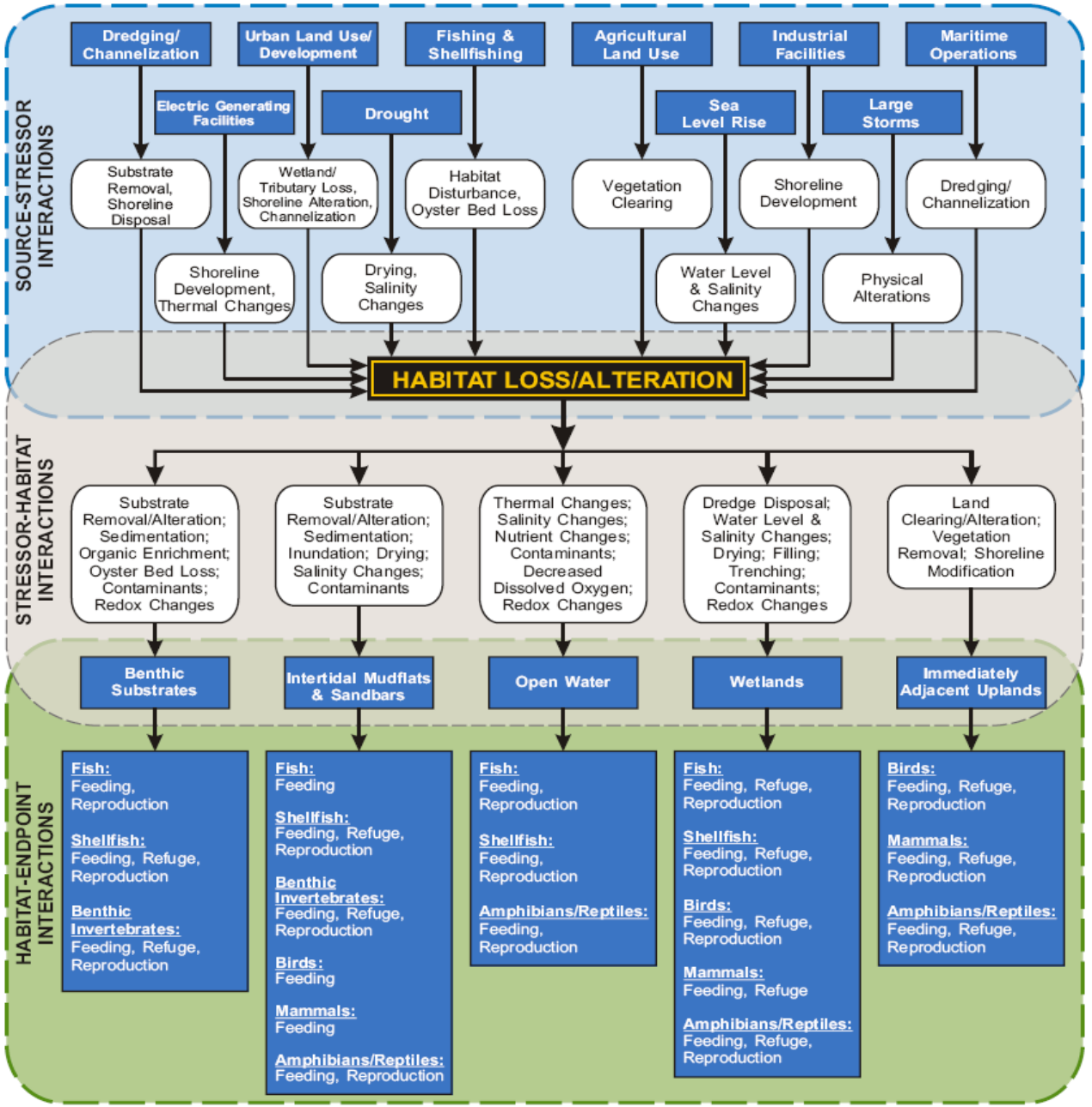
- Conceptual model development
- Stressor ranking
- Relative risk calculations

Overview of Regional Risk Assessment Approach



SOURCE:
ADAPTED FROM
LANDIS AND WIEGERS (2005)

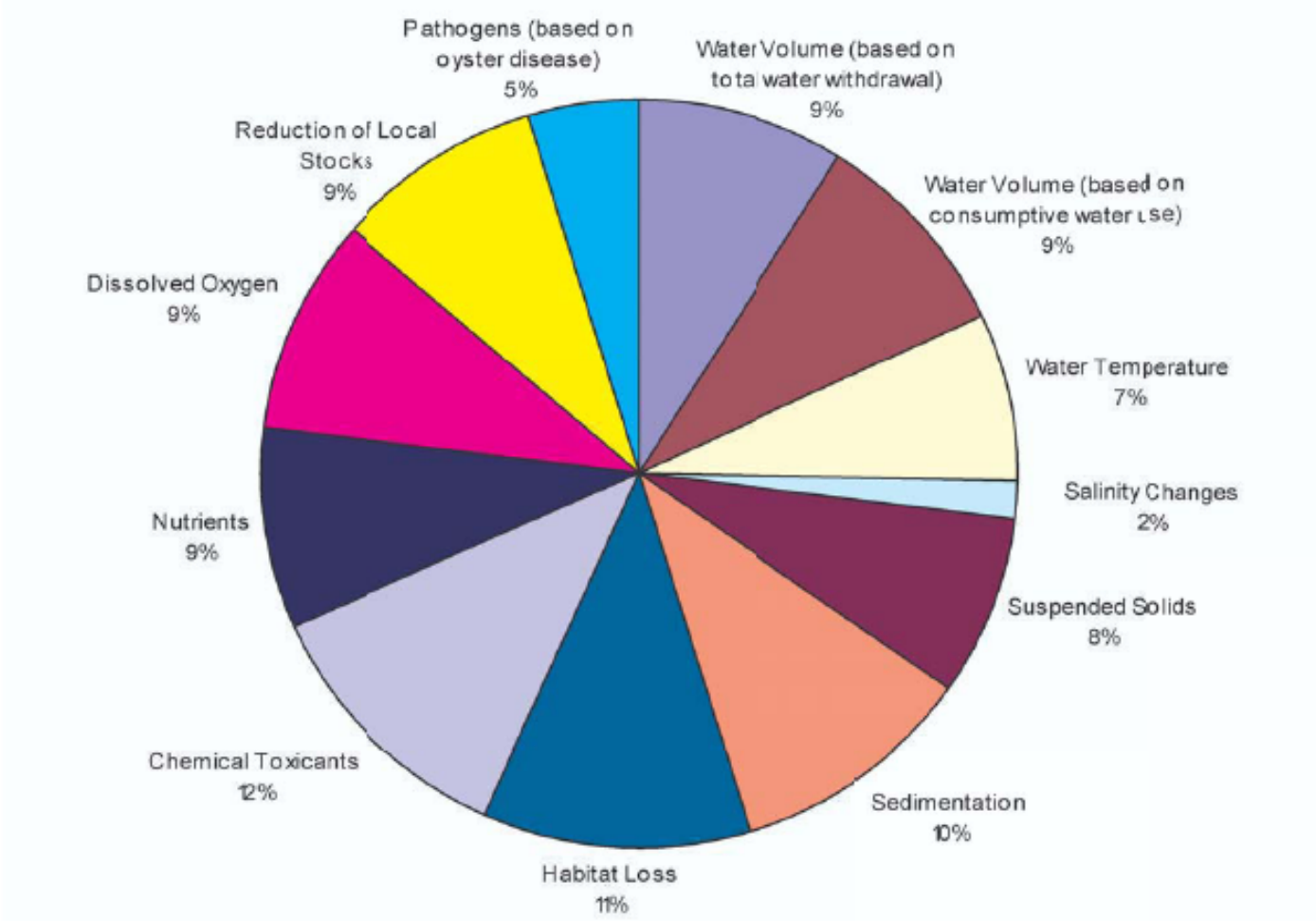
Example Conceptual Model



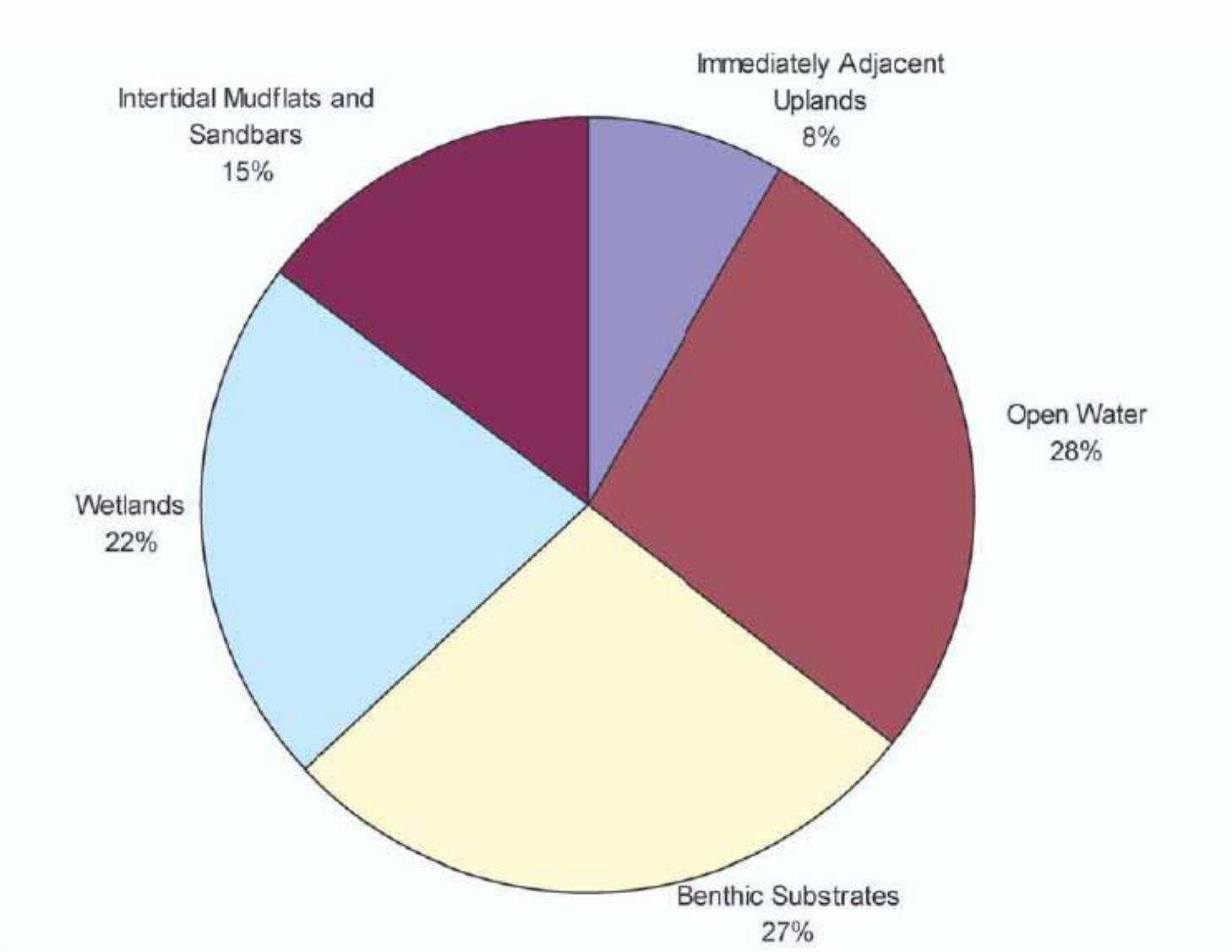
Preliminary Relative Ranking of Regional Stressors

Stressor Category	Stressor	Relative Stressor Strength[a]				
		Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Physical	Water Volume[b] (based on total water withdrawal)	M	M	M	H	L
	Water Volume[b] (based on consumptive water use)	M	M	M	M	L
	Water Temperature[b]	M	H	H	L	L
	Salinity Changes[b]	--	--	H	--	--
	Suspended Solids	L	L	H	H	L
	Sedimentation	L	L	M	H	H
	Barriers to Fish Access	?	?	?	?	?
	Habitat Loss	H	H	H	M	L
Chemical	Petroleum, PAHs, and Related Chemicals	H	H	M	M	L
	PCBs	H	H	H	M	L
	Dioxins and Furans	?	?	?	?	?
	Pesticides	H	H	M	L	L[c]
	Metals	H	H	M	M	L
	Nutrients	H	H	H	M	L
	Dissolved Oxygen	M	H	H	H	L
	Other Chemicals	?	?	?	?	?
Biological	Invasive Species	?	?	?	?	?
	Reduction of Local Stocks	M	M	M	M	M
	Pathogens (based on oyster disease)	--	--	--	--	H

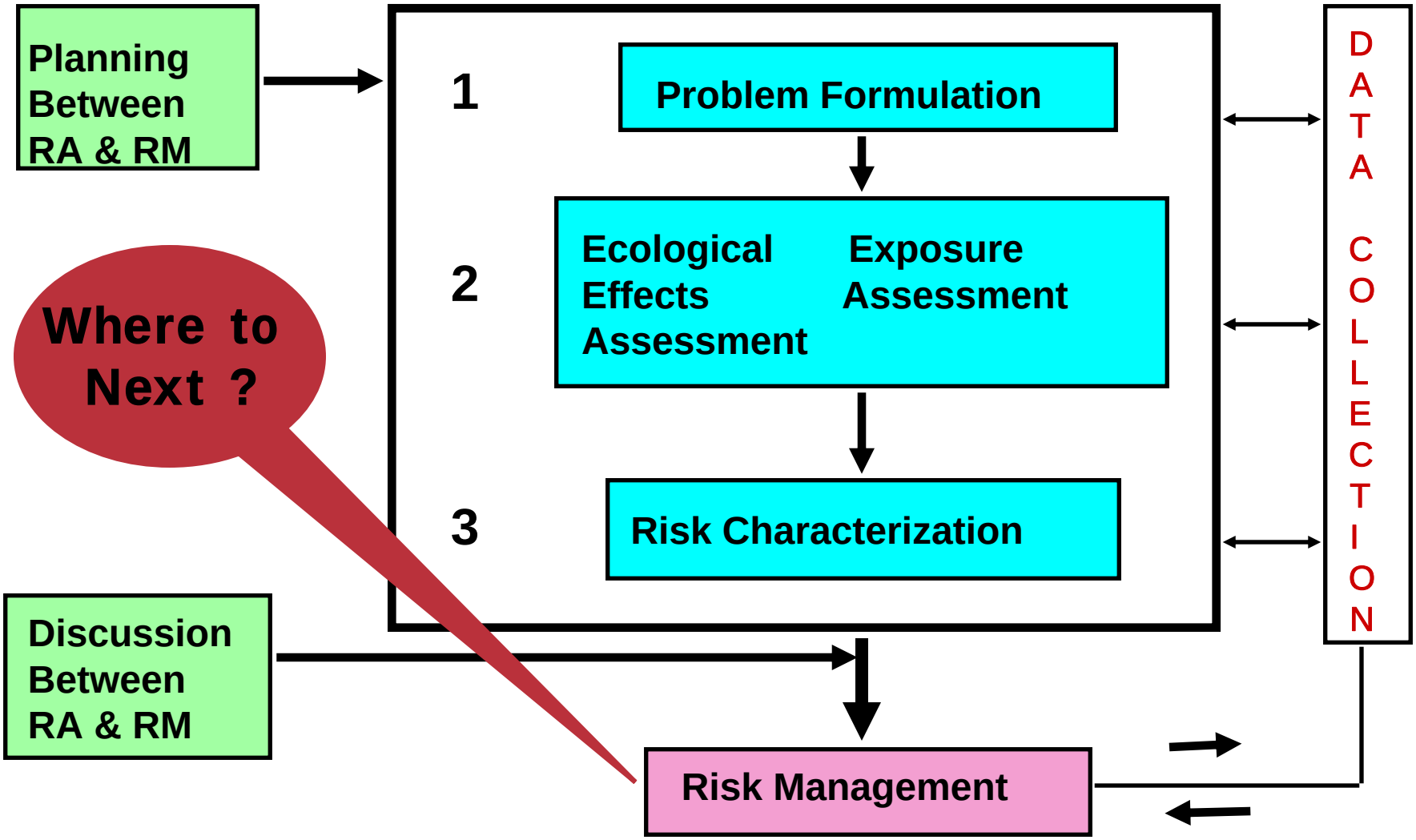
Draft Regional Risk Assessment Result



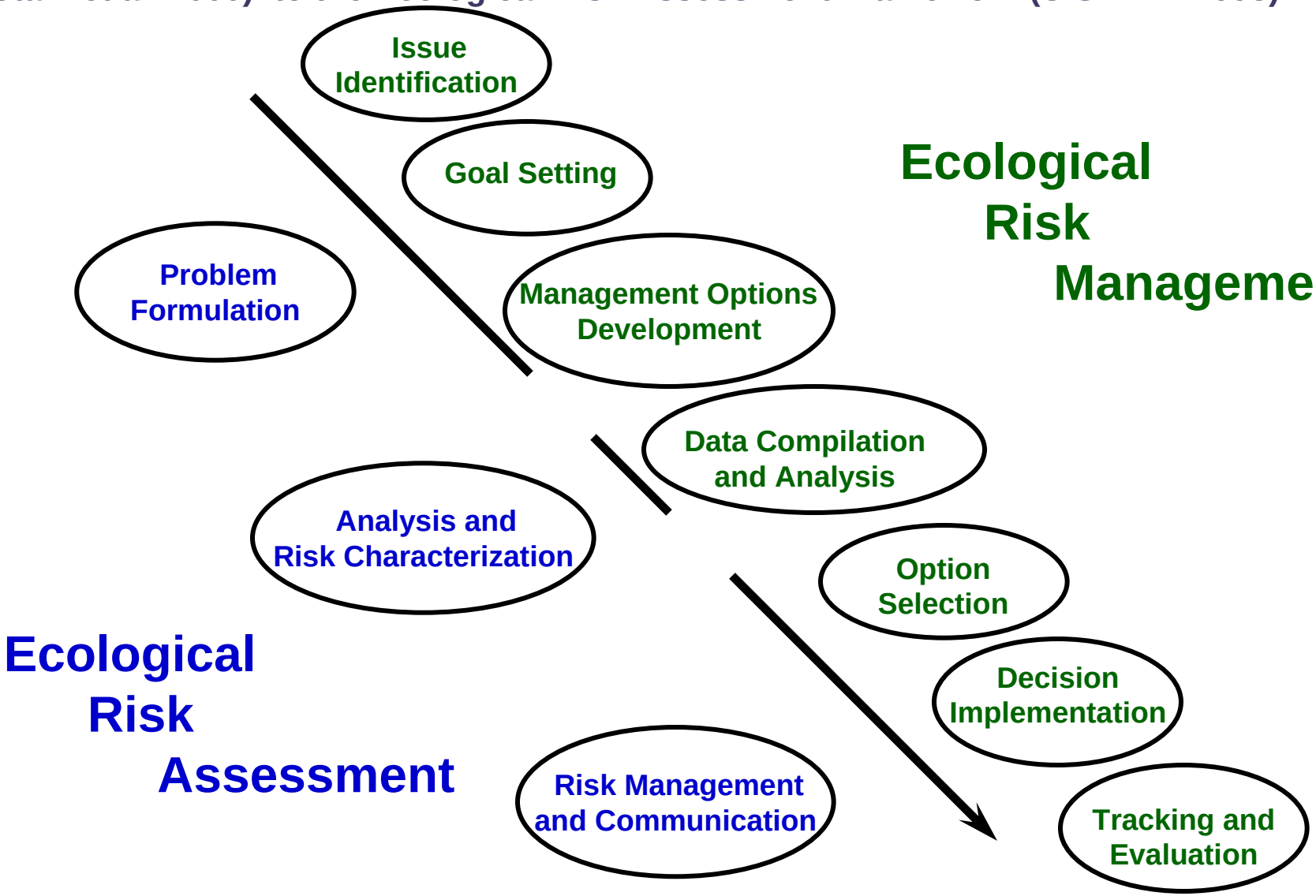
Percent Relative Risk by Habitat Type



Framework for Ecological Risk Assessment



Relationship of the Ecological Risk Management Framework (Pittinger et al. 1998; Stahl et al. 2000) to the Ecological Risk Assessment Framework (U.S. EPA 1998)



Summary

The public and private sector will need to work collaboratively

The role of the scientific community is to provide the scientific data to inform decisions

- The RRM is a good tool for prioritizing issues, especially on larger geographical scales

Goals and objectives must be specific, measurable, achievable, realistic and timely

Management actions and policy decisions should be monitored, and should be revised if they do not achieve the desired outcome(s)

All involved must be held accountable for meeting goals and expectations

What is needed?

- **Transparency**

- **Public private partnerships – stakeholder engagement**

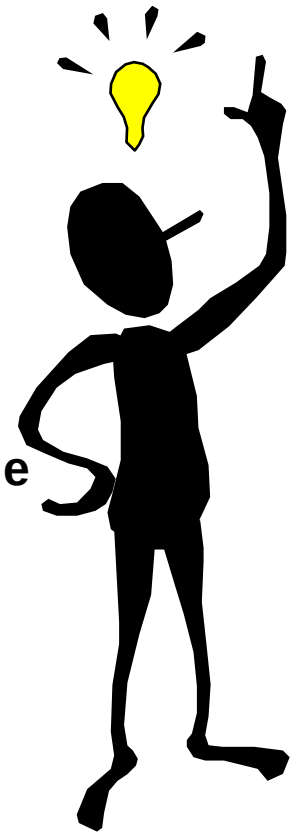
- **Keep it simple and focused**

- **Understand "problem" to establish realistic and measurable goals**
  - Focus on sustainability (ex. green roofs, development impacts)

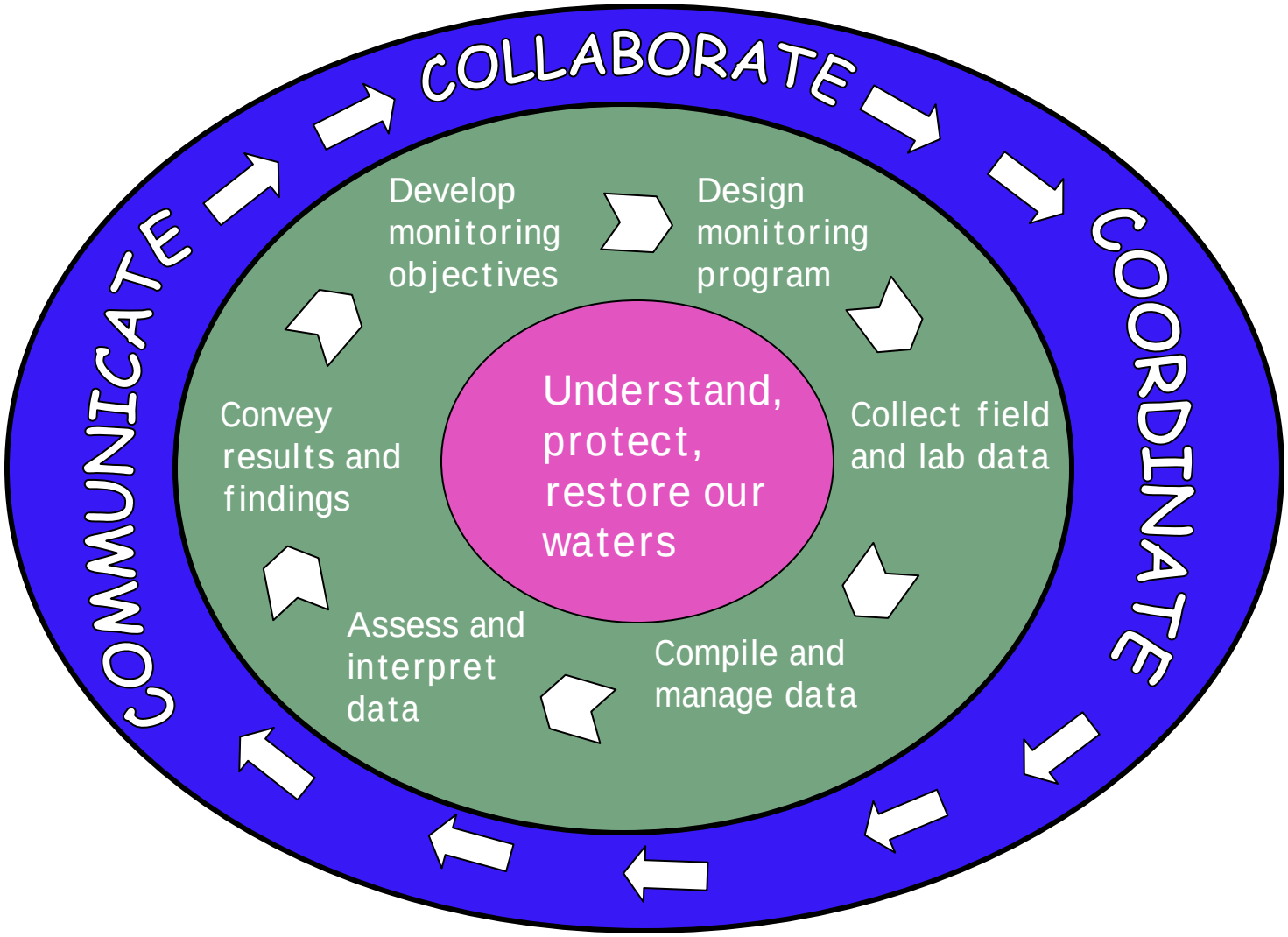
- **It's a different world, but science plays an essential role**

- **Understand communication challenges**

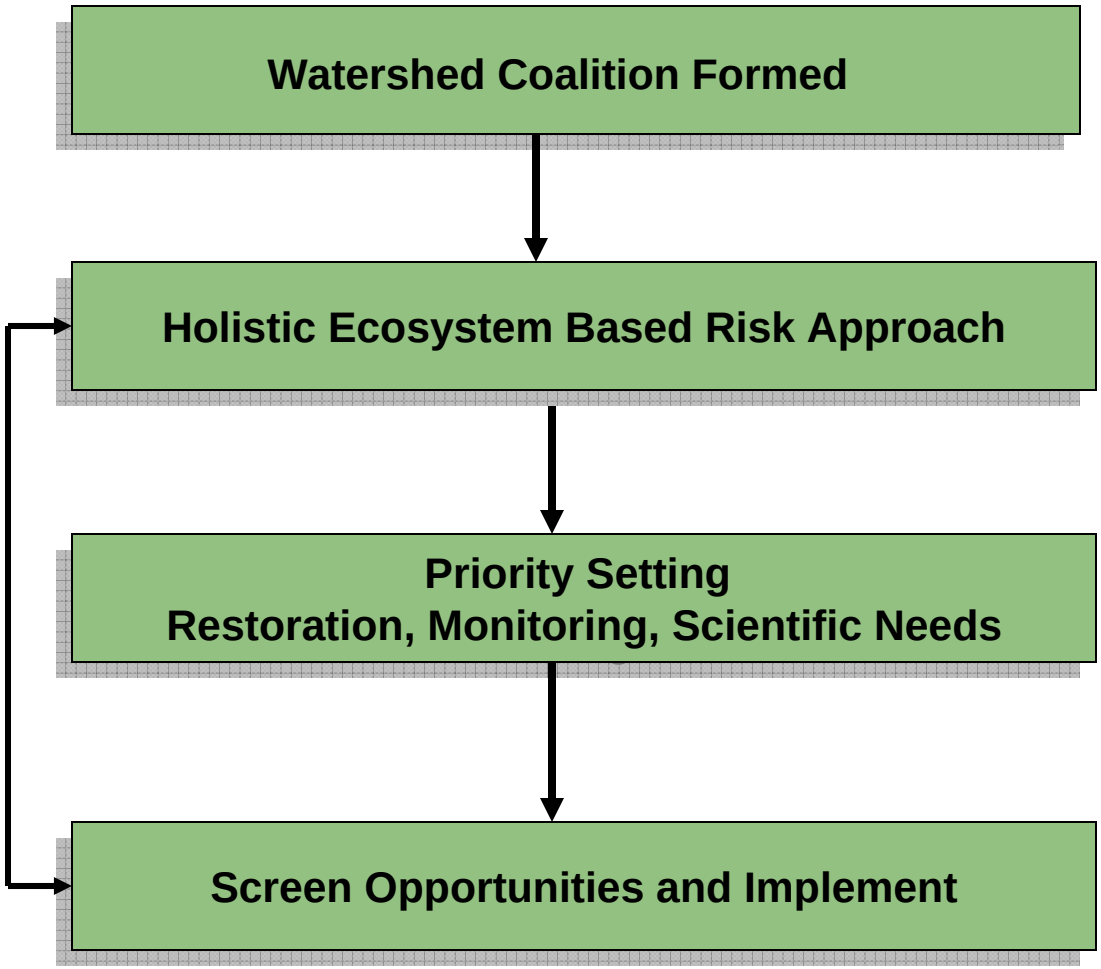
- **Strong leadership**



Collaborative Approach



Ideal Conceptual Framework



Funding

Ongoing Effort

- Ongoing Phase II: First synthesize of existing data; development of facility workplans

- Hand off development of first extensive database

- Continue to engage academic, industry, environmental, and regulatory community

- Support collaborative effort to develop a common regional adaptive watershed approach

Corporate Vision

Clear into the Future
THE DUPONT DELAWARE ESTUARY INITIATIVE

Enhance awareness, involvement, and understanding of the environmental and commercial values and histories of the Delaware River Estuary

Develop a shared community-wide vision to achieve watershed improvement

How is this demonstrated?

Education and Volunteerism

Science and Knowledge Intensity - Putting our Science to Work

Commitment to specific actions/projects to improve watershed or knowledge of its importance

The DuPont Nature Center at Mispillion Harbor Reserve

The DuPont Nature Center at Mispillion Harbor Reserve is a $2.1 million natural history interpretive center and wildlife observatory that opened to the public in May 2007. The Delaware Department of Natural Resources owns and operates the facility.

DuPont Environmental Education Center at the Russell Peterson Wildlife Refuge

Delaware Nature Society operates Center

DNREC manages refuge

Graduate Student Fellowship Program

Jaclyn Taylor
Third-year Master's student in Ecology and Evolution at Rutgers University
-graduated

Kelley Appleman
Third year Doctoral student in Marine Studies and a second year Master's student in Economics at the University of Delaware

Steven Pearson
PhD program at Drexel University with a concentration in Ecology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