Balancing Priorities: Developing a Monitoring Network to Meet Multiple Needs

Chattanooga 2004 National Water Quality Monitoring Workshop
Monday, May 17

• Session Organizers
  - Chuck Spooner, Jim Harrison, David Wangsness, Al Korndoefer
<table>
<thead>
<tr>
<th>Time</th>
<th>AGENDA</th>
<th>Presenter(s)/Facilitator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:30-1:15</td>
<td>Introduction to session&lt;br&gt;• Introduction of workshop participants—why are you here?&lt;br&gt;• Defining the terms we will use</td>
<td>Spooner</td>
</tr>
<tr>
<td>1:15-1:30</td>
<td>• Multi-Objective Planning - The Science and Practice</td>
<td>Spooner</td>
</tr>
<tr>
<td>1:30 -2:00</td>
<td>• Examples of State Monitoring Decisions&lt;br&gt;• <strong>Sampling Strategies for Estimating Acute and Chronic Exposures of Pesticides in Streams</strong></td>
<td>State Reps. &lt;br&gt;Wangsness</td>
</tr>
<tr>
<td>2:00 -2:45</td>
<td>• Applying Theory to Practice</td>
<td>General Discussion</td>
</tr>
<tr>
<td>2:45-3:15</td>
<td>• Integrating Monitoring Tools to Meet Multiple Needs: Roles for Predictive Tools&lt;br&gt;• What to look for during the conference</td>
<td>Harrison &lt;br&gt;Spooner</td>
</tr>
</tbody>
</table>
Defining Today’s Terms

• **A Network**
  - The stations our organization owns or uses
    • Specialized subcategories
    • Sites with common analytic goals (e.g. trends, compliance, etc.)
  - Stations that are used together in some way
    • Paired sites (e.g. Upstream / Downstream, Before & After)
    • Sites that are a part of a probabilistic sample set
Defining Today’s Terms

- **Comparability**
  - Parameters monitored
  - Timing (frequency, duration of record)
  - Precision
  - Detection levels
  - Methods
    - Filed
    - Laboratory
  - Etc.

- **Metadata**
  - Data describing the results obtained
Multi-Objective Planning
The Science and Practice

• Pareto-Optimal Solutions
  - Multi-Objective optimization
  - Used in robotics
  - Satellite coverage
  - Pharmacology

• Principals and Guidelines for Water and Related Land Resources
  Implementation Studies
  - Water supply studies
  - Flood control studies
  - Habitat impacts
The Framework for Monitoring

Understand, protect, restore our waters

- Develop monitoring objectives
- Design monitoring program
- Collect field and lab data
- Convey results and findings
- Assess and interpret data
- Compile and manage data

Collaborate

Communicate

Coordinate

NWQMC
NATIONAL WATER QUALITY MONITORING COUNCIL
Working Together for Clean Water
Design Monitoring Program

- Sampling network design
  - Site selection, what to monitor
  - How often, for how long
Compile and Manage Data

- Access to data
- Data assembly
- Data Verification
Assess and Interpret Data

- Summary statistics
  - Max, min, mean, range
  - Parametric/non-parametric
- Meets State Standards?
- Threshold (action) levels
- Time series plots
- Indicators/indices
The Science and Practice
Pareto-Optimal Solutions

• Pareto Charts
• Rank critical issues
  - Parameter coverage
  - Precision
  - Timing
• Prioritize
• Display groupings of data
• Display frequencies of responses
• Common assumptions on basic elements are needed
Simultaneous optimization of multiple objectives
- No single solution (unlike a single objective decision from linear programming)
- There is a set of pareto-optimal solutions

A pareto-optimal solution is one in which one where no objective can be improved without degrading the success of another

A pareto analyses are used to inform the other decision processes that are needed to choose among the mix of options
Principals and Guidelines proposes that “Accounts” be established to track the merits of plans.

- National economic development account
  - Displays changes in the economic value the national output of goods and services
- Environmental quality account
  - Displays non monetary effects on significant natural and cultural resources.
- Regional economic development account
- Other social effects account registers
A Possible Applications

- Economic account – Comparative cost of different networks changes
- Parameter coverage – number and type
- Benefits of a common practice (e.g. a common method)
• The take-home message:
  • There are methods for making multi-objective decisions
  • Pareto-Optimal Solutions have been used in water related planning as outlined in the Principals and Guidelines
  • Pareto charts are useful and intuitive tools to use in displaying and ranking issues of comparability
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Presenter(s)/Facilitator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:30-1:15</td>
<td>Introduction to session</td>
<td>Spooner</td>
</tr>
<tr>
<td></td>
<td>• Introduction of workshop participants—why are you here?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Defining the terms we will use</td>
<td></td>
</tr>
<tr>
<td>1:15-1:30</td>
<td>• Multi-Objective Planning - The Science and Practice</td>
<td>Spooner</td>
</tr>
<tr>
<td>1:30 -2:00</td>
<td>• Examples of State Monitoring Decisions</td>
<td>State Reps., Wangsness</td>
</tr>
<tr>
<td></td>
<td>• Sampling Strategies for Estimating Acute and Chronic Exposures of Pesticides in Streams</td>
<td></td>
</tr>
<tr>
<td>2:00 -2:45</td>
<td>• Applying Theory to Practice</td>
<td>General Discussion</td>
</tr>
<tr>
<td>2:45-3:15</td>
<td>• Integrating Monitoring Tools to Meet Multiple Needs: Roles for Predictive Tools</td>
<td>Harrison</td>
</tr>
<tr>
<td>3:15</td>
<td>• What to look for during the conference</td>
<td>Spooner</td>
</tr>
</tbody>
</table>