National Water Quality Monitoring Council
Working together for clean water

Water Quality Monitoring:
A Guide for Informed Decision Making

Rotating Basin Monitoring Designs

About

Many states and other monitoring entities employ rotating basin designs for assessing the condition of their surface waters. This approach addresses Clean Water Act objectives for assessing watersheds on a statewide basis, repeated at regular intervals, while allowing resources to be focused in a smaller geographic area in any given year. In general, to implement a rotating basin design, a state or region is divided into several geographic areas or hydrologic basins and one or more of these areas is assessed each year over the rotation cycle. A rotation cycle is commonly five or more years in length.

What you need to know

The sampling design used to assess individual basins or areas varies from program to program. Some states utilize a statistical survey approach within the basin of interest, where a probabilistic design involving random site selection is employed to allow one to make general statements about the characteristics of that basin, and at the end of the rotation cycle, about the condition of the state or region as a whole. Other states use a "targeted" or "fixed" design within the basin of interest. A targeted design typically places fixed sites along the main stem, at tributary inputs to the main stem, at watershed pour points, and/or above and below important discharges or changes in land use. Targeted surveys are effective at addressing watershed and site-specific questions, such as identifying specific reaches of stream or watersheds with impairments, determining sources and loads of pollutants or assessing temporal or spatial trends. Many states, such as Oregon, Indiana and Nebraska, use a combination of probabilistic and targeted sampling within a rotating basin approach, to address a broad array of questions about the basin.

Rotating Basin Summary

Strengths	Limitations	Questions Addressed
Focused approach in a smaller geographic areas allowing for a more robust characterization and more collaboration with other water resource programs and local entities. As well as cross program integration. Travel time to sites is reduced through selection of rotational areas. Assessment reports are scaled to a smaller area, making them more manageable and allowing for more detailed analysis of potential sources. Rotating basin designs paired with long-term trend monitoring at "integrator" sites overcome the lack of ongoing data between rotations. The approach is flexible regarding within-basin study designs, and adaptable to a variety of monitoring questions.	It will take 5 years or more to monitor the entire study area Annual changes in weather, stream flow, and other variables make it challenging to compare assessments between basins. If rotational assessments are not coordinated in a basin approach with the 303(d) listing cycle, they may not provide the data to support 303(d) listing or delisting on the most desirable time frame because of the time interval between rotations. Detecting trends is challenging with data collected on five year intervals. A water quality change of concern may not be detected for a number of years, depending on its timing relative to the rotation schedule.	What is the extent of waters in the basin, and the State as a whole, supporting all uses? How do basins compare in terms of extent of waters meeting standards and benchmarks? What is the extent of the water-quality problems in the basin? What are the main pollutants or conditions responsible for the problem? What are the trends in the overall condition of the basin and State? **A targeted design within basins can be used for addressing questions like:** Where do reaches in the basin show indications of impairment and where do reaches meet water quality standards? Which tributaries are contributing pollutants to the main stem that may be resulting in impairments? How does water quality change above and below a tributary or point source input? What are trends at long-term monitoring sites revisited at each rotation?

Table 1: The above table outlines the strengths, limitations, and products of rotating basin water quality monitoring.

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How are rotating basin designs conducted?

Basins are typically defined using Hydrologic Units or other standard characterization of watersheds or watershed groups. States utilize rotating basin design in a variety of ways. Utah utilizes a six year rotation and follows a probabilistic assessment with targeted monitoring two years later to follow up on problem areas. Florida selects one area to assess each year within a basin so that the entire basin is completed in five years. Connecticut and the Central Coast of California divide their respective jurisdictions into five areas (some including more than one basin or hydrologic unit) and sample one area per year over the course of five years using a targeted monitoring approach. Oregon samples three of its fifteen Hydrologic Unit Classifications each year over a five year rotation, employing a probabilistic approach for biomonitoring and targeted monitoring for toxics and groundwater. New Jersey uses a rotating basin approach for much of its biomonitoring and targeted monitoring, based on a 5- year cycle for its 5 major basins.

What types of information and products come from rotating basin designs?

The products that can be derived from a rotating basin design are as diverse as the study designs used within the basins. Some states coordinate their rotating basin approach with 303(d)/305(b) assessment and listing cycles, TMDL compliance monitoring needs, discharge permit cycles, or other programmatic needs.

For example, Indiana's five-year rotational strategy uses a combination of targeted and probabilistic monitoring to support permitting programs, CWA Section 305(b) assessments and 303(d) listings, TMDL determinations, drinking water source protection activities, agency-wide initiatives, watershed assessment reports and other products. Oregon used a risk based targeted toxics monitoring strategy in three geographic areas over a six-year period to generate the first statewide toxics assessment report. Due to the size of the state and complexity of its aquatic environment, California now focuses on three of its nine Water Quality Control Regions in each listing cycle, developing changes to 303(d) impaired waters listings for the entire state over three listing cycles. Data are used to support status and trend reports, basin or watershed specific assessments, special studies focused on specific contaminants or land use associations, integrated reports for 303(d)/305(b), and other products.

CASE STUDY:

California Central Coast Ambient Monitoring Program

The California Central Coast's Surface Water Ambient Monitoring Program (CCAMP) employs a 5-year watershed rotational strategy in a targeted assessment of its waters. The rotational design allows for more focused use of resources, and can also support special projects or TMDL data needs in the area of interest.

Conventional chemistry is collected monthly at fixed sites for trend assessment. Toxicity, bioassessment and other measures are collected less frequently at a subset of sites. CCAMP uses an analyte scoring approach similar to the Canadian Water Quality Index to score sites and watershed rotation areas for health. Site-level data are combined with modeled data from the California Healthy Watersheds project to assess "what percent of the watershed (or rotation area) is healthy?"

Sites are evaluated for statistically significant change in multiple parameters. Indications of change are used to help address the question, "in unhealthy areas are there indications of improvement?"

Figure 1: Five watershed rotation areas of the California Central Coast Region. Hydrologic Units are outlined.

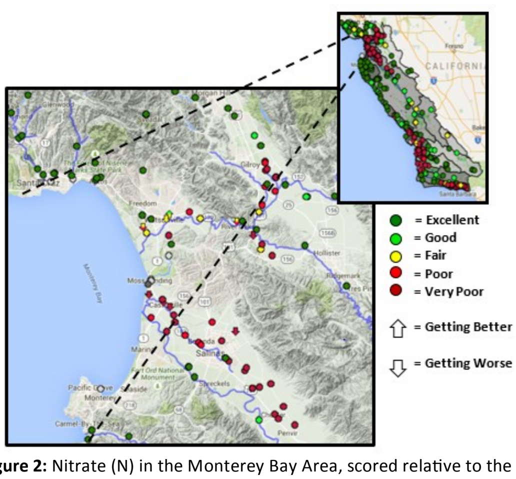

Figure 2: Nitrate (N) in the Monterey Bay Area, scored relative to the drinking water standard of 10 mg/L. Very high nitrate concentrations are found in the "lettuce bowl" of the Salinas Watershed.

CCAMP data are used extensively for 305(b)/303(d) listing, enforcement, watershed assessment, regulatory decision making, TMDL support and other management decisions. Where possible, TMDL compliance monitoring is associated with CCAMP stations, in consideration of the five-year watershed rotation schedule. Stakeholders and staff in monitoring, permitting, and enforcement programs coordinate each year prior to the start of the rotation to enhance usefulness of the data. All data, and associated documentation, is available online in map, graph, and table format at www.ccamp.org

Where can I go for more technical information on rotating basin designs?

New York State Rotating Integrated Basin Studies http://www.dec.ny.gov/chemical/30951.html
Connecticut Ambient Monitoring Strategy for Rivers and Streams: Rotating Basin Approach http://www.ct.gov/deep/lib/deep/water/water_quality_management/rotbasinplan.pdf
Oklahoma WQ Rotating Basin Monitoring Program http://www.ok.gov/conservation/Agency_Divisions/Water_Quality_Division/WQ_Assessment/WQ_Rotating_Basin_Monitoring_Program.html
Indiana Surface Water Quality Monitoring Strategy http://www.epa.gov/nhrlsup1/arm/documents/swqms2001finaldoc.pdf
Nebraska Basin Rotation Monitoring http://deq.ne.gov/NDEQProg.nsf/dc8559037dfefbf386257b8d007a14b3/ae3df8344c7c2c4786257cb50071f750!OpenDocument
Oregon Water Quality Monitoring Strategy http://www.deq.state.or.us/lab/techrpts/docs/WaterMonitoringStrategyFinal.pdf
Central Coast Ambient Monitoring Program (CCAMP), California Surface Water Ambient Monitoring Program: Website: www.ccamp.org; Technical Methods Report: http://www.waterboards.ca.gov/water_issues/programs/swamp/regionalreports.shtml#rb3

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