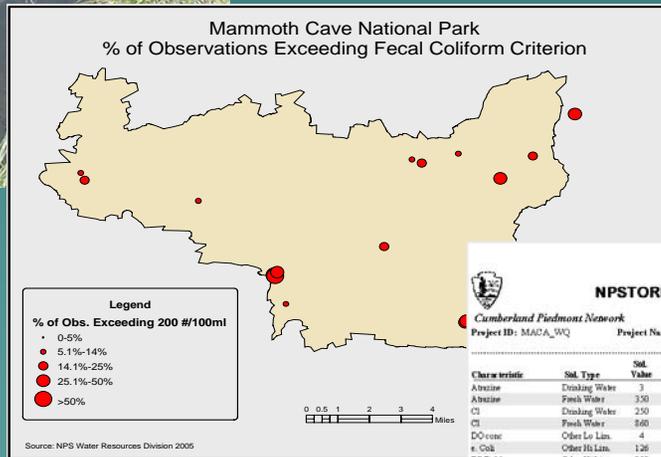




WATER QUALITY PROTOCOLS FOR VITAL SIGNS MONITORING IN NATIONAL PARKS

Integrating Science, Planning, and Management

Barry Long, Gary Rosenlieb, Roy Irwin, and Pete Penoyer



National Park Service
U.S. Department of the Interior
Natural Resources Report Card

Status

- Significant Concern
- Caution: May be a developing concern
- Good: Resources in good condition

Trend

- Condition is Improving
- Condition is Unchanged
- Condition is Deteriorating

Confidence

- High
- Medium
- Low

NPSTORE Water Quality Criteria Analysis - Period of Record

Cumberland Piedmont Network
Project ID: MACA_WQ Project Name: CUPN WQ Monitoring MACA

Filtered Results, Grouped by Project
Period of Record: 7/10/2002 - 7/10/2005

Characteristic	Sol. Type	Std. Value	Units	3/21-6/20			6/21-9/20			9/21-12/20			12/21-3/20					
				Total Obs.	Exceed Std.	Prop. Exceed	Total Obs.	Exceed Std.	Prop. Exceed	Total Obs.	Exceed Std.	Prop. Exceed	Total Obs.	Exceed Std.	Prop. Exceed			
Alkaline	Drinking Water	3	mg/l	216	1	0.00	93	1	0.01	74	0	0.00	36	0	0.00	71	0	0.00
Alkaline	Fresh Water	330	mg/l	216	0	0.00	93	0	0.00	74	0	0.00	36	0	0.00	71	0	0.00
C1	Drinking Water	250	mg/l	427	0	0.00	108	0	0.00	113	0	0.00	108	0	0.00	98	0	0.00
C1	Fresh Water	860	mg/l	427	0	0.00	108	0	0.00	113	0	0.00	108	0	0.00	98	0	0.00
DO conc	Other Lo Lim.	4	mg/l	440	0	0.00	100	0	0.00	125	0	0.00	97	0	0.00	110	0	0.00
* Coli	Other Hi Lim.	128	#/100ml	54	9	0.15	30	5	0.17	9	0	0.00	0	0	0.00	24	3	0.13
PC Field	Other Hi Lim.	200	#/100ml	322	77	0.24	62	24	0.39	108	14	0.13	77	28	0.36	75	11	0.15
Fecal Lab	Other Hi Lim.	200	#/100ml	44	15	0.34	0	0	0.00	0	0	0.00	31	9	0.29	13	6	0.46
FI	Drinking Water	4	mg/l	409	1	0.00	103	0	0.00	109	0	0.00	103	1	0.01	94	0	0.00
NO2	Drinking Water	3.3	mg/l	24	0	0.00	14	0	0.00	1	0	0.00	7	0	0.00	2	0	0.00
NO3	Drinking Water	44	mg/l	428	1	0.00	109	0	0.00	113	0	0.00	108	1	0.01	98	0	0.00
pH	Drinking Water	8.5	None	429	4	0.01	108	1	0.01	124	0	0.00	97	0	0.00	100	3	0.03
pH	Fresh Water	9	None	429	0	0.00	108	0	0.00	124	0	0.00	97	0	0.00	100	0	0.00
pH	Other Lo Lim.	6.5	None	429	2	0.00	108	0	0.00	124	2	0.02	97	0	0.00	100	0	0.00
SO4	Drinking Water	250	mg/l	429	0	0.00	109	0	0.00	113	0	0.00	109	0	0.00	98	0	0.00
Total Coliform	Other Hi Lim.	1000	#/100ml	54	1	0.02	30	0	0.00	0	0	0.00	0	0	0.00	24	1	0.04
Turbidity	Other Hi Lim.	50	NTU	434	18	0.04	100	0	0.00	110	1	0.01	106	15	0.14	110	2	0.02

Results filtered for:
Exclude QA/QC samples
Project = MACA_WQ; CUPN WQ Monitoring MACA

Censored Data Substitutions: *Non-detect=0.5 * Detect=0.01 Limit *Percent >QL=1.1 * UpperQuantificationLimit *Percent <QL=0.5 * LowerQuantificationLimit

The Law:

NATIONAL PARKS OMNIBUS MANAGEMENT ACT OF 1998

“The Secretary shall undertake a program of inventory and monitoring of National Park System resources to establish baseline information and to provide information on the long-term trends in the condition of National Park System resources. The monitoring program shall be developed in cooperation with other Federal monitoring and information collection efforts to ensure a cost-effective approach.”

What are Vital Signs?

Vital Signs are key elements that indicate the health of an ecosystem. Vital signs may occur at any level of organization including landscape, community, population, or genetic levels. They may be compositional (referring to the variety of elements in the system), structural (referring to the organization or pattern of the system), or functional (referring to ecological processes). Vital signs can be any measurable feature of the environment that provides insights into the state of the ecosystem.

“Focus on most significant indicators of long-term ecological trends and highest concerns among the parks in each network”

NPS VITAL SIGNS NETWORKS



Monitoring Plan Outline

Three-Phase Approach

- ◆ Chapter 1. Introduction and Background
 - ◆ Chapter 2. Conceptual Ecological Models
 - ◆ Chapter 3. Vital Signs
 - ◆ Chapter 4. Sampling Design
 - ◆ Chapter 5. Sampling Protocols
 - ◆ Chapter 6. Data Management
 - ◆ Chapter 7. Data Analysis and Reporting
 - ◆ Chapter 8. Administration/Implementation of the Monitoring Program
 - ◆ Chapter 9. Schedule
 - ◆ Chapter 10. Budget
 - ◆ Chapter 11. Literature Cited
- ◆ Three-year process from start of plan to final

Purpose of Vital Signs Water Quality Monitoring

Track and Support Attainment of NPS
and DOI Strategic Goals

Protect pristine water quality (e.g., ONRW)

Support additional CWA protections for
unimpaired water

Improve Impaired Water Quality

Support CWA provisions for improving water
quality (TMDL Development)

Core Parameters

- ◆ Required Parameters at all monitoring stations
 - Water Quality (4 water column field measurements)
 - ◆ Temperature (degrees Celsius)
 - ◆ Specific Conductance (uS/cm.)
 - ◆ pH (Standard pH Units)
 - ◆ Dissolved Oxygen (mg/l)
 - Water Quantity (quantitative or qualitative)
 - ◆ Flow or Discharge (flowing waterbody)
 - ◆ Stage/Level (non-flowing waterbody)
 - Photographic Documentation
 - ◆ Minimum record of one digital site photo

Guidelines for long-term monitoring protocols

Karen L. Oakley, Lisa P. Thomas, and Steven G. Fancy

Abstract Monitoring protocols are detailed study plans that explain how data are to be collected, managed, analyzed, and reported, and are a key component of quality assurance for natural resource monitoring programs. Protocols are necessary to ensure that changes detected by monitoring actually are occurring in nature and not simply a result of measurements taken by different people or in slightly different ways. We developed and present here guidelines for the recommended content and format of monitoring protocols. The National Park Service and United States Geological Survey have adopted these guidelines to assist scientists developing protocols for more than 270 national park units.

Wildlife Society Bulletin 2003, 31 (4):1000–1003 Peer edited

Water Quality Protocols

- ◆ Wadeable Streams
- ◆ Large Rivers
- ◆ Lakes and Ponds
- ◆ Seeps and Springs
- ◆ Wetlands and Wetland Habitats
- ◆ Groundwater
- ◆ Estuaries and Marine Areas
- ◆ Amphibians, Macroinvertebrates & Fish
- ◆ Stream Flow Quantity
- ◆ Nutrients and Toxic Contaminants.

Great Lakes Network

Large Rivers Water Quality Monitoring Protocol

National Park Service
Great Lakes Inventory and Monitoring Network

Version 1.0
January 30, 2007

Prepared by: S. Magdalene, D.R. Engstrom, J. Elias
Version: 1.0

Contact Information:
Great Lakes Inventory & Monitoring Network – National Park Service
2800 Lake Shore Drive East
Ashland, Wisconsin 54806
<http://www.nature.nps.gov/im/units/gln/>

Suggested citation: Magdalene, S., D.R. Engstrom, and J. Elias. 2007. Large rivers water quality monitoring protocol. Version 1.0. National Park Service, Great Lakes Network, Ashland, Wisconsin.



Great Lakes Network

Note:

The Large Rivers Water Quality Monitoring Protocol follows the recommendations of Oakley et al. (2003) and consists of the following:

1. **PROTOCOL NARRATIVE**
2. **STANDARD OPERATING PROCEDURES**, including the following:

SOP #1: Pre-Season Procedures
SOP #2: Training and Safety
SOP #3: Using a GPS
SOP #4: Site Establishment
SOP #5: Decontamination of Equipment to Remove Exotic Species
SOP #6: Field Measurements and Water Sample Collection
SOP #7: Processing Water Samples and Analytical Laboratory Requirements
SOP #8: Data Entry and Management
SOP #9: Data Analysis
SOP #10: Reporting and Information Dissemination
SOP #11: Post-Season Procedures
SOP #12: Quality Assurance/Quality Control
SOP #13: Revising the Protocol

TABLE OF CONTENTS

BACKGROUND AND OBJECTIVES

Rationale for Selecting this Resource to Monitor
Background and History; Describe Resource
Measurable Objectives
Quality Assurance and Quality Control

SAMPLING DESIGN

Rationale for Selecting This Sampling Design Over Others
Site Selection
Historical Variability and Statistical Power Analysis
Number and Location of Monitoring Stations
Frequency and Timing of Sampling
Level of Change that can be Detected by Proposed Sampling Design
Expectation of Improvement in Post-hoc Statistical Power

OVERVIEW OF SAMPLING METHODS

Field Season Preparations and Equipment Setup
Details of Taking Field Measurements and Collecting Samples
Post-Collection Sample Processing, End of Field Season Procedures
Quality Assurance and Quality Control

DATA HANDLING, ANALYSIS, AND REPORTING

Metadata Procedures, Overview of Database Design
Data Entry, Verification, and Editing
Data Archival Procedures, Quality Assurance and Quality Control
Routine Data Summaries and Statistical Analyses to Detect Change
Methods for Long-Term Trend Analysis, Reporting Schedule
Report Format with Examples of Summary Tables and Figures

PERSONNEL REQUIREMENTS AND TRAINING

Roles and Responsibilities, Crew Qualifications, Training Procedures

OPERATIONAL REQUIREMENTS

Annual Workload and Field Schedule, Facility and Equipment Needs
Startup Costs and Budget Considerations
Procedures for Revising and Archiving Previous Protocol Versions

LITERATURE CITED

Greater Yellowstone Network

REGULATORY WATER QUALITY MONITORING PROTOCOL

Version 2.0
June 1, 2006

Greater Yellowstone Inventory & Monitoring Network

Prepared by: Susan E. O'Ney
Version: 2.0

Contact Information:
Greater Yellowstone Inventory & Monitoring Network
National Park Service
Room 229, AJM Johnson Hall
P.O. Box 172780
Bozeman, Montana 59717
<http://www1.nature.nps.gov/im/units/gryn/index.shtml>

Suggested citation: O'Ney SE. 2006. Regulatory water quality monitoring protocol. Version 2.0. Bozeman (MT): National Park Service, Greater Yellowstone Network.



Northern Colorado Plateau Network

U.S. Department of the Interior
National Park Service
Inventory and Monitoring Program

Water Quality Vital Signs Monitoring Protocol for the Northern Colorado Plateau Network

Prepared by:
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Northern Colorado Plateau Network Inventory and Monitoring Program
National Park Service, U. S. Department of the Interior

Version 1.00 (January 2007)



San Francisco Bay Area Network

SAN FRANCISCO BAY AREA NETWORK FRESHWATER QUALITY MONITORING PROTOCOL

Protocol Narrative



Prepared by:

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Inventory and Monitoring Program
San Francisco Bay Area Network (SFAN)
National Park Service
U.S. Department of the Interior

August 2005

Version 2.01



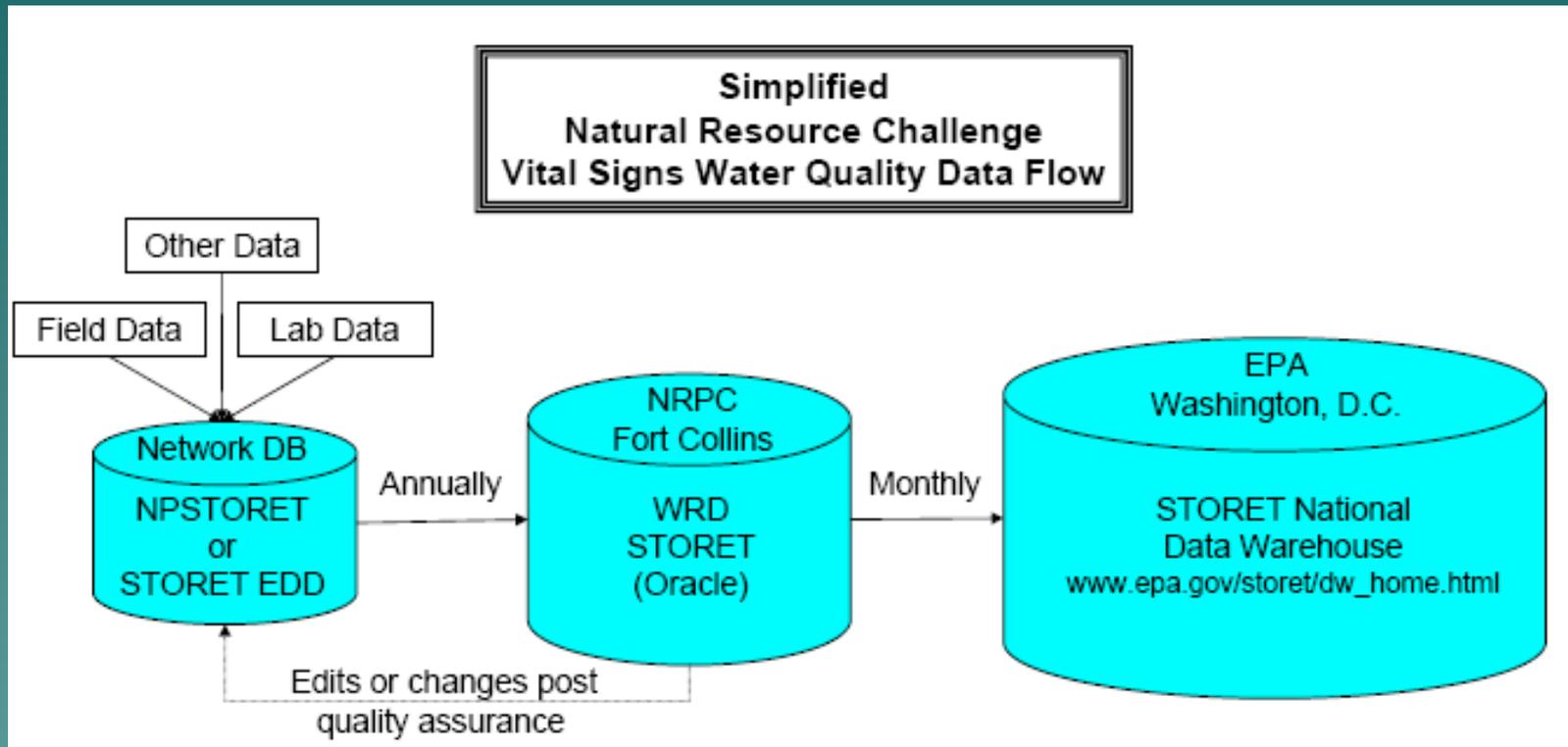
Special Issues and Considerations

- ◆ Decontamination of Equipment
- ◆ Cumulative Bias Interactions
- ◆ Minimum Detectable Difference
- ◆ Sample Size and Power Analysis
- ◆ Target Population Identification
- ◆ Judgmental VS Probabilistic Designs
- ◆ Stream Flow Discharge Influence

Status and Conclusions

- ◆ 27 Network Vital Signs Plans Completed
- ◆ More Than 15 Water Quality Protocols Completed or in Process
- ◆ More Than 15 Other Aquatic Resource Protocols Completed or in Process
- ◆ Over \$5 Million Invested Annually for Aquatic Vital Signs Monitoring (Including \$2.6 Million Through the NRPC-WRD)

Vital Signs WQ Data Mgt.



<http://www.nature.nps.gov/water/infoanddata/index.htm>