RECOMMENDATIONS

for

CORE WATER QUALITY MONITORING PARAMETERS and Other Key Elements of the NPS Vital Signs Program Water Quality Monitoring Component

Freshwater Workgroup Subcommittee

August 15, 2002

Fort Collins, Colorado

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EXECUTIVE SUMMARY

This workgroup was formed as an outgrowth of recommendations made at the November 2001 Water Quality Monitoring Workshop related to the possible requirement that a basic set of "core" water quality parameters be collected in the water quality monitoring component of the Vital Signs Program. The consensus expressed by participants in that meeting was that the Water Resources Division (WRD) of the National Park Service (NPS) should gain additional input from Parks and consult with other Federal and State agencies to determine 1) what a core set of parameters should consist of, 2) if they should be universally mandated at freshwater/marine/estuarine monitoring sites, and 3) if they should be the same for all types of waterbodies. A parallel workgroup to address core parameters for marine and estuarine monitoring was also scheduled to meet on a subsequent date in Rhode Island.

The consensus conclusion reached by the workgroup was that a core set of required parameters collected at all monitoring stations under a national program of this nature was a reasonable minimum goal to ensure some measure of commonality of data collection, comparability, and consistency. These core parameters also serve, to a degree, the purpose of having some common set of information that could be rolled up in some form on a national scale to report to Congress.

In addition, the workgroup was sounded for their observations and recommendations on other aspects of the water quality-monitoring program. The group responded with recommendations for amending and improvement in the following areas:

1. Basic Dataset and Metadata Requirements
2. Freshwater Monitoring Drivers & Hierarchy (A Two-Tiered Approach)
3. Meeting Reporting Needs for Servicewide State of the Parks, Annual Performance Plan and Congressional Reporting
4. Protocols and Protocol Development
5. Sampling Location, Frequency, and Site Rotation
6. Biological Monitoring (Biocriteria) – Status and NPS Role
7. Water Quality Monitoring Staffing & Training Needs of Networks
8. Analytical Lab Selection
9. Improving WRD Guidance
10. Performing Sound Science and the Role of Quality Assurance/Quality Control (QA/QC)
11. Including Other Broadly Useful Parameters in Those Required (e.g., Turbidity, Nutrients, Pathogens, Metals)

The key discussions and recommendations of the Freshwater Workgroup are documented in this "white paper." They are, in part, the basis by which WRD intends to proceed with its preparation of guidance to NPS Monitoring Networks in order to fulfill the implementation of the Vital Signs Program under the Natural Resource Challenge. Key topics and a summary of the consensus conclusions and recommendations of this workgroup are provided in the following pages.

INTRODUCTION

Background

The decision to obtain direct input from Park staff, other State and Federal agencies conducting monitoring, and academia on the question of mandating, Servicewide, a required set of "core" parameters for the water quality component of the Vital Signs Program was one outcome from the November 2001 Water Quality Monitoring Workshop–held in Fort Collins, CO, and sponsored by WRD. Freshwater and Marine/Estuarine subcommittees were formed to address this primary question. This "white paper" summarizes the deliberations of the Freshwater Workgroup.

The core parameter recommendations of this workgroup subcommittee are also provided herein. Additionally, the subcommittee discussed several secondary topics that will likely need to be considered by Networks in implementation of their water quality monitoring programs. The subcommittee's recommendations and suggestions on these topics are also provided for Network guidance.

Purpose

The workgroup was charged with the primary responsibility to determine for the water quality monitoring component of Vital Signs:

> Should there be a basic set of Servicewide "required" (or "core") monitoring parameters (data set) for freshwater resources?

In addition to questions surrounding a "core" set of parameters, the committee was sounded on several other topics related to the completeness and overall technical adequacy of the guidance issued by WRD to date. Secondary topics that were discussed (for which recommendations were provided by the committee) included:

1. Basic Dataset and Metadata Requirements
2. Freshwater Monitoring Drivers & Hierarchy (A Two-Tiered Approach)
3. Meeting Reporting Needs for Servicewide State of the Parks, Annual Performance Plan and Congressional Reporting
4. Protocols and Protocol Development
5. Sampling Location, Frequency, and Site Rotation
6. Biological Monitoring (Biocriteria) – Status and NPS Role
7. Water Quality Monitoring Staffing & Training Needs of Networks
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KEY CONCLUSIONS, RECOMMENDATIONS, AND DISCUSSION

The purpose of the following discussion is to provide general information and some broad, yet brief, guidance to Networks in these subject areas, as most of these topics will need to be addressed in some form by the Networks under this program. Discussions of these secondary topics, some general conclusions, and recommendations of the workgroup, resulting from these deliberations, follow. WRD's perspective on several of these topics is also provided on an informational basis to Networks. The WRD water quality monitoring technical guidance found at

http://www.nature.nps.gov/im/monitor/handbook.htm
and
http://www1.nrintra.nps.gov/wrd/wqmtg/links.htm

should be consulted for more detailed discussion and technical guidance on several of these topics and for web sites and other references to additional information sources.

Core Parameters

Conclusions and Recommendations: The workgroup concurred with previous recommendations of WRD and endorsed the concept that a required minimum parameter suite would be appropriate and most consistent with the broader goals of the Vital Signs Program. The consensus conclusion reached by the workgroup was that a core set of required parameters collected at all monitoring stations was a reasonable minimum goal to ensure some measure of commonality of data collection, comparability, and consistency in a national program of this nature. A "core" data set also serves, to a degree, the purpose of having some common set of information that could be rolled up in some form on a national scale to report to Congress.

Such a basic set of data that were widely collected would serve to characterize Network/Park water resources for purposes of some minimum level of data commonality and consistency Servicewide. The consensus-required parameters (water column) include Temperature (T), Specific Conductance (SC), pH, and Dissolved Oxygen (DO). Also, the workgroup recognized that flow/discharge was often meaningful, if not crucial, information to collect in conjunction with water column data. Therefore, the workgroup recommended that an additional parameter be required, and, in the absence of a quantitative flow measurement at/near the monitoring site (preferred but not required), at a minimum some qualitative estimate or assessment of flow/discharge (low, medium, high, flood stage, etc.) should also be documented (or a quantitative flow estimate be approximated) at all flowing freshwater monitoring sites in the program. At non-flowing freshwater monitoring sites (lakes, reservoirs, etc.), a qualitative assessment of stage/level of the waterbody should be reported along with some minimum profiling of the water column of the required parameters.

Further detailed guidance on the collection and reporting of these parameters will be provided in a WRD technical guidance document, currently being written. Draft guidance language is provided in the Addendum to this paper.

Discussion: WRD presented the rationale for their initial recommendation to collect four (4) water column parameters (above) in a "core" data set. The State and Federal monitoring representatives agreed that these parameters provide the most basic, yet informative, characterization of a waterbody. These four (4) parameters are primarily collected as basic data to characterize a waterbody or stream segment and typically are fundamental components of any monitoring and regulatory program.

There was a sidebar discussion that because collection of the four initial parameters is so basic to the characterization of a waterbody, that their inclusion as "metadata" would be appropriate and would avoid the need for, or discussion of, a "required core parameter list" altogether. To avoid confusion, this approach was not taken because water column measurements did not fit the EPA definition of metadata ("data about data"). The conclusion reached by the workgroup was that requiring these parameters Servicewide is a reasonable approach, particularly given the need for a highly cooperative approach with other State and Federal organizations (where these parameters are routinely collected). Because these parameters are relatively easily obtained with multiparameter probes (called "datasondes"), adding or deleting one or two parameters is not a significant cost or savings consideration, and therefore the exclusion of any single parameter makes little sense when synoptic sampling, if one or more of the other parameters are to be collected.

It was also pointed out that technological advances are making the acquisition of these parameters easier as time goes on, and this trend should be recognized and taken advantage of in establishing a long-term program. Also noted was that in a continuous monitoring deployment, the DO measurement may be the most problematic, as that sensor is most prone to fouling and sensor drift and therefore requires the greatest effort (post-processing) and staff resources to maintain good quality data. However, recent advances in the extended deployment of DO sensors may have largely overcome this concern.

In summary, there was general agreement that the core parameter field measurements would provide information to draw basic conclusions about and generally characterize a site or waterbody type at small incremental cost burden to a Network monitoring program. However, due to their potentially significant diurnal and seasonal variability, isolated/synoptic measurements would not necessarily be best used for comparison on a nationwide basis. Establishing their normal range or variance at a site over the long term, however, may be important for time-series monitoring purposes. In spite of this significant drawback in meeting one of the Servicewide objectives of the NPS program, a consensus was reached that these variables were the most appropriate to retain in the core set. The required set was kept small to maximize Network flexibility in selecting site-specific parameters to monitor to meet Network/Park needs. This approach also minimizes the cost burden to Networks where an expanded core set would run the risk of mandating the collection of unnecessary parameters at a large number of sites. Subcommittee participants anticipate that Networks would complement the core variable set both initially and over the long term with additional parameter measurements as area and site-specific stressors and threats to water quality and aquatic resources were better understood.

Secondary Topics

1. Basic Dataset and Metadata Requirements

Conclusions and Recommendations: The basic, required data set for all monitoring stations that are part of the NPS Vital Signs water quality monitoring program should consist of the following parameters and metadata:

--Measurement of the core water column parameters (temperature, specific conductance, pH, and dissolved oxygen), including a vertical profile of core variables in non-flowing waterbodies,
--A qualitative (at minimum) estimate/assessment of flow/discharge (flowing waterbody) or stage/level (non-flowing waterbody), and
--Specified metadata (Part E of the WRD guidance document).

The workgroup also reached consensus that, at a minimum, a one-time, digital, photographic documentation of all monitoring sites should be included in the metadata requirement. Additional photo documentation of sites (seasonal) is encouraged, particularly at sites where a habitat or biological monitoring component is part of the program, or will possibly be in the future.

Discussion: Each monitoring site and sampling event will require a basic set of metadata necessary for uploading of the data into STORET. WRD is ultimately responsible for uploading the monitoring data into STORET and is currently developing templates to assist Parks in capturing the necessary metadata. Without appropriate accompanying metadata, it will not be possible for WRD to load the data into STORET. This information will be provided in Part E of WRD's guidance document.

WRD will likely supplement the minimum list (EPA) of metadata to facilitate quality assurance/quality control (QA/QC) and subsequent interpretation and data analysis by others who may not have been involved first hand with the data collection. Most metadata would be captured on field forms and include such information as: ambient air temperature and weather conditions at the site during sampling, location, field instruments used, calibrations performed, etc. Metadata is an important component of data analysis and is used to assess data quality.

2. Freshwater Monitoring Drivers & Hierarchy (A Two-Tiered Approach)

Conclusions and Recommendations: Beyond the required data set of core parameters and associated site metadata there should be a two-tiered focus, or a hierarchy, oriented toward monitoring the more significant waterbodies of a Network under two broad categories:

> Category 1 Sites: Clean Water Act or Regulatory Driven/Related Monitoring involving 303d-listed, Outstanding Natural Resource Waters (designated or to be designated) or other designated waterbodies under provisions of the Clean Water Act. While the CWA is a Federal program, the narrative designated use standards and numeric criteria are predominately established or adopted from EPA by the individual States. Thus, following State monitoring protocols are a fundamental basis of operation within the CWA regulatory context.

Category 2 Sites: All other significant waterbodies that 1) have established threats or Network-identified stressors, 2) are subject to some ecological impairment or anticipated future impairment, 3) have no established baseline condition, or 4) are an aquatic resource with another Vital Sign tie-in having water column measurement needs to support biological monitoring (e.g., alkalinity water column monitoring tied to air monitoring of acid deposition having potential impacts to aquatic biota). Such parameters (or suites of parameters--physical, chemical or biological) would be selected by Networks to document changes (improvement or further degradation) in water quality related to specific region, area, or site concerns/stressors.

Discussion: The workgroup addressed the question: "What should be the primary focus/mission and drivers in monitoring the freshwater resources of a Network?" Addressing the first tier, or Category 1 waterbodies, is the fundamental requirement of Goal 1a4 of the NPS Strategic Plan, partially fulfilling the requirements of the Government Performance and Results Act (GPRA) to track the outcomes of expenditures. The Act mandates that Federal agencies (Federally-funded programs) focus on "measurable or quantifiable" results for reporting to Congress. In contrast to several other Vital Signs components, the CWA provides one recognized means (by formal statute and State-developed numeric criteria and narrative standards) for the NPS to broadly measure improvement, or further degradation, of "listed" or "designated" water resources and rollup that information in reports to Congress. NPS monitoring conducted under CWA provisions may serve a variety of purposes, including:

--Removing the waterbody from or adding it to a 303d list;
--Ensuring that water quality status of an Outstanding Natural Resource Water (ONRW) is maintained and protected or that ONRW designation is recognized and achieved for appropriate Park water resources;
--Helping States meet 305b reporting requirements, a possible source of cooperative funding in achieving Network/Park overall goals and objective; and
--Ensuring conformance with various institutional/agency anti-degradation policies.

Generally, the critical parameters or suites of parameters for monitoring (e.g., cause for listing) are identified by the reporting requirements of these CWA programs. Networks should work cooperatively with States to ensure any monitoring of 303d-listed waterbodies do not duplicate efforts of the State's TMDL program.

Addressing the second tier, or Category 2 waterbodies, offers the Networks and Parks the flexibility to address both Regional and Network-wide water quality concerns, threats, or potential impacts to waterbodies deemed a significant resource as well as critical Park-specific water quality/aquatic resource issues through the Network's selection of an additional suite (or suites) of parameters to monitor. The workgroup consensus was that WRD should identify and discuss appropriate monitoring suites of parameters (for particular stressors, water body types, land uses, regional biomes, etc.) and revise the guidance document accordingly. WRD indicated that monitoring parameter suites would be addressed in Part D of the guidance.

3. Meeting Reporting Needs for Servicewide State of the Parks, Annual Performance Plan, and Congressional Reporting

Conclusions and Recommendations: While the committee did not provide a specific recommendation for this topic, they did identify key questions that should be addressed by WASO, in conjunction with Networks and Parks, during the design of their monitoring program.

a. How best can the water quality data be used for Park management purposes?
b. What information do we want to roll up on a national level, and what are we using it for?
c. Is it always prudent to have to establish why we are collecting the parameter data (i.e. have a specific purpose in mind from start), or is the future use/importance or significance of some data (e.g., establishing a baseline for comparison) sometimes only apparent after the impairment is manifested
d. Are we duplicating monitoring efforts of others, and if so how do we determine this (e.g., monitoring the most significant waterbodies that may already be adequately monitored by other State/Federal agencies)?
e. How do we ensure the inclusion and rollup of data collected by others both inside and outside of Parks that may help to characterize the overall health of Park water resources?
f. Do the core variables (parameters) address any concerns of the Networks, and is it critical that they all do so, as some regions of the country may not see much use in some parameters (e.g., pH/DO in Alaskan glacial streams)?

Discussion: The topic of what data or information needs to be rolled up on a national scale was discussed by the workgroup in an attempt to clarify this issue. Although there was strong technical rationale provided for the "core" parameters (and they serve a purpose in evaluating whether the goals of the CWA are being met), WRD acknowledged the information provided by these parameters is oftentimes not the most useful for rollup and comparison on a Servicewide or national scale. Therefore, it was agreed that it was important to look at ways to rollup additional information on parameters (or suites of parameters) collected by Networks based on their evaluation of specific impacts to waterbodies. Although Network-selected parameters need not be the same Servicewide, it was recognized that rollup results could be framed in language that reflected some "percentage of Parks or subset of the whole program that identified a certain type of water resource problem" with their waterbodies. For example, changes in eutrophication related to nutrients, pH impacts due to acid mine drainage, or human health and recreational threats caused by high fecal coliform counts, could be documented through this monitoring program.

The workgroup also raised the question to WRD, and for general consideration and comment by the participants, as to what NPS needs to report in water quality rollups to Congress. Some participants indicated that simple reporting of statistical data might not be the best way to gain the Congressional ear and approval. Rather, Congress wants to hear stories (presumably success stories) on how monitoring funded by the Challenge was used to help Parks evaluate and understand the health and status of their water resources. There was also the question of availability and utility of the data gathered in assisting Park management decision-making. The consensus of the workgroup was that there needs to be a better definition or explicit statement of what questions NPS is attempting to answer with WRD rollups on the national level.

WRD indicated that the key questions the data rollup was to answer were to what degree NPS water resources or waterbodies (on some percentage basis) are:

a. Meeting Standards/Criteria under provisions of CWA;
b. Varying within optimal (normal) biological, chemical, physical, or habitat range;
c. Developing some trend (toward a more favorable or less favorable condition); and/or
d. Achieving non-degradation or are unimpaired.

These would likely be the fundamental yardsticks by which some formal statistical measure was used to present the monitoring results. WRD indicated that stories or other narratives used to help get the information across to Congress and the public could only improve communication of what tends largely to be numerical or statistical data. WRD agreed that the format and vehicle used in upward reporting of monitoring information to facilitate understanding of the information by the Congress and the public are important aspects in determining how the program and monitoring information will be received and used. The consensus of the workgroup was that more thought should go into this area as the program evolves.

4. Protocols and Protocol Development

Conclusions and Recommendations: The Network should be responsible for the identification of the appropriate sampling and analytical protocols to follow, based on the monitoring context (regulatory or non-regulatory) they find themselves working in (State) and any other applicable regulations that may govern the utility of their monitoring data. WRD's role will be to ensure, through the Detailed Water Quality Monitoring Plan review process, that Networks have identified the appropriate protocol to follow for the State(s) in which monitoring is conducted, or, should the NAWQA or other protocol be followed, any discrepancies between State protocols are resolved prior to performing field work and lab analytical tests where results could be used in a regulatory context.

Discussion: A general discussion of WRD's role (in identifying protocols and sampling/ analytical method protocol development that Networks should follow in implementing water quality monitoring) centered on two broad categories (Categories 1 & 2) as drivers of the program. Under a regulatory driver such as the Clean Water Act, the States have been delegated authorization by the EPA to implement CWA provisions. Thus, States play the lead and have the authoritative role in setting numeric criteria and narrative standards for the "designated use" of waterbodies ("assessment units" of EPA for purposes of 305b reporting). Monitoring-related sampling and analytical protocols that the individual States establish (or recognize) must be followed to evaluate if some "designated use" narrative standard or numeric criteria is being met. Failure to follow a prescribed State sampling and/or analysis protocol will usually result in the State's decision not to accept the data. Thus, WRD takes the position that the Networks have the responsibility to identify the appropriate State protocols for conducting monitoring that may involve a regulatory decision under the CWA or any other regulatory context for which States have primacy (e.g., RCRA, SDWA).

In the absence of monitoring performed to meet State specified criteria under the CWA, WRD has identified USGS NAWQA protocols (as presented in Book 9 of the National Field Manual) as the default protocol in lieu of applicable/prescribed State protocols or other widely accepted or recognized protocols (e.g. EMAP). Protocol development is too painstaking and expensive a procedure for WRD to undertake due to staffing demands. Nor does it make sense to undertake this endeavor with several acceptable protocols already established. There is also a trend for these protocols (States, EPA, NAWQA, EMAP) to become more similar as they evolve over time and agencies share/rely on each other's resources. It was noted that the NAWQA protocol is updated yearly and the most recent NAWQA and EMAP protocols may be accessed and downloaded from the Web. The National Water Quality Monitoring Council is also working to bring standardization and commonality among the various monitoring protocols and metadata. A NAWQA protocol for biological monitoring prepared under the Ecological Monitoring Assessment Program (EMAP) is also in draft form and will likely be available for Networks to consult by the time that most Networks begin implementation of their programs.

5. Sampling Location, Frequency, and Site Rotation

Conclusions and Recommendations: The workgroup reached consensus that 1) monitoring on a monthly basis (or something approaching that) was generally the preferred option for water column sampling and field measurements and 2) that rotation of monitoring sites on some temporal basis (year or multi-year intervals) was a reasonable means to achieve the goal of more widespread monitoring coverage of Network waterbodies. Furthermore, to the extent that greater sampling frequency improved the usefulness and informational content of the data in a particular context, it should be encouraged over lesser frequency sampling that may fail to adequately characterize a waterbody or differentiate anthropogenic impacts from natural chemical, physical, or biological variation over the long term.

Discussion: The workgroup entered into a general discussion of sampling location, sampling frequency, and the possibility that Networks may elect to rotate sample sites or monitoring stations to achieve greater coverage of Network waterbodies, given the limited monitoring resources of the program. WRD staff indicated that these were decisions to be made at the Network level. However, WRD noted that many monitoring organizations, based on past experience had recognized serious limitations in their low frequency monitoring data and were moving toward monthly monitoring of water quality (or a frequency approaching that of monthly monitoring) for maximum utility of the data. Furthermore, several States (e.g., UTAH) required monthly monitoring for a cooperative participation in their program (e.g., sharing of analytical costs). Also, Dr. Loftus of CSU in his presentation at the November 2001 WQ Monitoring Workshop made a strong statistical case that monitoring should be performed a minimum of 7 to 8 times per year in long-term programs where a diverse set of goals and objectives are sought. In addition, participants noted that the Water Quality Monitoring Council recognized that regular sampling (seasonal to monthly), with 2 or more event samples (flood, base flow, first flush with rain event) collected during the year, also provided often-critical information about the waterbody or impacts to aquatic ecosystems.

6. Biological Monitoring (Biocriteria) – Status and NPS Role

Conclusions and Recommendations: In States where biological monitoring is not advanced, Networks should proceed cautiously in this area, given their limited resources. However, the consensus of the workgroup was that biological monitoring and development of biocriteria monitoring in conjunction with State programs is so integral to the biologic mission of the NPS that moving in this direction should be encouraged where costs are reasonable and it is not detrimental to meeting other monitoring goals and objectives the Network may have identified.

Discussion: The workgroup generally agreed that the biological component of water resource monitoring in Parks would likely evolve into the major element of the water quality monitoring program. The anticipated trend toward an increasingly biological monitoring focus is due to the biological expertise that already exists in Parks, the NPS focus on an integrated approach to aquatic resources, and the likely greater availability of unimpaired waterbodies inside of units of the National Park System, which could be used as reference sites by other biological monitoring programs. Park aquatic resources may thus offer Networks an opportunity to achieve their monitoring objectives through a cooperative effort by leveraging other State and Federal agencies seeking unimpaired reference sites.

Concern was expressed that 1) biological monitoring programs and reference sites in some States are not well established, 2) developing biological monitoring programs can potentially be a significant upfront investment and be subject to future changes in methods and procedures (matrices) that could negate some of the early efforts, and 3) in many States there may not be widespread consensus on what a healthy waterbody should look like in a biological context (i.e. the desired biologic condition), so procedures may be modified until standard reference criteria and protocols are developed and broadly accepted. Therefore, Network participation in biologic monitoring programs where several components are in a state of flux may not prove worthwhile.

There was concern expressed by some workgroup participants that bio-aquatic monitoring of some species may fall into gray areas between the aquatic biological assessments carried out under Vital Signs and the water quality component. With funding being so limited, some participants expressed the likelihood that smaller riparian species (otter, beaver, dipper, etc.) would not be monitored in favor of larger land mammals (under other Vital Signs) or fauna more closely tied to water column chemical or physical habitat effects such as fish and macro-invertebrates (under the water quality component). WRD staff made it clear that in most instances it would not be appropriate to use water quality funding for biologic monitoring purposes beyond those generally accepted species that would be used in State or Federal bio-criteria monitoring programs. Monitoring for those species that are not conventionally viewed as a component of biodiversity matrices for water quality should be conducted with funds from other Vital Signs program elements.

7. Water Quality Monitoring Staffing & Training Needs of Networks

Conclusions and Recommendations: Workgroup participants identified Network and Park staffing and training as potentially weak links in the water program. A significant proportionate cost to Network yearly budgets (which currently range from $70K to $110K) would result from

hiring even one full-time water-quality technician, and it was not clear that an effective in-house monitoring program could be conducted without filling this position at the Network level. Also of concern was the ability of Parks to consistently dedicate staff to support regular monitoring by Network field personnel. Training, equipping, and retaining water quality staff so that the desired program continuity and level of data quality are achieved and maintained over time may be a difficult challenge for many Networks. These factors plus the limited ability of Parks to dedicate equipment (field vehicles and field instruments) solely to this program could all negatively affect data quality.

Discussion: The workgroup discussed several topics related to meeting staffing and training needs for Networks choosing to conduct their monitoring programs in-house. It was apparent that a successful in-house program could not be implemented using existing Park staff alone. A sizeable staffing commitment at the Network level, consisting of at least one full time position (e.g., sampling technician) to both coordinate and implement the program in the field, along with substantial assistance from other Park personnel in the Network to assist in field work, will be necessary. It was noted that due to the inherent safety risks working around water, sampling teams must be comprised of a minimum of two people. Furthermore, the demands and staff dedication required to conduct sampling on a regular basis (e.g. monthly) over the large geographic area of a Network would be demanding for a single Network individual even with considerable support from Park staff.

WRD indicated that it could play little or no role in Network staffing decisions and that Networks would largely need to work out the staffing details based on their individual budgets, cooperative efforts they can develop, and the ability of individual Parks to provide staff on a consistent and dependable basis.

The question arose as to what role WRD would play in training of Network water quality personnel. WRD indicated that they were not sufficiently staffed to take on a training responsibility at this time, but as enough Networks determined that monitoring would be conducted in-house and identified staff training as a need, WRD could possibly serve as a "facilitator" of training through a USGS program (or other, widely-recognized, established, quality training program). Depending on the training program offered the workgroup estimated that cost of formal training, per person, could range from $1700 to nearly $3000. Also mentioned was the possibility that lower cost training of staff may be accomplished through a State cooperative program with a Network.

8. Analytical Lab Selection

Conclusions and Recommendations: To the extent feasible, networks should contract with a single laboratory, accredited by the National Environmental Lab Accreditation Program (NELAP), or rely on some cooperative relationship with State labs or State accredited labs that are commonly used in State CWA programs. Despite some variation in procedures and analytical protocols between the labs of various States, it is believed this is the best means to keep data variability due to analytical method to a minimum in Servicewide rollups.

Discussion: The topic of lab selection was addressed briefly by the workgroup. Participants noted that lab variability has frequently compromised data comparability in the past. It was pointed out that the NAWQA program overcame this problem by establishing a single national laboratory with an emphasis on applying a consistent set of analytical methods to perform nearly all NAWQA program analytical work. The constraints of the NPS program make the Servicewide use of a single laboratory essentially impossible. One Network is developing their own lab; but, in general, with the exception of unique circumstances, the economics of each Network establishing an analytical laboratory is not feasible. The staffing and equipment necessary to provide for a full range of analytical capabilities (and to meet the QA/QC requirements) needed solely to support water quality monitoring analytical work of a single Network is prohibitive. However, WRD noted that some minimal in-house lab capabilities (preferably centrally located within a Network) would be needed by Networks to support fieldwork and calibration and maintenance of field instruments.

9. Improving WRD Guidance

Conclusions and Recommendations: WRD will continue to update its guidance document with a focus on being as concise as possible to limit the volume of material. Formal review requests to Park staff will be solicited upon completion of the update that incorporates the results of the Freshwater and Marine/Estuarine Workgroups. The document will remain in draft form for the foreseeable future as Network staff begins to use the document and provide feedback.

Discussion: WRD solicited input from the NPS participants on how the technical guidance document prepared by WRD might be improved. WRD indicated the guidance document would only be released in draft form for the foreseeable future and may never reach a final status. This is due to constant, ongoing changes in both technological and programmatic areas. Most workgroup participants indicated that they had not had an opportunity to read the document and that a formal review request was the best means to ensure a proper review. WRD staff indicated that once the results of the Freshwater and Marine Workgroups were incorporated into an updated version of the technical guidance, they would seek more formal review from Park and Region staff.

Generally, comments on document improvement revolved around making it less voluminous. However, everyone realized that the subject matter was quite complex, and in order to reduce content considerable detail would have to be left out, leading to greater potential for misunderstandings and error in its application. The main purpose of the WRD technical guidance is to provide detail and reference sources for the water quality component that would complement the more general programmatic guidance that NRID provides for the Vital Signs Program.

10. Performing Sound Science and the Role of QA/QC

Conclusions and Recommendations: QA/QC will be a significant emphasis of WRD, and Networks should plan to budget 10 to 20 per cent of their monitoring costs toward this component of their overall monitoring program.

Discussion: There was general workgroup discussion on the role and degree of quality assurance and quality control that was required and prudent in this program. WRD emphasized that from the start of the program quality of data should be stressed over quantity. This is best achieved by identifying the appropriate protocols, having staff well-equipped and trained on those protocols, and then following through with the appropriate number of quality control samples in the form of repeating probe-based, in situ field measurements or running appropriate numbers of field or laboratory duplicates and blanks. In general, reducing the number of QC samples (usually 10% to 20% of the total) to save costs or so that more environmental samples can be collected, should be avoided. QA/QC should be considered an inherent cost of any program and should be budgeted up front. Part B of the WRD guidance addresses QA/QC issues and considerations comprehensively.

11. Including Other Broadly Useful Parameters in Those Required (e.g., Turbidity, Nutrients, Pathogens, Metals)

Conclusions and Recommendations: Although several additional monitoring parameters were identified as potentially broadly applicable to monitoring conducted by Networks, the required core freshwater parameters would not be expanded beyond the 4 proposed initially by WRD and the 5th additional parameter (quantitative or qualitative flow/level) selected by the workgroup. Part D of the WRD Guidance should address and discuss the grouping of additional parameters into suites on the basis of some shared set of stressors or threats to a biome or aquatic resource, that may be tied to a particular land use, atmospheric impact or point or non-point source discharge etc.. This would facilitate a Network's parameter selection process to ensure no important indicator parameters are left out.

Discussion: The workgroup considered additional parameters (turbidity, metals, nutrients, fecal coliform etc.) on a case-by-case basis for inclusion in the list of core, or required, parameters. Although in many instances these parameters could be good basic data to acquire and applicable to a wide variety of sites, their utility was not deemed by the workgroup to be universal, and the costs associated with their collection and analysis could not be justified in all/most monitoring situations. Because many, if not all, of these water quality variables could be used as indicators of a particular threat/stressor, it was decided that Networks with site- or area-specific information from their planning and assessment efforts would be better equipped to select these individual parameters (or suites of parameters) in their monitoring program.

ADDENDUM

The consensus reached at the Freshwater Workgroup meeting was that WRD, through its technical guidance document, should specify the core parameters and metadata to be required Servicewide and address additional monitoring parameter selection of Networks under two broad categories. These two categories include "monitoring driven by CWA provisions (e.g., 303d-listings or other regulatory programs such as that required for ONRWs)" and "all other, issue-related parameters or suites of parameters." This latter group of parameters generally address other aquatic concerns a Park or Network may have or provide a basis for assessing long-term trends in water quality. A revised draft guidance language (**in bold below**) and further discussion of these categories and some specifics reached by the group are provided below.

The following two sections (A & B) are proposed wording revisions to the WRD Draft Guidance resulting from this Freshwater Workgroup meeting. Section C summarizes recent programmatic guidance from the Office of the Associate Director and the I & M Program which affects implementation of the Water Quality Component.

A. WRD Required Parameter Monitoring and Metadata:

WRD is requiring that five (5) basic monitoring parameters/variables be collected at all monitoring stations on a Servicewide basis. WRD will provide a list of required metadata to support NPS Servicewide reporting needs and the requirements of data management in STORET. The basic parameter list includes the original four (4) water column parameters (temperature, specific conductance, pH, and dissolved oxygen) proposed at the November (2001) workshop. This list was expanded by the Freshwater Workgroup (March 2002) to include, at a minimum, the qualitative assessment of flow for flowing water bodies and a qualitative assessment of level/stage for non-flowing water bodies. However, a quantitative measurement of flow/level is preferred and strongly recommended at all monitoring sites (flowing and non-flowing waterbodies) due to the limited utility of water quality data that cannot be adjusted for flow. Non-flowing water sites (lakes, reservoirs, wetlands etc.) shall also include a vertical profile of core parameters due to the tendency of non-flowing waterbodies to stratify.

Group consensus was reached that these four (4) field-measured parameters, a qualitative estimation of flow/stage/level, and appropriate metadata represented a minimum data set for all monitoring stations and should be clearly specified in both the WRD technical guidance document and acknowledged in the detailed monitoring plans of Networks. The workgroup also determined that required metadata will include **digital photographic documentation of each monitoring site** (1 picture at minimum, but seasonal/yearly documentation, etc. is also being recommended where feasible). For consistency and comparability Servicewide, the required parameter and unit of measurement are specified below (with all parameters being reported as temperature compensated values*).

1. **Temperature (°C)**
2. **Specific Conductance (µS/cm)***
3. **pH in standard (pH) units***
4. **Dissolved Oxygen (DO in mg/L)***

(Note: Specific Conductance is conductivity that is temperature compensated to 25° C, pH and DO are also temperature compensated measurements (25° C) and DO is calibrated based on site barometric pressure.)

5. Flow/Discharge & Level Measurements

The workgroup recognized that a flow/discharge measurement for flowing waterbodies and a stage or level measurement for non-flowing waterbodies is in many instances a critical component of monitoring. However, given the practical constraints of this program (funding being a major one) the workgroup concluded that it was best not to mandate these quantitative measurements universally. In many instances where a quantitative flow measurement is not possible/feasible, the qualitative estimate of flow/level will be an acceptable substitute in lieu of the preferred quantitative measurement. The qualitative estimate will be required as follows:

Flowing Water Case – Qualitative characterization of flow/discharge (e.g., stream/river);

At a minimum, some estimation of flow will be made based on visual estimation of relative % of bank full at the sampling site as follows: (Low, ≤ 25%; Intermediate, between 25% and 75% of bank full; High, 75% to 100% of bank full; Flood/Overbank > 100% of bank full) or a similar percent estimation based on the stream hydrograph from the nearest gaging station that is too distant for an accurate quantitative measurement of flow for the monitoring site. (Note: for some small streams, it may be possible to obtain an approximate quantitative flow measurement simply by using a bucket and a stop watch.)

Still/Non-flowing Water Case – Qualitative characterization of waterbody level or stage (e.g., lake, reservoir, pond, wetland, etc.) in lieu of a water level measurement based on a surveyed in level/staff gage that may be regularly reported by some waterbody owner or responsible agency (BLM, COE, BOR, USGS) that maintains level/stage records.

At a minimum, some estimation of water level for the waterbody (low, intermediate, high, or in flood, implying exceedance of normal yearly range) should be reported with water quality data. In addition, a depth profile of basic water column parameters is required for standing/non-flowing water bodies (lakes, reservoirs, etc.). Where appropriate, WRD will give general guidance on depth profiling to ensure some basic consistency in these measurements. However, both spatial and depth sampling considerations are often site or waterbody-type specific and any State guidance should be consulted in determining appropriate spatial and depth integrated sampling at non-flowing water sites.

A quantitative flow measurement should be established by gage at/near a flowing-water monitoring site in most instances. It is required for Total Maximum Daily Load (TMDL) determinations, in several other regulatory situations, and oftentimes may be required by

cooperators where other agencies may choose to use or help fund NPS data collection. Where possible, it is recommended that monitoring be established at an existing gaging station or that a new staff/level gage be established for a monitoring site. A quantitative flow measurement is highly recommended for monitoring stations but not required by WRD.

B. Freshwater Monitoring Drivers & Hierarchy (A Two-Tiered Approach)

1. Category 1: Monitoring Driven by CWA Provisions (i.e., based on 303d Listings, 305b reporting, or ONRW maintenance or designation)

The workgroup discussed at length the significance played in monitoring by Networks of 303d listed water bodies (identified by States under an authorization of the Clean Water Act). There was general agreement that, together with 305b assessment units (waterbody) reporting requirements, this offers an opportunity to provide useful monitoring data in several venues, share monitoring costs with States, identify acceptable protocols, and obtain a data set that is quantifiable for rollup on a national scale to determine if GPRA goals are being met. The consensus reached by the workgroup was that 303d-listed waterbodies, together with ONRWs and waterbodies being considered for ONRW status by Parks, should have priority consideration by Networks in their monitoring program.

2. Category 2: Other Issue-Related Parameters or Suites of Parameters (i.e. Network selected monitoring parameters to address stressors, land use issues, present or anticipated future impairments/threats, etc.). [To be developed further by WRD.]

The workgroup concluded that WRD should provide discussion in the guidance document on other key water column parameters to consider and suites of parameters that may be appropriate for monitoring other issue-related aquatic concerns or provide a basis for evaluating changes or trends in water quality over the long term. These parameters should have generally widespread utility/application and when monitored, provide acute and/or chronic information on aquatic resource health and possible trends for best integration with other vital signs. They may be required in some more common regulatory situations and should at least be considered by Networks at many of their monitoring sites.

WRD will address organization of this second group of parameters into monitoring suites or groups of parameters that are most applicable to specific land use concerns, certain biomes, stressors and threats related to water body types, etc. The emphasis of this second group of parameters will be in dealing with particular issues and in the characterization of changes or trends in water quality over the long term. The chemical water column parameters in conjunction with other biological parameters and physical monitoring components (habitat, geomorphic elements) are recommended for general consideration at the appropriate/applicable monitoring sites as determined by the Network monitoring design staff. WRD will provide guidance on their general utility within each suite that address a monitoring concern, to facilitate screening and appropriate application by Networks.

C. Recent Guidance

Subsequent to the workgroup meeting, recent guidance out of the NRID has been made available to Networks that clarifies how the Vital Signs Program and water quality components are to be integrated. Although not a topic of the workgroup, their integration would likely have been an area of discussion, so is mentioned here on an informational basis. Direction from the Associate Director's Office to Regional I & M Coordinators (May 2, 2002) on the **"Development of Park Vital Signs Monitoring and Integration of Water Quality Monitoring"** provides guidance for full programmatic integration of design and implementation of the water quality monitoring component with the Network-based Vital Signs Monitoring Program. This programmatic guidance was recently developed by the Natural Resources Information Division (NRID) to facilitate full integration of the two monitoring programs.

WRD has elected to fully adopt this programmatic guidance and will make any necessary adjustments to the water quality component of Vital Signs to facilitate this integration accordingly. To avoid confusion, WRD is adopting the NRID phased monitoring plan development approach and associated terminology (Phase 1, Phase 2, Phase 3) and abandoning use of phase terminology (Phase I, II, & III) for the 3 steps of planning and assessment, design, and implementation used previously in the water quality program.

Network staff implementing the water quality component should be fully familiar with and consult this and related documents for content and completion schedules in their monitoring plan development. Critical components of the overall integration of water quality monitoring with that of other vital signs include:

1. A three-phase approach to monitoring plan development with a common format and implementation schedule for both Vital Signs and the water quality component;
2. A peer review process; and
3. A detailed design and protocol development process.

Additional programmatic guidance on annual reporting and work plan development (**Annual Administrative Report and Work Plan For Inventories and Vital Signs Monitoring**), also recently produced by NRID, provides schedules, format and content information for the generation of Vital Signs annual work plans and reports that the water quality component is also adopting. However, the WRD technical guidance remains the best resource for detailed technical information and specific considerations in planning, designing, and implementing a water quality monitoring program and information system.