

# Section 2: Quality Assurance Project Plans (QAPPs)

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# Section 2: Quality Assurance Project Plans (QAPPs)

## 2.1 Introduction

This section of the QA Navigator describes an important tool that you can use in developing your own QA Program—the Quality Assurance Project Plan. A model Quality Assurance Project Plan (QAPP) is also provided in Appendix A. The QAPP is a comprehensive planning document that sets the general framework and requirements for a monitoring project. It describes the scope of the project, the organization and individuals involved, the data quality objectives, the monitoring procedures, and the specific quality control measures to be employed. QAPPs are often modified as the monitoring project evolves and matures.

## 2.2 Do you need a QAPP?

If your organization will conduct a water quality monitoring program with funding from the State Water Resources Control Board, the Regional Water Quality Control Boards, the USEPA, or other government agencies you will usually be required to provide a QAPP as a contract requirement. A Model QAPP for Citizen Monitors, which addresses commonly used physical, chemical, and biological water quality parameters, has been provided in Appendix A of The QA Navigator. You may use the Model QAPP as a template for satisfying your contract requirement.

If you are not receiving funding from one of the government agencies, and are not required to have a QAPP, then you may decide not to produce one. You may be able to produce good quality data without the use of a QAPP, if your data are obtained under a set of rigorous “rules” or guidelines. Nevertheless you may still use the guidelines found in the Model QAPP to improve the quality of your data and develop the appropriate documentation of your monitoring activities.

Whether you have a QAPP or not, you will still need to have a set of Standard Operating Procedures (SOPs) which your monitors must use in performing field and laboratory procedures. You may use an existing document such as those provided by the United States Environmental Protection Agency (USEPA) or the SWRCB’s Clean Water Team, or you can develop your own based on these and other reference documents.

## 2.3 Review and approval process

Your QAPP should be approved by your group’s monitoring leader, your group’s quality assurance officer, any partner or academic organization on which you are relying for a significant portion of quality assurance assistance, and by a representative of the agency that is providing funding for the project.

- If your monitoring is performed under a contract managed by a State Water Resources Control Board (SWRCB) staff person, your QAPP must be reviewed and approved by the QA officer for the SWRCB.
- If your monitoring project is performed under a contract managed by a Regional Water Quality Control Board (RWQCB) staff person, the QA officer for that RWQCB must approve your QAPP. If that RWQCB does not have a QA officer then the SWRCB QA officer will approve the QAPP.

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- If your QAPP has made reference to technical support from a member of the SWRCB Clean Water Team, then that Clean Water Team Regional Coordinator should also review and approve the QAPP.

### 2.4 The Model QAPP

The Model QAPP which appears in Appendix A was derived from the Southern California Volunteer Monitoring QAPP (SWRCB, 1998). SWRCB staff developed that QAPP originally for the Los Angeles Volunteer Monitoring Steering Committee, which is composed of various agencies, institutions, and citizen monitoring organizations. The Southern California Volunteer Monitoring QAPP was itself based on the recommendations provided by the USEPA (1996). Since then other groups in California have used the Southern California Volunteer Monitoring QAPP as a template for developing their own QAPPs.

The Southern California Volunteer Monitoring QAPP covered only certain chemical and physical water quality methods, such as conventional water quality parameters (temperature, dissolved oxygen, pH, conductivity, and turbidity), nutrients (ammonia, nitrate, and phosphate) using comparators, and certain urban pollution field kits (for phenols, copper, chlorine, and detergents). The Model QAPP has been modified for some of these parameters (additional methods included, such as electronic colorimeters for nutrients and nephelometers for turbidity), and additional biological parameters (bacteria and benthic macroinvertebrate bioassessment) have been incorporated as well.

You may use the Model QAPP as a template for developing your own QAPP. Instructions in the hard-copy version included in Appendix A are presented in bold type. You may obtain an electronic, color-coded version of the Model QAPP by contacting Dominic Gregorio of the SWRCB Clean Water Team at (916) 341-5488.

The following are descriptions of each section of the Model QAPP:

#### ***Title and Approval Page***

You should include the Title of the QAPP, the author, the date and spaces for signatures and dates for those individuals approving the QAPP. This page (page 1) and all other pages should contain a header as shown on the Model QAPP. Your QAPP will likely be an evolving document. For this reason the header contains a line for Revision Number. When revisions are made you will need to have a new approval page with new signatures.

#### ***Table of Contents***

You should use the Table of Contents to list each section, including the appendices, of your QAPP.

#### ***Distribution List***

This is where you will identify the individuals or entities that will be receiving copies or revisions of your QAPP. You would also state here how other interested individuals could obtain a copy of the QAPP.

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### ***Organization of the Project***

This is the place where you will describe the organizational framework for your monitoring project. You have two options to choose from in the Model QAPP. The first option is for a QAPP that collectively incorporates the monitoring activities performed by more than one organization. If your organization will be networking and cooperating with other citizen monitoring groups, then this is the option you should follow. You are encouraged to follow this option in planning and preparing your QAPP, since this sort of networking approach will result in greater collective resources and strengths.

If you really don't have anyone in your immediate area to network with, then follow the second option, which is to prepare a QAPP in which only one citizen monitoring organization will be involved. Regardless of which option you follow, you should identify the individuals (by name, to the extent that is practical) responsible for the various functions identified in the QAPP. (Also see Appendix B of The QA Navigator for a description of functions and tasks for these individuals):

- Management (monitoring leaders and trainers)
- Field operators and team captains (volunteers and staff)
- Data managers and computer operators
- Quality assurance personnel
- Technical advisors

You are encouraged to obtain at least three but no more than eight technical advisors that will assist you in making technical decisions and in reviewing and analyzing your data. Each advisor should have a specialty listed in addition to their organization. For example: "Joe Smith, MS Chemistry, Instructor, Diamond Springs Community College." If you are developing a multi-organizational QAPP the monitoring leaders may be listed as technical advisors. However you should clearly state that such individuals have no "vote" on the review of their own group's data or procedures.

### ***List of Technical Tasks in Monitoring Water Quality***

Considering the steps, tasks, and procedures associated with an environmental monitoring project, keeping track of who is doing what is critical. *The Clean Water Team's List of Technical Tasks in Monitoring Water Quality* can serve as a guide to establishing your project's list of tasks and the individuals responsible for performing them. The list (Appendix B) walks you through a variety of tasks, including: question formulation, parameter selection, reconnaissance and monitoring station selection, development of DQOs and sampling design, method selection, equipment purchase and testing, training, data gathering, data management and entry, data validation and analysis, and reporting of project findings. The list also includes estimates for the level of effort required to complete each task, and placeholders for you to write in the proper titles and identification of individuals responsible for performing the task, the products resulting from each task, and a timeline for task completion.

The Clean Water Team created the *List of Technical Tasks in Monitoring Water Quality* using Microsoft EXCEL. Electronic versions of the list are available from the Clean Water Team upon request.

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### ***Problem Statement***

You should provide your own problem statement here based on your understanding of local circumstances and conditions. An example is provided in the Model QAPP. This section should also include the goals of your project, who will use your data, and how will it be used. You may also briefly describe here any previous studies that support your problem statement.

### ***Project/Task Description***

This is the place where you should describe what will be monitored and how often will it be monitored. Describe the parameters that will be analyzed directly by your group members, and also describe separately those parameters sampled by your monitors but analyzed by a professional laboratory. In this section you should state how you will determine what your data means. For example, you may compare your findings to the Basin Plan Objectives or to a benthic macroinvertebrate reference site. The Project/Task Description should also include a timetable. This timetable should indicate dates for identifying monitoring leaders, training your leaders, recruiting volunteers, obtaining instruments, training volunteers, initiating monitoring and data entry, quality control sessions, and data reviews by the technical advisory committee.

This Project/Task Description of the Model QAPP covers a variety of different water quality parameters. As with other sections of the Model QAPP you should treat this as a menu; you may choose the parameters that you will be performing and discard the rest. You should only commit to what you feel is manageable and practical for your group. Your Project/Task Description should describe only those what parameters your group will perform. You should also identify the SOPs to be employed by your monitors. These SOPs may be the protocols described in the USEPA Volunteer Stream Monitoring Manual, USEPA Volunteer Estuary Monitoring Manual, USEPA Volunteer Lake Monitoring Manual, the SWRCB Clean Water Team's Compendium of Water Quality Monitoring and Assessment, and/or other protocols deemed appropriate by you and your technical advisors.

### ***Data Quality Objectives***

Data quality objectives (DQOs) specify how good your data needs to be in order to meet the goals of your project. You may refer to Section 1 for a more complete discussion of DQOs and how they are arrived at. The four steps include:

1. Formulating study questions.
2. Selecting parameters to be measured and developing spatial and temporal sampling designs.
3. Defining tolerable error and required sensitivity.
4. Selecting methods.

In the Model QAPP no single question was formulated to drive the selection of DQOs presented. It is after all an example intended for your modification and tailoring. The data quality elements are discussed alphabetically in terms of accuracy, completeness, comparability, precision, representativeness and sensitivity. Many of the DQOs in the Model QAPP will support regulatory decision-making.

**Accuracy** describes how close your measurement is to its true value. To determine accuracy you can measure a sample of known concentration (referred to as a *standard*) and

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compare the known value against the measured value (Box 2.1). In the Model QAPP the accuracy of chemical and physical measurements is determined by performing tests on standards at the *quality control sessions* (also sometimes referred to as intercalibration exercises) held twice a year. Accuracy for bacterial parameters will be determined by analyzing a *positive control sample*. A positive control is similar to a standard, except that a specific discreet value is not assigned to the bacterial concentrations in the sample. This is due to the fact that bacteria are alive and capable of mortality and reproduction. Instead of a specific value, an approximate target value of the bacterial concentration is assigned to the sample by the laboratory preparing the positive control sample. For benthic macroinvertebrate analysis, accuracy should be determined by having 20% of the samples re-analyzed and validated to Level 3 (genus level) by a professional taxonomist.

### BOX 2.1: Example of Calculating Accuracy

During a recent training session, volunteer monitors each calibrated their individual pH meters (using their own standards) and then measured a common standard solution of pH 7.0. The following results were read:

7.5	7.2	6.5	7.0
7.4	6.8	7.2	7.4
6.7	7.3	6.8	7.2

Determine the mean result. Most calculators will determine a mean. To calculate:

$$\text{Mean: } \bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

ACCURACY = mean value - true value

To obtain a percent reading: Divide the ACCURACY by the true value and multiply by 100.

The average of these measurements is equal to 7.08. Since we know that the reference or true value is 7.00, the difference between the mean pH value is off or biased by +0.08 units or 1%. This level of accuracy is within a data quality objective of  $\pm 10$  percent.

**Comparability** is the degree to which data can be compared directly to similar studies. Again, you may use the methods described in the following documents to ensure that your data can be compared to others:

- USEPA's Volunteer Monitoring Manuals for Streams, Lakes or Estuaries,
- SWRCB Clean Water Team's Compendium of Water Quality Monitoring and Assessment,
- San Francisco Estuary Institute's Citizen Monitoring Protocols,
- Heal the Bay's Malibu Creek Stream Team Pilot Project, Shattering the Myths of Volunteer Monitoring, and
- California Department of Fish and Game's (CDFG) Stream Bioassessment Protocol for Citizen Monitors.

Before modifying these methods, or developing alternative or additional methods, your technical advisors should evaluate and review the effects of the potential modification. It will be important for you to address their concerns about data quality before proceeding with the monitoring program.

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**Completeness** is the fraction of valid data that you collected versus the amount of data that you originally planned to collect, expressed as a percent. An invalid measurement would be one that does not meet the sampling methods requirements and the other data quality objectives. The Model QAPP generally states that 80% of all measurements should be taken when anticipated. This accounts for adverse weather conditions, safety concerns, and equipment problems.

To determine the percent completed, divide the number of valid samples collected and analyzed by the number of samples anticipated in the monitoring design. Multiply by 100%. In the example below (Table 2.2), the volunteers met their objective of 80% completeness for temperature, but not dissolved oxygen. The volunteers reviewed their sampling methods and realized that some volunteers were not fixing the dissolved oxygen samples correctly. When they corrected this activity their completeness improved.

**Table 2.2: Example of Completeness**

Parameter	Collection Period	No. of Samples Anticipated	No. Valid Samples Collected and Analyzed	Percent Completed	Comments
Temperature	6/1/96 - 9/1/96	35	33	94.3%	
Dissolved Oxygen	6/1/96 - 9/1/96	35	27	77.1%	Volunteers were not fixing samples correctly in field.
Temperature	9/1/96 - 12/1/96	35	32	91.4%	
Dissolved Oxygen	9/1/96 - 12/1/96	35	32	91.4%	

**Precision** describes how well repeated measurements agree. In the Model QAPP, precision objectives refer to repeated measurements taken by different volunteers on the same sample (at the quality control sessions) and by the same volunteer on replicate water samples from the same location in the field. Box 2.2 provides an example of how precision may be calculated when there are more than two results for the same sample.

### BOX 2.2: Example of Calculating Precision

During a recent training session, volunteer monitors checked their individual pH meters against a standard buffer solution of pH 7.0. The following results were read:

7.5	7.2	6.5	7.0
7.4	6.8	7.2	7.4
6.7	7.3	6.8	7.2

Determine the mean result. Most calculators will determine a standard deviation. To calculate:

standard deviation: 
$$S = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2}$$

PRECISION = (standard deviation / mean) X 100

The standard deviation of these measurements is 0.32. The mean is 7.08. The PRECISION is 4.5%. This level of precision is within a data quality objective of 10 percent.

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Precision for bacterial parameters is determined by having the same monitor complete the procedure for laboratory duplicates from the same sample. You should do this once for every 20 samples, and at a minimum once daily. You may also determine precision for benthic macroinvertebrate analysis at the quality control sessions. A minimum of two teams of monitors should inspect each other's processed grids immediately following completion of the subsampling procedure. There should be no more than 10% missed organisms. One of your technical advisors should then evaluate each of your monitors by testing their identification to order and family level on at least 20 specimens, including at least one representative from each of the major orders and families as determined by the technical advisor for your watershed.

**Representativeness** describes how relevant the data are to the actual environmental condition. Problems can occur if:

- Samples are taken in a stream reach that does not describe the area of interest (e.g. a headwaters sample should not be taken downstream of a point source),
- Samples are taken in an unusual habitat type (e.g. a stagnant backwater instead of in the flowing portion of the creek),
- Samples are not analyzed or processed appropriately, causing conditions in the sample to change (e.g. water chemistry measurements are not taken immediately).

**Sensitivity** is the ability of the instrument to detect one concentration from the next. The *method detection limit* is the lowest possible concentration the instrument or equipment can detect. This is important to record because you can never determine that a pollutant was not present, only that you could not detect it. The *resolution* of the method also describes sensitivity.

### ***Training Requirements and Certification***

Your monitoring leaders should participate in a hands-on water quality monitoring program conducted by the SWRCB's Clean Water Team Citizen Monitoring Coordinators, or their designees. For macroinvertebrate bioassessment your monitoring leaders must also participate in a course provided by the California Department of Fish and Game, the Sustainable Lands Stewardship Institute, the American Fisheries Society, or the State Water Resources Control Board. Trained leaders may then train their rank-and-file monitors.

### ***Documentation and Records***

This is where you should identify the records you need for your project, including field and laboratory data sheets, QC checks, calibration records, maintenance logs, voucher collections, and sampling location descriptions. Copies of the blank data sheets should be included in the QAPP appendix. The data sheet should include instrument and calibration information, spaces for the results of blanks, duplicates, etc., and spaces for signatures of field or lab analysts, the monitoring project manager who reviews/approves the data, and the data manager who transfers data to electronic form. Section 3 of this QA Navigator describes an approach to managing your information that can both facilitate good record keeping and expedite the review process.

You should also describe how the records will be reviewed, handled, and stored. Data sheets should be reviewed for outliers and omissions before leaving the sample site. The monitoring leader should sign data sheets after review. Data sheets should be stored in hard

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copy form at a specified location unique to your group. You should archive field sheets for a minimum of three years from the time they were collected. If data entry is performed at another location, duplicate data sheets should be used, with the originals remaining at your headquarters. Hard copies of all data as well as computer back-up disks should be maintained at your headquarters.

### ***Sampling Approach: Criteria for Selection of Sampling Sites***

This is where you will outline the experimental design of your monitoring program. You should include a map, identifying sampling locations, in the QAPP appendix and refer to that map in this section. You should also describe how you decided on these sampling locations. The criteria used when choosing sampling locations should include the following considerations:

- access is safe,
- permission to cross private property is granted,
- sample can be taken in main river current or where homogeneous mixing of water occurs,
- sample is representative of that portion of the waterbody,
- location complements or supplements historical data,
- location represents an area that possesses unique value for fish and wildlife or recreational use.

If your monitoring program requires reference sites then these locations should be chosen upstream of any potential impact. A site chosen to reflect the impact of a particular discharge, tributary or land use should be located downstream of the impact, but upstream of any secondary discharge or disturbance. Remember that you must first obtain permission to access sampling locations from all pertinent property owners.

You should also use this section of the QAPP to describe the logistics of your program. You are recommended to have your monitors work in teams of at least two people, with one person designated as the team captain. If a scheduled team cannot conduct the sampling together, then the team captain should be instructed to contact the monitoring leader so that arrangements can be made for a substitute trained monitor. If a substitute is not found then the sampling effort should be terminated for that day. Remember that safety is of primary importance! For example, no in-stream sampling should be conducted if there are flood warnings or advisories.

### ***Sampling Method Requirements***

You will describe the sampling methods in this section. This includes samples that your monitors will analyze as well as those that will be sent elsewhere (e.g., a commercial lab) for analysis. Describe the procedure by which the samples are collected, and the sampling equipment to be used. Also describe the sample bottles, sample preservation and holding times for each parameter.

The Model QAPP describes the sampling equipment, sample holding container, sample preservation method and maximum holding time for each parameter. Again, as with other sections, you may use this as a menu to select the appropriate methods for the parameters you will be sampling.

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### **Sample Handling and Custody Procedures**

This section of the QAPP applies to samples that are collected in the field and brought to a lab for analysis, whether it is your citizen laboratory or that of another organization (e.g. a commercial lab) that will be performing the analysis. You should label samples with the waterbody name, sample location, sample number, date and time of collection, sampler's name, and method used to preserve sample (if any).

When samples are transferred from one volunteer to another, the field data form will likely suffice as a chain of custody form. When samples are transferred to an outside professional laboratory, then you should use a dedicated Chain of Custody form. This form identifies the waterbody name, sample location, sample number, date and time of collection, sampler's name, and method used to preserve sample (if any). It also indicates the date and time of transfer, and the name and signature of the sampler and the sample recipient. When you send samples to a certified commercial lab it is recommended that you use a Chain of Custody form provided by that laboratory. For benthic macroinvertebrate samples, you are recommended to use the California Department of Fish and Game Aquatic Bioassessment Laboratory Chain of Custody form.

The Model QAPP also uses this section to describe waste handling procedures. You must handle wastes with the utmost safety, and wastes should always be placed in containers that are clearly marked as waste containers. Always dispose of waste materials according to appropriate state and local regulations.

### **Analytical Methods Requirements**

You should identify here the specific methods that you will use to analyze your samples. You may choose from the menu of methods provided in the Model QAPP or you may select your own methods. The analytical methods in the Model QAPP were chosen based on the following criteria, which you should consider as well when selecting methods:

- capability of volunteers to use methods,
- provide data of known quality,
- ease of use,
- methods can be compared to professional methods in *Standard Methods for the Examination of Water and Wastewater*, (APHA, AWWA, WEF, 1998).

### **Quality Control Requirements**

Quality Control (QC) refers to the activities that are used to measure and maintain the program's data quality so that it meets the Data Quality Objectives (DQOs). You will measure Quality Control (QC) samples to ensure valid data are collected. Depending on the parameter, quality control samples should consist of *field blanks*, *replicate samples*, or *split samples* (Table 2.3). As mentioned previously, the Model QAPP commits to quality control sessions held twice a year to verify the proper working order of instruments, evaluate and refresh volunteers on their procedures and determine whether the data quality objectives are being met. The different kinds of QC samples identified in the Model QAPP are described briefly below:

*Blanks samples* are composed of distilled water and are used to determine if there are problems or errors with your analytical procedures or instruments. When wet chemistry

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procedures are used, blanks are referred to as *reagent blanks* because the reagents are added to the distilled water. *Field blanks* are initiated in the field at the time of sampling, and *laboratory blanks* are initiated in the laboratory prior to or during the analysis of samples.

The Model QAPP requires that blanks be performed each day sampling and analysis occur for all chemical, physical and bacterial parameters except temperature, pH, and dissolved oxygen. For analysis performed in the field it requires field blanks, and for analysis performed in the lab it requires lab blanks. Blanks are not appropriate for benthic macroinvertebrate analysis.

*Replicate samples* are defined as being separate samples taken at the same time and place but analyzed separately. When there are only two replicate samples, these are referred to as *duplicate samples*. Duplicate samples should be collected as soon as possible after the initial sample has been collected, and should be subjected to identical handling and analysis. *Laboratory replicates* are sub-samples from the same field sample. If there are two lab replicates (i.e., the sample is sub-sampled twice) then these are referred to as *laboratory duplicates* (Table 2.3).

The Model QAPP requires chemical, physical, and bacterial analysis to have duplicate samples analyzed once every 20 samples, or quarterly whichever comes first. In addition, for nutrient or bacterial analysis performed in the laboratory, laboratory duplicates must also be performed. For benthic macroinvertebrate sampling, instead of duplicate sampling, each sampler will be evaluated annually by measuring the area sampled upstream of the net. The area should be two square feet and should be verified by using a two square foot PVC frame.

*Split samples* are the result of dividing a single sample into two or more different sample containers. Split samples can be performed in the field (*field split*) or can be performed in the lab (*lab split*). Each of the split samples is then sent to different laboratories for analysis. *Spiked samples*, also known as *standards*, are samples with a known concentration of the chemical being analyzed. *Split standards* are lab splits of spiked samples produced in that laboratory.

### Table 2.3: Types of Quality Control Samples

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TYPE	SUB-TYPE	
<b>Blanks:</b> “Clean” samples used to detect problems in sampling, transport, and lab analysis.	Laboratory Reagent Blank	Initiated in the lab; includes reagents with H <sub>2</sub> O.
	Field Blank	Initiated in the field.
	Equipment or Rinsate Blank	To evaluate if there is carryover contamination from reuse of sampling equipment.
<b>Replicates/Duplicates:</b> Separate samples taken at same time and place and analyzed independently.	Laboratory Replicate	More than 2 subsamples from same field sample.
	Laboratory Duplicate	2 subsamples from same field sample.
	Field Replicate	More than 2 subsamples, same field sample.
	Field Duplicate	2 subsamples same field sample.
<b>Splits:</b> One sample divided equally into 2 or more containers and analyzed independently.	Laboratory Split	Measures analytical precision.
	Field Split	Measures analytical precision and field sampling precision.

According to the Model QAPP, standards should be analyzed semi-annually as part of the quality control session. Split standards should be prepared, analyzed by the monitors, and also sent to a professional laboratory before the maximum sample handling time is exceeded. The professional laboratory should analyze the sample using the referenced “standard method.” Monitors should perform at least three analyses on that same sample. From these results accuracy and precision may be determined.

It is difficult to produce absolute standards for bacteria. Instead, split field samples or split positive controls, should be analyzed for bacteria by your group and an outside professional laboratory twice annually.

For validation of benthic macroinvertebrate samples, the Model QAPP requires that a minimum of 20% of your samples be sent to an outside professional taxonomist. Following analysis the selected samples will be reconstituted. Reconstituted means opening the vials containing the 100 identified specimens, pouring the specimens back into the original sample jar, and gently stirring the contents. In addition, the Model QAPP states that your group’s sub-sampling/sorting and taxonomic skills will be evaluated annually. You will be able to determine accuracy and precision by the results of these evaluations.

### ***Instrument/Equipment Testing, Inspection and Maintenance Requirements***

Here you will describe your procedure for the inspection and maintenance of instruments and sampling gear. You should also describe the record keeping associated with that procedure. For example, you should keep a maintenance log that documents all of your instrument inspection, maintenance, and calibration activities.

### ***Instrument Calibration and Frequency (chemical and physical parameters)***

Describe your procedures, including the use of standards, for calibrating your instruments. Identify where your standards will be obtained. Also describe how frequently your instruments will be calibrated, and the record keeping associated with instrument calibration. In general, the Model QAPP requires that electronic instruments used for conventional water quality analyses be calibrated daily.

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### ***Inspection/Acceptance Requirements***

This is where you can describe how your group inspects your instruments, sampling gear, and reagents upon receiving them from the manufacturer.

### ***Data Acquisition Requirements***

In this section you will identify the sources of analytical data that are not measured by your group. For example, you should identify the professional laboratory, or the procedure for selecting a laboratory, that will be analyzing samples that your monitors collect, including QC samples. Also identify the agency sources (e.g., United States Geologic Survey) of any maps, aerial photos, or other spatial information sources (e.g., GIS) that will be used by your group.

### ***Data Management***

Here you should describe your procedures for recording, checking and electronically entering your data. Field data sheets should be checked and signed by the monitoring leader. Your monitoring project manager should flag any invalid results where holding times have been exceeded, sample identification information is incorrect, samples were inappropriately handled, or calibration information is missing or inadequate. Flagged data should not be entered as final results in the electronic data management system. Independent laboratories should report their results to your monitoring project manager. Your monitoring project manager should verify sample identification information, review the chain-of-custody forms, and identify the data appropriately in the database. Your technical advisors should also review these data.

Your data management coordinator should review the field sheets and enter only the valid data deemed acceptable by the monitoring project manager and the technical advisors. By now you have assembled a considerable amount of documentation on the project QA/QC activities. To improve the efficiency in managing this information, enter your data into a Microsoft EXCEL spreadsheet, Microsoft Access database, or other comparable system, using a format that is compatible with STORET, and the SWRCB's or the Regional WQCB's database guidelines. Following initial entry, your data manager should review electronic data, comparing it to the original data sheets and correct entry errors that may occur. Section 3 of the QA Navigator also describes how to create an information management system that can be integrated with this element of the QAPP.

### ***Assessment and Response Actions***

The review of all field procedures and data is the responsibility of your monitoring project manager, with the assistance of the technical advisory committee. Monitors should be accompanied by the monitoring project manager or a technical advisor on at least one of their first five sampling trips. Within the first three months of your monitoring project you may request that the State Water Board Clean Water Team evaluate your field and laboratory procedures. If possible, monitors in need of performance improvement will be retrained on-site. All volunteers should also attend a refresher course offered by your group. If errors in sampling technique are consistently identified, retraining may be scheduled more frequently.

## Section 2: Quality Assurance Project Plans (QAPPs)

### ***Reports***

Describe how frequently, and to whom you will report your data. Also specify whether your reports will contain only raw data. Have the technical advisors review draft reports to ensure the accuracy of data analysis and data interpretation.

### ***Data Review, Validation and Verification***

Your data should be reviewed quarterly by your technical advisors to determine if the data meet your DQOs. They may identify outliers, spurious results, or omissions to your monitoring project manager. They may also evaluate compliance with the data quality objectives. They can suggest corrective action that should be implemented by your monitoring project manager. Problems with data quality and corrective action should be reported in final reports. You should wait until your technical advisors have approved the data before it is released in raw form or in any reports.

### ***Validation and Verification Methods***

Here you can describe how you check your data. You may refer to the quality control and data management procedures described above, and explain what actions will be taken to address any problems discovered.

Unusual results, or sample readings out of the expected range should be reported to the monitoring project manager. A second sample should be analyzed as soon as possible to verify the condition. If you find that the data are invalid, then the data should be noted (flagged) on the data sheet. You should then take further actions to trace the sources of error, and to correct those problems. If the error is a result of improper monitoring procedures, then you may re-train monitors until their performance is acceptable.

### ***Reconciliation with DQOs***

This is where you should describe the procedure for assuring that your data meet the DQOs. Your technical advisors and monitoring leaders should work together to accomplish this, preferably on a quarterly basis. A quorum should be established (for example, 1/2+1) and used for technical advisory committee decisions. If a quorum does not show up at the meeting, work can still proceed. The work product (e.g., review and comments on data or reports) must then be sent out to the whole technical advisory committee for approval with a 30-day review period. This approach will prevent delays and make for efficient and timely feedback to the monitors.

If data do not meet the DQOs the technical advisory committee may suggest corrective action (e.g., replacing instruments or reagents, altering procedures, re-training monitors). In some cases the QAPP may need amendments, including possible changes to your DQOs.