APPENDIX B

DEVELOPMENT AND REVIEW OF MONITORING AND MODELING PLAN

The permit writer is likely to require the permittee to develop a monitoring and modeling plan. This may be required during the application process prior to the development of the permit or as a permit condition. If, during the review of the plan, the permit writer determines the plan is lacking information or the scope of the plan is inappropriate, the permit writer should note the deficiencies and require the plan to be modified and resubmitted. Development of the monitoring and modeling plan may require an iterative approach to match data, informational needs, and available resources. The plan may need to change as more knowledge is gained about the CSS and CSOs through the early steps of data collection.

Exhibit B-1 outlines the major elements the monitoring and modeling plan should generally contain. The permit writer should consider requesting that the permittee submit the monitoring and modeling plan in a specific format so that critical information can be taken from the plan and incorporated into the permit as requirements, where appropriate. Extensive information on the development of a monitoring and modeling plan is contained in the *Combined Sewer Overflows—Guidance for Monitoring and Modeling* (EPA, 1995d).

The monitoring and modeling plan should balance the costs of monitoring and modeling against the information needed to characterize the combined sewer system (CSS), combined sewer overflows (CSOs), and the receiving water and to develop, implement, and verify the effectiveness of CSO controls. Since monitoring data and modeling results are important factors in making CSO control decisions, it is crucial that collected monitoring data accurately represent the conditions that exist throughout the CSS, CSOs, and the receiving water. Monitoring data are used as modeling inputs and for model calibration and verification, so accurate, representative monitoring data are also necessary if the permittee intends to perform modeling to assist in the selection of the most appropriate CSO controls. In some cases, a permittee may have a considerable amount of existing data from previous monitoring efforts and may only need to perform a limited amount of additional monitoring. The permit writer should remember these

Exhibit B-1. Outline of Major Monitoring Plan Elements

A. Identification of Monitoring and Modeling Goals and Objectives

1. Define the CSS's hydraulic response to rainfall
2. Determine CSO flows and pollutant concentrations/loadings
3. Evaluate the impacts of CSOs on receiving water quality
4. Provide data to support modeling
5. Support the review and revision (as appropriate) of water quality standards
6. Support implementation and documentation of the nine minimum controls (NMC)
7. Evaluate the effectiveness of the NMC
8. Evaluate and select CSO control alternatives through long-term control plan (LTCP) implementation
9. Evaluate the effectiveness of LTCP implementation
10. Achieve site-specific objectives

B. Review of Existing Data and Information

1. Summary of existing data and information
2. Determination of how existing data address goals and objectives
3. Identification of data needs

C. Development of Sampling Program to Address Data Needs

1. Duration of monitoring and modeling plan
2. Monitoring locations
3. Frequency of sampling and/or number of precipitation events to be sampled
4. Criteria for when the samples will be taken (e.g., greater than x days between precipitation events)
5. Sampling protocols (e.g., type of samples, chain of custody)
6. Analytical methodologies and detection limits
7. Flow measurement protocols
8. Pollutants or parameters to be analyzed and/or recorded
9. Sampling and safety equipment and personnel
10. Quality Assurance/Quality Control (QA/QC) procedures for sampling and analysis

D. Discussion of Methods for Data Management and Analysis

1. Data management
2. Statistical methods for data analysis
3. Modeling strategy, including model(s) selected
4. Use of data to support NMC implementation and LTCP development

E. Implementation Plan

1. Recordkeeping and reporting
2. Personnel responsible for implementation
3. Scheduling
4. Resources (funding, personnel, and equipment)
5. Health and safety issues

factors when reviewing any proposed monitoring and modeling plan. Although the permit writer should provide flexibility to allow for scheduling and budget constraints, he or she should not accept an inadequate monitoring and modeling plan.

A review team that has members knowledgeable in developing and implementing monitoring programs should be convened to review a proposed monitoring and modeling plan. If the proposed monitoring and modeling plan does not meet the established goals, the permit writer should raise these issues and work with the permittee to develop a monitoring and modeling plan that meets the established objectives. In addition, in some instances, the permit writer and/or the permittee may need to establish priorities to perform the most critical data collection first and schedule additional monitoring activities within a reasonable time period.

When reviewing a monitoring and modeling plan and developing monitoring requirements in the permit, the permit writer should consider sampling locations, pollutants to be monitored, frequencies, duration including periods of rainfall or other seasonal issues, sample types, and analytical methods, among other appropriate factors as listed in Exhibit B-1. These factors are described in the following discussion using examples. The specific sampling details are important because the permit writer may want to incorporate them into the permit:

- **Sampling Location**—Generally, the permittee will need to collect rainfall data, flow data, and pollutant data to define the CSS's hydraulic response to rainfall and determine CSO flows and pollutant loadings.

  - If sufficient existing rainfall data are not available, the permittee may need to install rain gages to collect the data. Rain gages should be located so that they provide data that are representative of the entire CSS drainage area.

  - To assess flow patterns and volume in the CSS, the permittee may need to select some sampling locations along various trunk lines of the collection system if flow data from existing monitors and at hydraulic controls (e.g., pump stations) are not sufficient. The permittee should also sample the portions of the collection system that are likely to receive significant pollutant loadings (e.g., areas where significant industrial users are located) to obtain flow and loading data.

  - When monitoring CSOs, if it is not feasible to monitor all CSOs, a defined percentage of the total outfalls in the system should be sampled. The specific number of outfalls to be monitored should be based on the size of the collection system, the total number of overflow locations, the number of different receiving water bodies, and potential and known impacts. If only selected locations are sampled, they should represent the system as a whole or represent the worst-case scenario. For example, if all CSOs are not monitored, selected locations could be chosen that represent overflows that occur most frequently, have the largest pollutant loading or flow volume, or discharge to sensitive areas.

  - For receiving water monitoring, the selection of appropriate locations depends on the characteristics of the receiving water (e.g., size of the water body, horizontal and vertical variability), the pollutants of concern, and the location of sensitive areas.

- **Pollutants**—CSSs need to be monitored for pollutants of concern, including pollutants with water quality criteria for the specific designated use(s) of the receiving water and pollutants key to the attainment of the designated use(s). The pollutants or classes of pollutants recommended for monitoring in most cases include biochemical oxygen demand or dissolved oxygen, total suspended solids, settleable solids, nutrients, toxic pollutants reasonably expected to be present, and bacteriological indicators. In some cases, specific pollutants should be measured; in other cases, surrogates of a pollutant class may be used. For example, heavy metals may be addressed by only monitoring copper, lead, and zinc because these are the metals most commonly found in CSOs. If water quality standards for mercury and arsenic are being exceeded, however, then they should be monitored. The selection of pollutants to be monitored should also be based on the characteristics of the nondomestic discharges to the collection system or watershed. Receiving water monitoring may include biological assessment and sediment monitoring in addition to the pollutants listed above.

- **Frequency of Monitoring**—Frequency of monitoring should reflect the type and amount of data needed to achieve the program goals. Monitoring programs may include:

  - Sampling a certain size precipitation event (e.g., 3-month, 24-hour storm)
  - Sampling all precipitation events that result in overflows
  - Sampling a certain number of precipitation events (i.e., monitor until five storms are collected of a certain minimum size)

  The precipitation events to be sampled should be separated by an adequate duration so that a sample of worst-case conditions is collected. The National Pollutant Discharge Elimination System (NPDES) Storm Water Program uses the criterion that the duration between the beginning of the precipitation event sampled and the end of the previous measurable precipitation event be at least 72 hours.

An assessment of the monitoring frequency should include consideration of the following criteria:

- **Relative risk of CSO impacts**. If facilities discharge to sensitive areas or high quality waters, more frequent monitoring may be warranted. For example, the monitoring frequency should increase in an area where human contact occurs through swimming, boating, and other recreational activities.
- **Variability of discharge**. CSOs with variable flows should be monitored more frequently than CSOs with relatively consistent flows.

For receiving water characterization, the monitoring plan should target seasons, flow regimes, and other critical environmental conditions.

- **Duration of Monitoring Program**—The duration of the monitoring program is generally based on sampling a number of storm events adequate to provide the data needed to either calibrate and validate the CSS hydraulic model, or to provide sufficient data to evaluate CSO control alternatives where a model is not used. During that period (which generally may be a season or several months), storms of varying intensity, antecedent dry days, and total volume should be monitored to represent the range of conditions experienced by the CSS. The duration should be sufficient to sample enough storm events to readily estimate means and variations of pollutant concentrations in CSOs. The sampling period for flow and occurrence monitoring may extend for the duration of the permit; the sampling period for instream monitoring or other special studies may be relatively short. When feasible, permit writers should coordinate monitoring requirements if the data will be used for the same purpose (e.g., calculation of a wasteload allocation).

- **Sample Type**—The sample type may be composite or grab, depending on site-specific conditions and the intended use of the data. To determine average loadings of pollutants to the receiving stream, it may be most appropriate to collect flow-weighted composites. Because CSOs may be intermittent and the volume dependent upon precipitation events, however, it may not be appropriate to collect 24-hour composite samples, which are used for continuous nondomestic and municipal wastewater discharges. Instead it may be more appropriate to collect a composite over the duration of the entire discharge. It is critical that the permittee use sample types that will adequately characterize CSOs. However, the permit writer should be aware that the composite samples are more resource intensive than grab samples. Grab samples may be appropriate if only approximate levels of pollutants are needed or if the most important concern is the impact of worst-case conditions (i.e., first 15 or 30 minutes of overflow). In addition, grab samples should be collected for pollutant parameters not amendable to compositing (e.g., pH, bacteria).

- **Analytical Methods**—Analytical methods should be selected pursuant to 40 CFR Part 136, which references one or more of the following:

  - Test methods in Appendix A to 40 CFR Part 136 (i.e., *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*).
  - *Standard Methods for the Analysis of Water and Wastewater* (most current EPA-approved edition)
  - *Methods for the Chemical Analysis of Water and Wastes*

  The analytical methods contained in Part 136 are test methods designed only for specified pollutants or parameters. For other parameters, it may be necessary for the permit writer to specify the analytical methods required on a case-by-case basis. For example, Part 136 does not contain biomonitoring test procedures; therefore, the permit writer will need to specify the methods. EPA has published recommended biomonitoring test protocols.

In reviewing these elements of the monitoring and modeling plan, as well as the other elements listed in Exhibit B-1, the permit writer should consider the amount of existing data the permittee has collected. A permittee with a substantial set of existing data may not need to conduct additional monitoring for all the conditions addressed above.

The permit writer should also determine whether models or data analysis methodologies specified in the monitoring and modeling plan are appropriate for the CSS and the type of data being collected. If the monitoring and modeling objectives include informational needs, modeling, or statistical, graphical, or other data analyses, techniques should be specified so reliable and consistent information is obtained. This will ensure that data collection efforts meet the needs of the analytical methods. Review by the appropriate members of the review team (i.e., statisticians or other experts in monitoring and modeling plan development and implementation) will ensure that the proposed data collection and analytical methodologies will meet the stated objectives of the monitoring and modeling plan.

Each plan will need to be evaluated on a case-by-case basis. The permit writer may enlist the EPA permitting and/or monitoring staff in reviewing the monitoring and modeling plans submitted by the permittee. If the review team determines that the proposed plan is

inadequate, then the permit writer should work with the permittee to address deficiencies in the plan.