CHAPTER 3

INITIAL SYSTEM CHARACTERIZATION - EXISTING DATA ANALYSIS AND FIELD INVESTIGATION

As explained in Chapter 2, the development of a long-term control plan (LTCP) requires a thorough characterization of the combined sewer system (CSS). Accurate information on CSS design, CSS responses to wet weather, pollutant characteristics of CSOs, and biological and chemical characteristics of receiving waters is critical in identifying CSO impacts and the projected efficacy of proposed CSO controls. Before in-depth monitoring and modeling efforts begin, however, the permittee should assemble as much information as possible from existing data sources and preliminary field investigations. Such preliminary activities will contribute to a baseline characterization of the CSS and its receiving waters and help focus the monitoring and modeling plan.

The primary objectives of the existing data analysis and field investigation are:

- To determine the current level of understanding and knowledge of the CSS and receiving water
- To assess the design and current operating condition of the CSS
- To identify any known CSO impacts on receiving waters
- To identify the data that still need to be collected through the monitoring and modeling program
- To assist in implementation and documentation of the nine minimum controls (NMC).

The activities required to meet these objectives will vary widely from system to system. Many permittees have already made significant progress in conducting initial system characterizations. Implementation of the NMC, which was expected by January, 1997, should have enabled permittees to compile a substantial amount of information on their CSSs. In addition,

studies by EPA, State agencies, or other organizations may provide substantial information and data for the receiving water characterization.

This chapter describes the following activities in the initial system characterization:

- ***Physical Characterization of CSS-*** identification and description of all functional elements of the CSS and sources discharging into the CSS, delineation of the CSS drainage areas, analysis of rainfall data throughout the drainage area, identification of all CSO outfalls, and preliminary CSS hydraulic analyses.
- ***Characterization of Combined Sewage and CSOs-*** analysis of existing data to determine volume and pollutant characteristics of CSOs.
- ***Characterization of Receiving Waters-*** identification of the designated uses and current status of the receiving waters affected by CSOs, water quality assessment of those receiving waters, and identification of biological receptors potentially impacted by CSOs.

The permittee should consult with the NPDES permitting authority and the review team (see Section 2.6) when reviewing the results from the initial system characterization and in preparation for developing the monitoring and modeling plan (Chapter 4). Performing and documenting initial characterization activities may help satisfy certain requirements for NMC implementation and documentation. Thus, it is essential that the permittee coordinate with the NPDES permitting authority on an ongoing basis throughout the initial characterization process.

3.1 PHYSICAL CHARACTERIZATION OF CSS

3.1.1 Review Historical Information

For the first part of the physical characterization, the permittee should compile, catalogue, and review existing information on the design and construction of the CSS to evaluate how the CSS operates, particularly in response to wet weather events. The permittee should compile, for the entire CSS, information on the contributing drainage areas, the location and capacity of the POTW and interceptor network, the location and operation of flow regulating structures, the location of all known or suspected CSO outfalls, and the general hydraulic characteristics of the system (including

existing flow data for both wet weather and dry weather). Historical information is often available from the following sources:

- ***Sewer Maps of Suitable Scale-*** Sewer maps define the pipe network of the sewer system and may indicate the drainage areas that contribute to each CSO outfall. Ideally, they should include the combined, separate sanitary, and separate storm sewer systems, manhole locations for monitoring access, catch basin locations, and pipe shapes and materials. Sewer maps may also show curb/surface drainage, roof connections, pipe age, and ongoing roadway construction projects and their influence on storm flow. Many cities have also used Geographic Information Systems (GIS) to develop maps of their sewer systems. Data provided from these maps, such as the invert elevations, can be used to calculate individual pipe capacities and to develop detailed hydraulic models. Sewer maps should be field checked because field conditions may differ significantly from the plans (see System Field Investigations, Section 3.1.3).

- ***Topographic Maps-*** The U.S. Geological Survey (USGS) provides topographic maps, usually with lo-foot contour intervals. The local municipality or planning agency may have prepared topographic maps with finer contour intervals, which may be more useful in identifying drainage areas contributing to CSOs.

- ***Aerial Photograph-When*** overlaid with sewer maps and topographic maps, aerial photos may aid in identifying land uses in the drainage areas. Local planning agencies, past land use studies, or State Departments of Transportation may have aerial photographs suitable for the initial characterization.

- ***Diversion Structure Drawings-*** Drawings of CSS structures, in plan and section view, indicate how the structures operate, how they should be monitored, and how they could be altered to facilitate monitoring or improve flow control.

- ***Rainfall Data-*** Rainfall data are one of the most important and useful types of data collected during the initial system characterization. Reliable rainfall data are necessary to understand the hydraulic response of the CSS and, where applicable, to model this response. Sources of data may include long-term precipitation data collected from a weather station within or outside the CSS drainage basin, or short-term, site-specific precipitation data from stations within the drainage basin or sub-basins. Wastewater treatment plants may also collect their own rainfall data or maintain records of rainfall data from a local weather station.

  Long-term rainfall data collected within the drainage basin provide the best record of precipitation within the system and hence have the greatest value in correlating historic overflow events with precipitation events and in predicting the likelihood of wet weather events of varying intensities. If such data are not available, however, both long-term regional and short-term local data may be used. For calibration and validation of

hydraulic models (see Section 7.4), it is important to use rainfall data collected from within or in very close proximity to the drainage area.

National rainfall data are available from the National Weather Service, which operates thousands of weather monitoring stations throughout the country. Rainfall data for some areas are available on the Internet (the National Weather Service home page can be found at http://www.nws.noaa.gov/). The local municipality, airports, universities, or other State or Federal facilities can also provide rainfall data. The National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center (NCDC), Climate Services Branch is responsible for collecting precipitation data. Data on hourly, daily, and monthly precipitation for each monitoring station (with latitude and longitude) can be obtained on computer diskette, microfiche, or hard copy by calling (704) 259-0682, or by writing to NCDC, Climate Services Branch, The Federal Building, Asheville, NC 28071-2733. Some NCDC data are also available on the Internet (NCDC's home page can be found at http://www.ncdc.noaa.gov/). The NCDC also provides a computer program called SYNOP for data analysis.

Additionally, permittees with few or no rain gages located within the system drainage basin may want to install one or more gages early in the CSO control planning process. Collection and analysis of rainfall data are discussed in Chapters 4 and 5.

Other Sources of Data

A variety of other historical data sources may be used in completing the physical characterization of a CSS. As-built plans and documentation of system modifications can provide reliable information on structure location and dimensions. Similarly, any recent surveys and studies conducted on the system can verify or enhance sewer map information. Additional information may also be available from:

- GIS databases
- Treatment plant upgrade reports
- CSS flow records (for both dry weather and wet weather)
- Treatment plant and pump station flow and performance records
- Design specifications
- Infiltration/inflow (I/I) studies
- Sewer system evaluation surveys (SSES)
- Storm water master plans

- Storm water utility records and reports
- Section 208 areawide waste treatment plans
- Section 201 facility plans
- Local property taxation records
- Federal and State highway maps and plans
- County/city planning and zoning agencies.

The availability of these sources of information varies widely among permittees. Collection system operation and maintenance personnel can be invaluable in determining the existence and location of such data, as well as providing system knowledge and insight.

3.1.2 Study Area Mapping

Using the historical data, the permittee should develop a map of the CSS, including the drainage basin of combined sewer areas and separate storm sewer areas. Larger systems will find it useful to map sub-basins for each regulating structure and CSO. This map will be used for analyzing system flow directions and interconnections, analyzing land use and runoff parameters, locating monitoring networks, and developing model inputs. The map can also be a valuable planning tool in identifying areas of special concern in the CSS and planning further investigative efforts and logistics. The map should be modified as necessary to reflect additional CSS and receiving water information (such as the locations of other point source discharges to the receiving water, the location of sensitive areas, and planned or existing monitoring locations), when these become available.

The completed map should include the following information:

- Delineation of contributing CSS drainage areas (including topography)
- General land uses (e.g., residential, commercial, industrial) and degree of imperviousness
- POTW and interceptor network

- Trunk sewer and interceptor sewer locations and sizes
- Diversion structures (e.g., gates, weirs)
- CSO outfalls (including the presence of backflow gates)
- Access points (e.g., manholes safely accessible considering traffic and pipe depth; flat, open areas accessible for sampling)
- Pump stations
- River crossings
- Rain gages
- Existing monitoring locations (CSS, CSO, storm water, other point and nonpoint sources, and receiving water)
- USGS gage stations
- Receiving water bodies
- Soil types
- Ground water flow
- Outlying separate sanitary sewer areas draining to the CSS (where applicable)
- Other point source discharges such as industrial discharges and separate storm water system discharges
- Existing industrial and municipal treatment facilities
- Existing non-domestic discharges to the CSS.

It may be useful to generate two or more maps with different scales, such as a coarse-scale map (e.g., 7.5-minute USGS map) for land uses and other watershed scale information and a finer-scale map (e.g., 1” = 200’ or 1” = 400’) for sewer system details. In some cases, a Computer Aided Design (CAD) or GIS approach can be used. Some advanced sewer models can draw information directly from CAD tiles, eliminating the duplication of entering data into the model. A

municipality's planning department may be a useful source for the hardware, software, and data needed for such mapping efforts.

3.1.3 System Field Investigation

Before developing a monitoring and modeling program, the permittee should supplement historical CSS information with field observations of the system to verify findings or fill data gaps. For example, visual inspection of regulator chambers and overflow structures during dry and wet weather verifies information included in drawings and provides data on current conditions. Further, it is necessary to verify that gates or flow diversion structures operate correctly so that ensuing monitoring programs collect information representative of the expected behavior of the system. Field inspections should address all areas of the CSS, including the pipe network, flow diversion structures, CSO outfalls, pump stations, manholes, and catch basins.

In general, field inspection activities may be used to:

- Verify the design and as-built drawings
- Locate and clarify portions of the system not shown on as-built drawings
- Identify dry weather overflows and possible causes of the overflows (e.g., diversion structures set too low)
- Identify locations of CSO outfalls (and whether they are submerged)
- Identify non-standard engineering or construction practices (e.g., irregularly-designed regulators, use of atypical materials)
- Examine the general conditions and operability of flow regulating equipment (e.g., weirs, gates)
- Identify areas in need of maintenance, repair, or replacement
- Identify areas that are curbed, areas where roof downspouts are directly connected to the CSS, and impervious areas.

Although generally beyond the scope of a small system characterization effort, in-line TV cameras can be used to survey the system, locate connections, and identify needed repairs. WPCF (1989) describes in-line inspection methods in detail and provides additional useful information for system evaluations.

The field investigation may also involve preliminary collection of both dry weather and wet weather flow and depth data, which can support the CSS flow monitoring and modeling activities later in the CSO control planning process. Preliminary CSS flow and depth estimates can begin to answer the following questions:

- How much rain causes an overflow at each outfall?
- How many dry weather overflows occur? How frequently and at which outfall(s)? How much flow is being discharged during dry weather?
- Do surcharging or backwater effects occur in intercepting devices or flow diversion structures?
- How deep are the maximum flows at the flow diversion structures? Would alteration of a diversion structure affect whether a CSO occurs?

A variety of simple flow measurement techniques can help answer these questions prior to development and implementation of a monitoring and modeling plan. These include:

- ***Chalk Board-*** A chalk board is a simple depth-measuring device, generally placed in a manhole. It is a vertical board with a vertical chalk line drawn on it. Sewer flow passing by the board washes away a portion of the chalk line, roughly indicating the maximum flow depth that occurred since the board was placed in the sewer.
- ***Chalk Spraying-*** A sprayer is used to blow chalk into a CSO structure. Passing sewer flow washes away the chalk, indicating approximate flow depth since spraying.
- ***Bottle Boards-A*** bottle board is a vertical board with a series of attached open bottles. As flow rises the bottles with openings below the maximum flow are filled. When the flow recedes the bottles remain full indicating the height of maximum flow (see Exhibit 5-6).

- ***Block*** Tests-Block tests do not measure depth, but are used to detect the presence of an overflow. A block of wood or other float is placed atop the overflow weir. If an overflow occurs, it is washed off the weir indicating that the event took place. The block can be tethered to the weir for retrieval.

These simple flow measurement techniques could be a useful component of the NMC for monitoring to characterize CSO impacts and the efficacy of CSO controls. The permittee should discuss this with the permitting authority. In some limited cases, automated continuous flow monitoring may be used. These techniques and other CSS monitoring techniques are discussed in Chapter 5.

3.1.4 Preliminary CSS Hydraulic Analysis

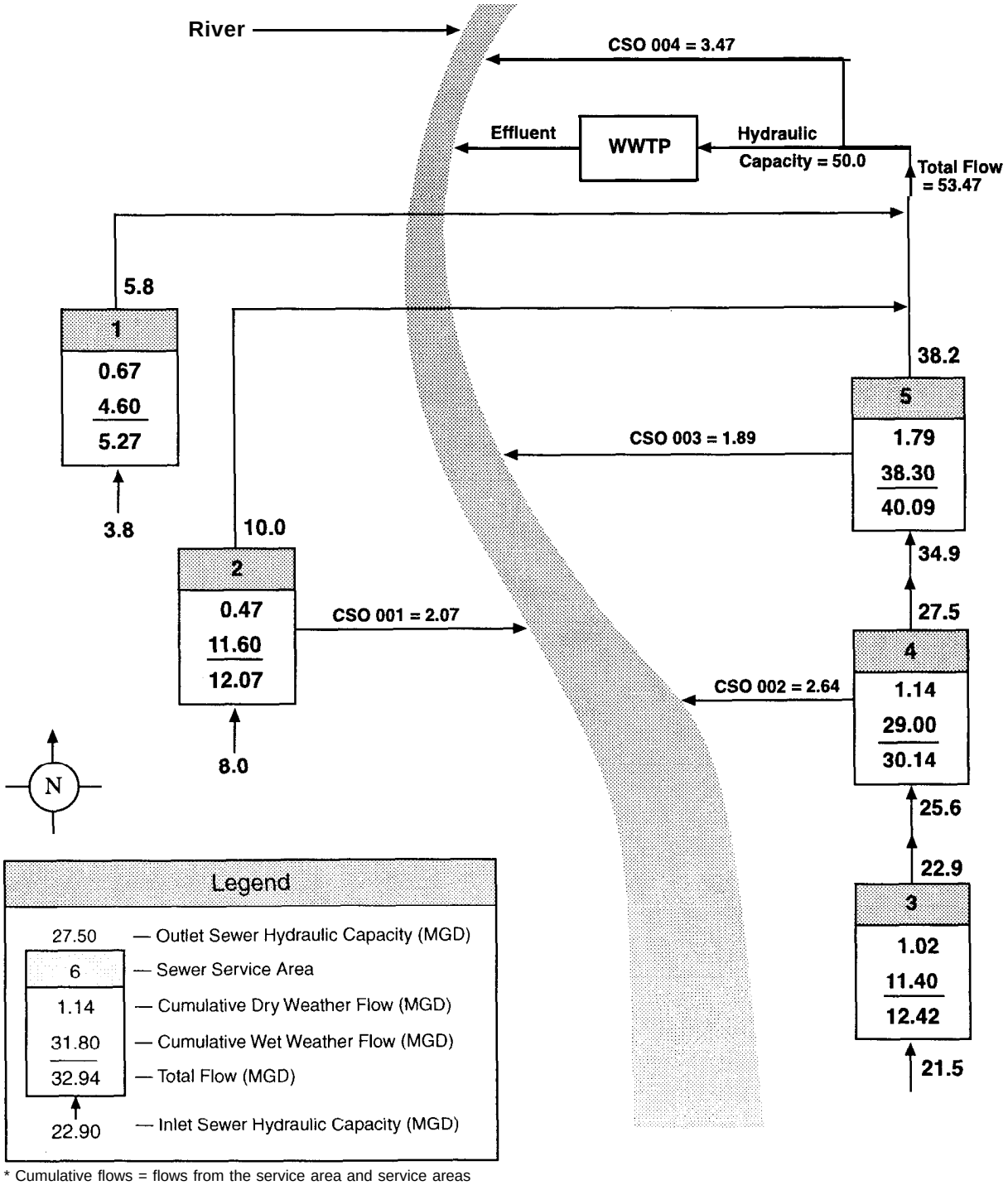
The physical characterization of the CSS should include a flow balance, using a schematic diagram of the collection system. Exhibit 3-1 provides an example of a basic flow balance diagram. It shows expected wet weather and dry weather flows through each service area, and the likely flows at each CSO based on sewer hydraulic capacities. The diagram can be expanded to include additional detail, such as breaking down the cumulative flows at each regulator to show schematically where the flows are entering the system. This can sometimes reveal local bottlenecks that may be resolved by relocating the connection to a downstream portion of the system where there is greater capacity.

The following steps can be used to develop a flow balance diagram or conduct a similar flow analysis:

- Section the collection system into a series of basins of small enough area to characterize the major collection system elements, differing land uses, receiving streams, and other characteristics that may become important during the development of a monitoring and modeling plan. These basins will likely be refined as work progresses.

- Establish the hydraulic capacity of each element of the system. For a preliminary analysis, this can be done using the unsurcharged capacity of the system, based on pipe size and slope, pump station capacity, and a knowledge of bottlenecks in the system.

Exhibit 3-1. Basic Flow Balance Diagram



* Cumulative flows = flows from the service area and service areas upstream in the collection system. Wet weather flow values are for the average of several sampled storm events.

- For each basin, develop a dry weather estimate of flow delivered to the system. This can be done in a preliminary way by using total dry weather flow to the treatment plant, disaggregated to each basin using population. Care should be taken where significant differences in infiltration are suspected.

- For each basin, develop an estimate of wet weather inflow and wet weather-induced infiltration. This estimate should be based on a consistent storm or return frequency in each basin. (Flow monitoring in the CSS, including rainfall and runoff assessment, is discussed in Chapter 5.)

- Display these data in a manner that aids data analysis, such as in a flow balance diagram (Exhibit 3-1).

The schematic diagram, together with the historical data review and supplemental field study, should enable the permittee to assign typical flows and maximum capacities to various interceptors for non-surcharged flow conditions. Flow capacities can be approximated from sewer maps or calculated from invert elevations. The resulting values provide a preliminary estimate of system flows at peak capacity. Calculations of flow within intercepting devices or flow diversion structures and flow records from the treatment plant help in locating sections of the CSS that limit the overall hydraulic capacity.

The preliminary hydraulic analysis, together with other physical characterization activities, will be useful in designing the CSS monitoring program and identifying areas that should receive greater attention in developing the monitoring and modeling plan. This preliminary analysis can help in identifying likely CSOs, the magnitude of rainfall that causes CSOs, estimated CSO volumes, and potential control points. A hydraulic model may be useful in conducting the analysis.

3.2 CHARACTERIZATION OF COMBINED SEWAGE AND CSOS

3.2.1 Historical Data Review

As part of the initial system characterization, the permittee should review existing data to determine the pollutant characteristics of combined sewage during both dry and wet weather conditions, and, if possible, CSO pollutant loadings to the receiving water. The purpose of this effort is to identify pollutants of concern in CSOs, their concentrations, and where possible, likely sources

of such pollutants. Together, these assessments will support decisions on what pollutants should be monitored and where. This is discussed in detail in Chapter 4.

The POTW's records can provide influent pollutant and flow data for both dry weather and wet weather conditions. Such data can be analyzed to answer questions like:

- How do the influent volume, loads, and concentrations at the plant change during wet weather?
- What is the average concentration of parameters such as solids, BOD, and metals at the plant during wet weather flow?
- Which pollutants are discharged by industrial users, particularly significant industrial users?

For example, data analysis could include plotting a plant inflow time series by storm(s) and comparing it to a rainfall time series plot for the same storm(s). In some cases, the permittee may also be able to use POTW data to identify which portions of the CSS are contributing significant pollutant loadings.

Potential sources of information for this analysis include:

- General treatment plant operating data
- POTW discharge monitoring reports (DMRs)
- Treatment plant optimization studies
- Special studies done as part of an NPDES permit application
- Pretreatment program data
- Collection system data gathered during NMC implementation
- Existing wet weather CSS sampling and analyses
- Facilities plans and designs.

The permittee can potentially use national or regional storm water data (e.g., Nationwide Urban Runoff Program (NURP) data[1]) (US. EPA, 1983a) to supplement its available data, although more recent localized data are preferred. If approximate CSS flow volumes are known, approximate CSS pollutant loads can be estimated using POTW data, CSS flow volume, and assumed storm water concentration values. However, assumed constant or event mean concentration values for storm water concentrations, such as NURP data, should be used with some reservation for CSOs since concentrations vary during a storm and from storm to storm.

In order to obtain recent and reliable characterization data, the permittee may need to conduct limited sampling at locations within the CSS as well as at selected CSO outfalls as part of the initial system characterization. Since this limited sampling is usually less cost-effective than sampling done as part of the overall monitoring program, the permittee should fully evaluate the need for such data as part of the initial characterization. Chapter 5 provides details on CSS monitoring procedures.

3.2.2 Mapping

The permittee should plot existing pollutant characterization data on the study map for points within the CSS as well as for CSO outfalls. This will highlight areas where no data exist and areas with high concentrations of pollutants.

3.3 CHARACTERIZATION OF RECEIVING WATERS

3.3.1 Historical Data Review

The third part of the initial system characterization is to establish the status of each receiving water body impacted by CSOs. Using existing data and information and working with the NPDES and water quality standards (WQS) authorities, the permittee should attempt to answer the following types of questions:

[1] Some NURP data may no longer be useful due to changed conditions (e.g., lead data might not apply since control programs have been in place for many years). The permittee should contact the permitting authority to determine the applicability of NURP data.

- Does the receiving water body contain sensitive areas (as defined by the CSO Control Policy)?
- What are the applicable WQS? Is the receiving water body currently attaining WQS, including designated uses?
- Are there particular problems in the receiving water body attributable wholly or in part to CSOs?
- What are the hydraulic characteristics of the receiving water body (e.g., average flow, tidal characteristics, instream flow regulations for dams and withdrawals)?
- What other dry and wet weather sources of pollutants in the watershed are discharging to the receiving water body? What quantity of pollutants is being discharged by these sources?
- What is the receiving water quality upstream of the CSO outfalls?
- What are the ecologic and aesthetic conditions of the receiving water body?

The following types of receiving water data will help answer these questions:

- Applicable State WQS
- USGS and other flow data (including tide charts)
- Physiographic and bathymetric data
- Water quality data
- Sediment data
- Fisheries data
- Biomonitoring results
- Ecologic data (habitat, species diversity)
- Operational data (hydropower records).

The permittee may already have collected receiving water data as part of other programs or studies. For example, the NPDES permit may require sampling upstream and downstream of the treatment plant outfall or the permittee may have performed special receiving water studies as part of its NPDES permit reissuance process. Receiving water data may also be obtained through

consultation with the NPDES permitting authority, EPA Regional staff, State WQS personnel, and State watershed personnel. The CWA requires States to generate and maintain data on certain water bodies within their jurisdictions.

The following reports may provide information useful for characterizing a receiving water body:

- ***State 303(d) Lists-*** Under CWA section 303(d), States and authorized Tribes identify, and establish total maximum daily loads (TMDLs) for, all waters that do not meet WQS even after implementation of technology-based effluent limitations and any more stringent effluent limitations or other pollution control requirements.[2]

- ***State 304(l) Lists-*** CWA section 304(l) required States to identify surface waters adversely affected by toxic and conventional pollutants from point and non-point sources, with priority given to waters adversely affected by point sources of toxic pollutants.[3] This one-time effort was completed in 1990. EPA recommends that the permittee discuss with the permitting authority data on toxic "hot spots" identified under this requirement.

- ***State 305(b) Reports-*** Under CWA section 305(b), States must submit a water quality assessment report to EPA every two years.

- ***Section 319 State Assessment Reports-*** Under CWA section 319, States were required to identify surface waters adversely affected by nonpoint sources of pollution, in a one-time effort following enactment of the 1987 CWA Amendments.

Generally, permittees may retrieve this information at EPA or State offices, EPA's Storage and Retrieval of U.S. Waterways Parametric Data (STORET) system, EPA's Water Quality System resident within STORET, or EPA's Water Body System (WBS). Since these data bases might not include the particular water bodies being evaluated, the permittee should contact State officials prior to seeking the data.

[2] EPA recommends that the permittee discuss with the permitting authority the status of existing TMDL reports and the schedule for doing new TMDLs for the CSO-impacted receiving water bodies.

[3] These lists are not complete for some locations, so the lists should be discussed with State WQS staff before they are used extensively.

In addition, studies conducted under enforcement actions, new permitting actions, and special programs and initiatives may provide relevant data on receiving water flow, quality, and uses. BASINS (Better Assessment Science Integrating Point and Nonpoint Sources) contains water quality monitoring data and data on point sources and land use (US. EPA, 1997a). EPA's EMAP (Environmental Monitoring and Assessment Program) contains data on a limited number of receiving waters and the EMAP Internet site (http://www.epa.gov/emap/) provides links to other sources of environmental data (including STORET). EPA and State personnel may have information on studies conducted by other Federal organizations, such as the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, USGS, and the National Biological Service, and other organizations such as The Nature Conservancy and formalized volunteer groups. For example, USGS's National Water-Quality Assessment (NAWQA) Program contains water quality information on 60 U.S. river basins and aquifers.[4] The permittee may save considerable time and expense by consulting directly with these entities during the initial system characterization.

The receiving water characterization should also include an evaluation of whether CSOs discharge to sensitive areas, which are a high priority under the CSO Control Policy.[5] The LTCP should prohibit new or significantly increased overflows to sensitive areas and eliminate or relocate such overflows wherever physically possible and economically achievable. (This is discussed in more detail in *Combined Sewer Overflows - Guidance for Long-Term Control Plan,* U.S. EPA, 1995a). The permittee should work with the NPDES permitting authority, the U.S. Fish and Wildlife Service, and relevant State agencies to determine whether particular receiving water segments may be considered sensitive under the CSO Control Policy.

In addition to reviewing existing data, the permittee may wish to conduct an observational study of the receiving water body, noting differences in depth or width, tributaries, circulation (for

[4] Information on the NAWQA program is available from USGS (703-648-5716) and the USGS Internet site (http://wwwrvares.er.usgs.gov/nawqa/).

[5] Sensitive areas, as discussed in the CSO Policy, are defined by the NPDES authority but include Outstanding National Resource Waters, National Marine Sanctuaries, waters with threatened or endangered species and their habitat, waters with primary contact recreation, public drinking water intakes or their designated protection areas, and shellfish beds.

estuaries), point sources, suspected nonpoint sources, plant growth, riparian zones, and other noticeable features. This information can be used later to define segments for a receiving water model.

To supplement the observational study, the permittee may consider limited chemical or biological sampling of the receiving water. Biocriteria or indices may be used in States such as Ohio that have systems in place. Biocriteria describe the biological integrity of aquatic communities in unimpaired waters for a particular designated aquatic life use. Biocriteria can be numerical values or narrative conditions and serve as a reference point since biological communities in the unimpaired waters represent the best attainable conditions (U.S. EPA, 1991 a). A limitation of biocriteria is that they normally do not take into account wet weather conditions unique to urban streams, such as runoff from highly impervious areas.

3.3.2 Mapping

The permittee should plot existing receiving water characterization data on the study map. This will permit visual identification of areas for which no data exist, potential areas of concern, and potential monitoring locations. GIS mapping can be used as an aid in this process. In addition to the elements listed in Section 3.1.2 and 3.2.2, the map could include the following:

- WQS classifications for receiving waters at discharge locations and for upstream and downstream reaches, and an indication of whether receiving waters are tidal or non-tidal
- Location of sensitive areas such as downstream beaches, other public access areas, drinking water intakes, endangered species habitats, sensitive biological populations or habitats, and shellfishing areas
- Locations of structures, such as weirs and dams, that can affect pollutant concentrations in the receiving water
- Locations of access points, such as bridges, dams, and existing monitoring stations (such as USGS stations), that make convenient sampling sites.

3.4 IDENTIFY DATA GAPS

The final task in the initial system characterization is to identify gaps in information that is essential to a basic understanding of the CSS's response to rain events and the impact of CSOs on the receiving water. The following questions may help to identify data gaps that need to be addressed in the monitoring and modeling plan:

Physical Characterization of CSS

- Have all CSO outfalls been identified? (Has the permittee taken all reasonable steps to identify outfalls-e.g., reviewing maps, conducting inspections, looking at citizen complaints?)
- Are the drainage sub-areas delineated for each CSO outfall?
- Is sufficient information on the location, size, and characteristics of the sewers available to support more complex analysis, including hydraulic modeling (as needed)?
- Is sufficient information on the location, operation, and condition of regulating structures available to construct at least a basic hydraulic simulation? (Even if a hydraulic computer model is not used, this level of knowledge is critical to understanding how the system works and for implementing the NMC.)
- Are the minimum amount of rainfall and minimum rainfall intensity that cause CSOs at various outfalls known?
- Are the areas of chronic surcharging in the CSS known?
- Have potential monitoring locations in the CSS been identified?
- Are there differences between POTW wet weather and dry weather operations? If so, are these clearly understood? (Improved wet weather operation can increase capture of CSS flows significantly.)

Characterization of Combined Sewage and CSOs

- Are the flow and pollutant concentrations of CSOs for a range of storm conditions known?
- Are the sources of CSS pollutants known?

- Is sufficient information available on pollutant loadings from CSOs and other sources to support an evaluation of long-term CSO control alternatives?

Characterization of Receiving Waters

- Are the hydraulic characteristics of receiving waters known, such as the average/ maximum/minimum (7Q10) flow of rivers and streams or the freshwater component, circulation patterns, and mixing characteristics of estuaries?

- Are locations of sensitive areas and designated uses identified on a study map?

- Have existing monitoring locations in the receiving water been identified? Have potential monitoring locations (e.g., safe, accessible points) in the receiving water been identified for areas of concern and areas where no data exist?

- Are sufficient data available to assess existing water quality problems and the potential for future water quality problems, including information on:

  - Streambank erosion
  - Sediment accumulation
  - Dissolved oxygen levels
  - Bacterial problems, such as those leading to beach closures
  - Toxicity (metals)
  - Nuisance algal or aquatic plant growths
  - Damage to a fishery (e.g., shellfish beds)
  - Damage to a biological community (e.g., benthic organisms)
  - Floatables or other aesthetic concerns?

- Is sufficient information available on natural background conditions that may preclude the attainment of WQS? (For example, a stream segment with a high natural organic load may have a naturally low dissolved oxygen level.)

- Is sufficient information available on other pollutant sources (e.g., agricultural sources, other nonpoint sources, and municipal and industrial point sources, including those upstream) that may preclude the attainment of WQS?

The answers to these types of questions will support the development of goals and objectives for the monitoring plan, as described in Chapter 4.