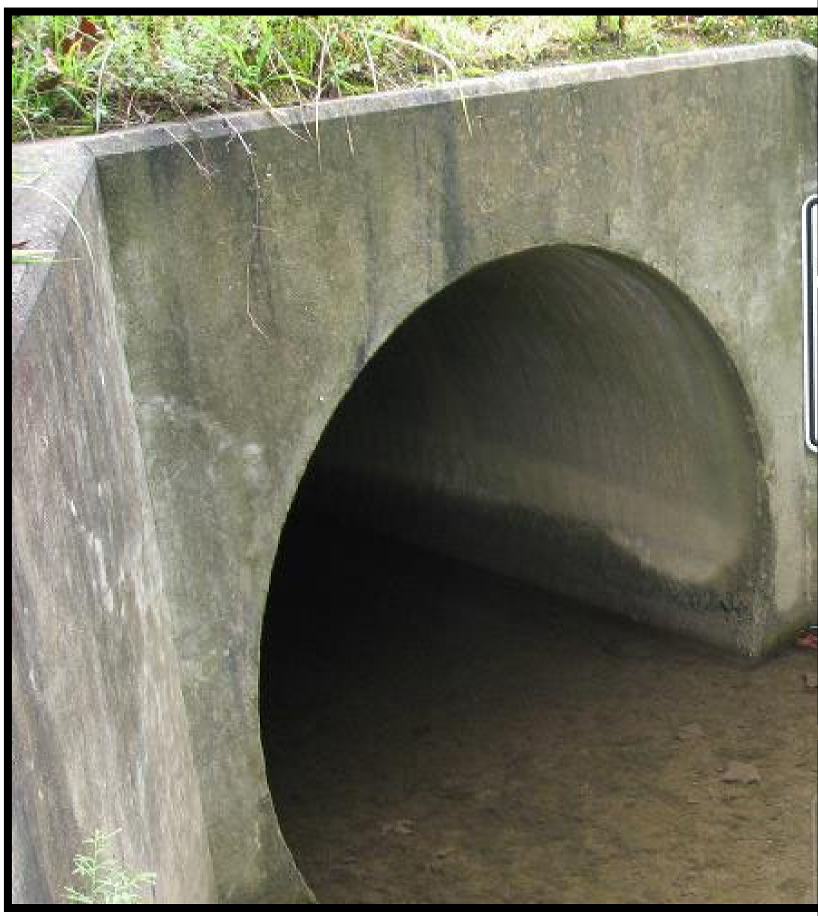
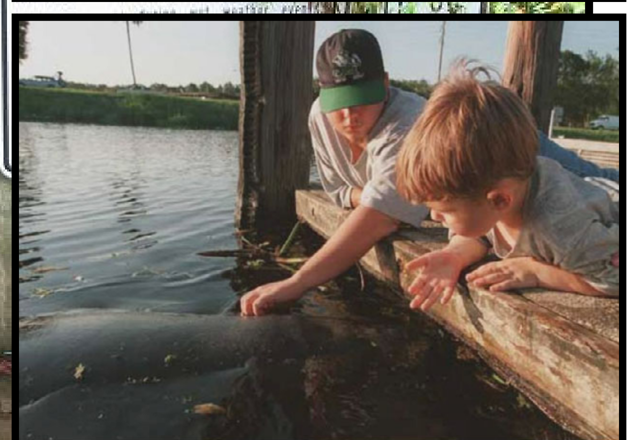
United States
Environmental Protection
Agency

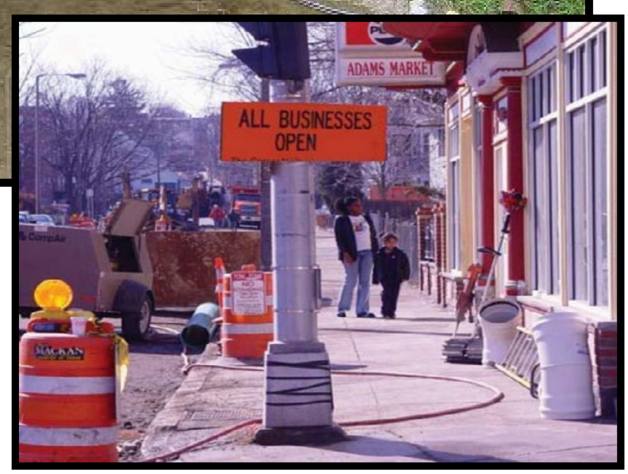
Office of Water (4203)
Washington, DC 20460
www.epa.gov/npdes/cso

EPA-833-R-07-005
May 2007

# The Long-Term Control Plan-EZ (LTCP-EZ) Template:
## A Planning Tool for CSO Control in Small Communities





# Table of Contents

## LIST OF ACRONYMS

AF – Annualization Factor

BOD – Biochemical Oxygen Demand

CPH – Costs per Household

CPI – Consumer Price Index

CSO – Combined Sewer Overflow

CSS – Combined Sewer System

DO – Dissolved Oxygen

DMR – Discharge Monitoring Report

DWF – Dry Weather Flow

EPA – Environmental Protection Agency

FWS – Fish and Wildlife Service

I/I – Inflow/Infiltration

IR – Interest Rate

LTCP – Long-term Control Plan

MG – Million Gallons

MGD – Million Gallons per Day

MHI – Median Household Income

NOAA – National Oceanic and Atmospheric Administration

NMC – Nine Minimum Controls

NMFS – National Marine Fisheries Service

NPDES – National Pollutant Discharge Elimination System

POTW – Publicly Owned Treatment Works

TMDL – Total Maximum Daily Load

TSS – Total Suspended Solids

WQS – Water Quality Standards

WWT – Wastewater Treatment

WWTP – Wastewater Treatment Plant

# BACKGROUND

## What is the LTCP-EZ Template and what is its Purpose?

The combined sewer overflow (CSO) Long-Term Control Plan (LTCP) Template for Small Communities (termed the "LTCP-EZ Template") is a planning tool for small communities that have requirements to develop a LTCP to address CSOs. The LTCP-EZ Template provides a framework for organization and completion of a LTCP that builds upon existing controls and leads to the elimination or control of CSOs in accordance with the federal Clean Water Act. Use of the LTCP-EZ Template and completion of the forms and schedules associated with the LTCP-EZ Template can produce a Draft LTCP.

The LTCP-EZ Template consists of FORM LTCP-EZ and related schedules and instructions. It provides a starting place and a framework for small communities for organization and analysis of basic information that is central to effective CSO control planning. Specifically, FORM LTCP-EZ and Schedules 1 – NINE MINIMUM CONTROLS, 2 – MAP, and 3 – PUBLIC PARTICIPATION allow organization of some of the basic information required to comply with the CSO policy. Schedule 4 – CSO VOLUME provides a process for assessing CSO control needs under the "presumption approach." It allows the permittee or other user (the term permittee will be used throughout this document, but the term should be interpreted to include any users of the LTCP-EZ Template) to estimate a target volume of combined sewage that needs to be stored, treated, or eliminated. Schedule 5 – CSO CONTROL enables the permittee to evaluate the ability of a small but widely used set of CSO controls to meet the reduction target. Finally, Schedule 6 – CSO AFFORDABILITY provides an EPA affordability analysis to determine the community's financial capabilities. Permittees are free to use FORM LTCP-EZ and as many schedules as needed to meet their local needs and requirements. FORM LTCP-EZ and its schedules are available in hard copy format or as computer-based spreadsheets.

This publication provides background information on the CSO Control Policy and explains the data and information requirements, technical assessments, and calculations that are addressed in the LTCP-EZ Template and are necessary for its application.

## What is the Relationship Between LTCP-EZ and the CSO Control Policy?

The Clean Water Act Section 402(q) and the CSO Control Policy (EPA 830-B-94-001) (http://www.epa.gov/npdes/pubs/owm0111.pdf) require permittees with combined sewer systems (CSSs) that have CSOs to undertake a process to accurately characterize their sewer systems, demonstrate implementation of the nine minimum controls (NMC), and develop a LTCP. The U.S. Environmental Protection Agency (EPA) recognizes that resource constraints make it difficult for small communities to prepare a detailed LTCP. Section I.D of the CSO Control Policy states that:

> *The scope of the LTCP, including the characterization, monitoring and modeling, and evaluation of alternatives portions of the Policy may be difficult for some small CSSs. At the discretion of the NPDES Authority, jurisdictions with populations under 75,000 may not need to complete all of the formal steps outlined in Section II.C. of this Policy, but should be required through their permits or other enforceable mechanisms to comply with the nine minimum control (II.B), public participation (II.C.2), and sensitive areas (II.C.3) portions of this Policy. In addition, the permittee may propose to implement any of the criteria contained in this Policy for evaluation of alternatives described in II.C.4. Following approval of the proposed plan, such jurisdictions should construct the control projects and propose a monitoring program sufficient to determine whether water quality standards are obtained and designated use are protected.*

EPA developed the LTCP-EZ Template, in part, because it recognizes that expectations for the scope of the LTCP for small communities may be different than for larger communities. However, the LTCP-EZ Template does not replace the statutory and regulatory requirements applicable to CSOs; those requirements continue to apply to the communities using this template. Nor does its use ensure that a community using the LTCP-EZ Template will necessarily be deemed to be in compliance with those requirements. It is hoped, however, that use of the LTCP-EZ Template will facilitate compliance by small communities with those legal requirements and simplify the process of developing a LTCP.

> *IMPORTANT NOTE: Each permittee should discuss use of the LTCP-EZ Template and coordinate with the appropriate regulatory authority or with their permit writer and come to an agreement with the permitting authority on whether use of the LTCP-EZ Template or components thereof is acceptable for the community.*

## Who Should Use the LTCP-EZ Template?

The LTCP-EZ Template is designed as a planning tool for use by small communities that have not developed LTCPs and have limited resources to invest in CSO planning. It is intended to assist small communities in developing an LTCP that will build on NMC implementation and lead to additional elimination and reduction of CSOs where needed. CSO communities using the LTCP-EZ Template should recognize that this planning tool is for use in facility-level planning. Use of the LTCP-Template should be based upon a solid understanding of local conditions that cause CSOs. CSO communities should familiarize themselves with all of the technical analyses required by the LTCP-EZ planning process. CSO communities should obtain the assistance of qualified technical professionals (e.g., qualified engineer, hydraulic expert, etc.) to assist with completion of analyses if they are unable to complete the LTCP-EZ Template on their own. More detailed design studies will be required for construction of new facilities.

The LTCP-EZ Template is particularly well suited for small CSO communities that have relatively uncomplicated CSSs. The use of the LTCP-EZ Template may or may not be suitable for large CSO communities with populations of greater than 75,000 or even for the largest of the small CSO communities. Large CSO communities and small CSO communities that have many CSO outfalls and complex systems may need to take a more sophisticated approach to LTCP development, and this should be evaluated by consultation with regulators as discussed above.

Because the LTCP-EZ uses a specific approach to analyzing the CSS and controlling CSOs, these instructions emphasize the need for dialogue between small CSO communities and their appropriate regulatory authority on use of the LTCP-EZ Template. Both the permittee and the permitting agency should evaluate the applicability of the LTCP-EZ.

The LTCP-EZ Template is intended to provide a very simple assessment of CSO control needs. As such, it may reduce effort and costs associated with CSO control development. However, permittees should bear in mind that due to its simple nature, the LTCP-EZ Template may not evaluate a full range of potential CSO control approaches.

## What Approach is used in the LTCP-EZ Template?

Schedules 4 - CSO VOLUME and Schedule 5 – CSO CONTROL use the “presumption approach” described in the CSO Control Policy to quantify the volume of combined sewage that needs to be stored, treated, or eliminated. The CSO Control Policy describes two alternative approaches available to communities to establish that their LTCPs are adequate to meet the water quality-based requirements of the Clean Water Act: the “presumption approach” and the “demonstration approach” (Policy Section II.C.4.a.) The “presumption approach” sets forth criteria that, when met, are presumed to provide an adequate level of control to meet the water quality-based requirements:

> *… would be presumed to provide an adequate level of control to meet water quality-based requirements of the Clean Water Act, provided the permitting authority determines that such presumption is reasonable in light of data and analysis conducted in the characterization, monitoring, and modeling of the system and the consideration of sensitive areas described above (in Section II.C.4.a). These criteria are provided because data and modeling of wet weather events often do not give a clear picture of the level of CSO controls necessary to protect WQS (water quality standards).*

The estimation of a target volume of combined sewage that needs to be stored, treated, or eliminated in Schedule 4 – CSO VOLUME in the LTCP-EZ Template uses the “presumption approach” described in the CSO Control Policy.

The permittee is advised to consider a limited rainfall and flow monitoring program. Performance of simple regression analyses (e.g., rainfall vs. flow response) can be used to refine the LTCP-EZ Template output and increase confidence in the sizing of controls generated using the LTCP-EZ Template. The permittee can refer to *EPA’s Combined Sewer Overflows Guidance for Monitoring and Modeling (EPA 832-B-99-002, January 1999) (http://www.epa.gov/npdes/pubs/sewer.pdf)* for examples of this approach to rainfall response characterization.

**Selected criterion under the “presumption approach” used in the LTCP-EZ Template**

The CSO Control Policy allows a community’s LTCP to meet any one of three criteria to be “presumed to provide an adequate level of control . . . .” The LTCP-EZ Template uses one of those criteria only, set forth in section II.C.4.a.i. as follows:

*No more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflow events per year. For the purpose of this criterion, an overflow event is one or more overflows from a CSS as the result of a precipitation event that does not receive the minimum treatment specified* below.

The "minimum treatment specified" with respect to the criteria in Section II.C.4.a.i. of the CSO Control Policy is defined as:

- *Primary clarification; removal of floatable and settleable solids may be achieved by any combination of treatment technologies or methods that are shown to be equivalent to primary clarification;*
- *Solids and floatable disposal; and*
- *Disinfection of effluent, if necessary, to meet water quality standards, protect designated uses, and protect human health, including removal of harmful disinfection chemical residuals, where necessary.*

This approach is used because the criteria set forth under the "presumption approach" lend themselves to quantification with simple procedures and a standardized format.

**Calculations within Schedule 4 - CSO VOLUME and Schedule 5 – CSO CONTROL**

Schedules 4 and 5 use design storm conditions to assess the degree of CSO control required to meet the *average of four overflow events per year* criteria. Design storms are critical rainfall conditions that occur with a predictable frequency. They are used with simple calculations to quantify the volume of combined sewage to be stored, treated, or eliminated to meet the criterion of no more than four overflows per year, on average. The "design storm" is explained in further detail in the instructions for Schedule 4 – CSO VOLUME.

The LTCP-EZ Template also provides permittees with simple methods to assess the costs and effectiveness of a variety of CSO control alternatives in Schedule 5 – CSO CONTROL.

Use of the "presumption approach" and the use of Schedules 4 and 5 may not be appropriate for every community. Some states have specific requirements that are inconsistent with Schedules 4 and 5. Also use of the LTCP-EZ Template does not preclude permitting authorities from requesting clarification or requiring additional information. Permittees should consult with the appropriate regulatory authority to determine whether or not the "presumption approach" and its interpretation under Schedules 4 and 5 are appropriate for their local circumstances.

## How is Affordability Assessed?

The CSO Financial Capability Assessment Approach outlined in EPA's *Combined Sewer Overflows–Guidance for Financial Capability Assessment and Schedule Development* (EPA 832-B-97-004) is contained in Schedule 6 – CSO AFFORDABILITY. (http://www.epa.gov/npdes/pubs/csofc.pdf)

## SUMMARY

The LTCP-EZ Template is an optional CSO control planning tool for small communities. It provides one approach for assembling and organizing the information required in an LTCP. FORM LTCP-EZ and Schedules 1 (Nine Minimum Controls), 2 (Map) and 3 (Public Participation) allow organization of some of the basic elements to comply with the CSO policy. Schedule 4 – CSO VOLUME allows the permittee to estimate a target volume of combined sewage that needs to be stored, treated, or eliminated. Schedule 5 – CSO CONTROL enables the permittee to evaluate the ability of a small but widely used set of CSO controls to meet the reduction target. FORM LTCP-EZ and its schedules are available in hard copy format or as computer-based spreadsheets. Schedule 6 – CSO AFFORDABILITY provides an EPA affordability analysis to assess the community's financial capabilities.

The CSO Control Policy and all of EPA's CSO guidance documents can be found at the following link:
*http://cfpub.epa.gov/npdes/home.cfm?program_id=5*

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# GENERAL INSTRUCTIONS: LTCP-EZ TEMPLATE

FORM LTCP-EZ encompasses all of the information that most small CSO communities need to develop a draft LTCP. This includes characterization of the CSS, documentation of NMC implementation, documentation of public participation, identification and prioritization of sensitive areas where present, and evaluation of CSO control alternatives and affordability.

The LTCP-EZ Template includes a form (Form LTCP-EZ) and schedules for organizing the following information:

- General information about the CSS, the wastewater treatment plant (WWTP) and the community served
- NMC implementation activities (Schedule 1 – NMC)
- Sensitive Area considerations
- Water quality considerations
- System characterization, including a map of the CSS (Schedule 2 – MAP)
- Public participation activities (Schedule 3 – PUBLIC PARTICIPATION)
- CSO volume that needs to be controlled (Schedule 4 – CSO VOLUME)
- Evaluation of CSO controls (Schedule 5 – CSO CONTROL)
- Affordability analysis (Schedule 6 – CSO AFFORDABILITY)
- Recommended CSO Control Plan, including financing plan and implementation schedule.

**Using the Electronic Forms for the LTCP-EZ Template**

The electronic version of the LTCP-EZ Template forms have cells that link data in one worksheet to other worksheets, and therefore it is important that you work on the worksheets in order and fill in all of the pertinent information. If you are filling in the LTCP-EZ Template forms by hand, you will have to copy the information from one form into the other.

Permittees intending to use the LTCP-EZ Template should assemble the following information:

- The NPDES permit.
- General information about the CSS and the WWTP including sub-sewershed delineations for individual CSO outfalls and the capacities of hydraulic control structures, interceptors, and wastewater treatment processes.
- Relevant engineering studies and facility plans for the sewer system and WWTP if available.
- Maps for sewer system.
- General demographic information for the community.
- General financial information for the community.
- A summary of historical actions and current programs that represent implementation of the NMCs. The NMC are controls that can reduce CSOs and their effects on receiving waters, do not require significant engineering studies or major construction, and can be implemented in a relatively short period (e.g., less than approximately two years).
- Information on water quality conditions in local waterbodies that receive CSO discharges.

**Guidance from EPA**

EPA has developed the *Combined Sewer Overflows Guidance For Long-Term Control Plan* (EPA 832-B-95-002) (http://www.epa.gov/npdes/pubs/owm0272.pdf) document to assist municipalities with developing a long-term control plan that includes technology-based and water quality-based control measures that are technically feasible, affordable, and consistent with the CSO Control Policy.

Once complete, the LTCP-EZ Template (FORM LTCP-EZ with accompanying schedules) can serve as a draft LTCP for a small community. All of the schedules provided in the LTCP-EZ Template may not be appropriate for every permittee. It may not be necessary to use all of the schedules provided in this template in order to complete a draft LTCP. In addition, permittees can attach the relevant documentation to FORM LTCP-EZ in a format other than the schedules provided in the LTCP-EZ Template.

# INSTRUCTIONS: FORM LTCP-EZ

## General Information

**Line 1 – Community Information.** Enter the community name, National Pollutant Discharge Elimination System (NPDES) permit number, owner/operator, facility name, mailing address, telephone number, fax number, and email address, as well as the date.

**Line 2 – System Type.** Identify the type of system that this LTCP is being developed for:

- NPDES permit for a CSS with a WWTP or
- NPDES permit for a CSS without a WWTP

**Line 3a – CSS.** Enter the total area served by the CSS in acres.

**Line 3b –** Enter the number of permitted CSO outfalls.

**Line 4 – WWTP.** Enter the following information for WWTP capacity in million gallons per day (MGD).

- **Line 4a** – Primary treatment capacity in MGD.
- **Line 4b** – Secondary treatment capacity in MGD.
- **Line 4c** – Average dry weather flow in MGD. Dry weather flow (DWF) is the base sanitary flow delivered to a CSS in periods without rainfall or snowmelt. It represents the sum of flows from homes, industry, commercial activities, and infiltration. Dry weather flow is usually measured at the WWTP and recorded on a Discharge Monitoring Report (DMR).

  For the purposes of the calculation in the LTCP-EZ Template, base sanitary flow is assumed to be constant. There is no need to adjust entries for diurnal or seasonal variation.

## Nine Minimum Controls

The CSO Control Policy (Section II.B.) sets out nine minimum controls, which are technology-based controls that communities are expected to use to address CSO problems, without undertaking extensive engineering studies or significant construction costs, before long-term measures are taken. Permittees with CSSs experiencing CSOs should have implemented the NMC with appropriate documentation by January 1, 1997.The NMC are:

- NMC 1. Proper operations and regular maintenance programs for the CSS and CSO outfalls.
- NMC 2. Maximum use of the CSS for storage.
- NMC 3. Review and modification of pretreatment requirements to ensure CSO impacts are minimized.
- NMC 4. Maximizing flow to the publicly-owned treatment works (POTW) for treatment.
- NMC 5. Prohibition of CSOs during dry weather.
- NMC 6. Control of solid and floatable materials in CSOs.
- NMC 7. Pollution prevention
- NMC 8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts.
- NMC 9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.

**Line 5 – NMC.** Permittees can attach previously submitted documentation on NMC implementation, or they can use Schedule 1 – NMC to document NMC activities. Please check the appropriate box on Line 5 to indicate how documentation of NMC implementation is provided.

If Schedule 1 – NMC is used, please document the activities taken to implement the NMC. Documentation should include information that demonstrates:

- The alternatives considered for each minimum control
- The actions selected and the reasons for their selection
- The selected actions already implemented
- A schedule showing additional steps to be taken
- The effectiveness of the minimum controls in reducing/eliminating water quality impacts (in reducing the volume, frequency, and impact of CSOs).

Leave the description blank if no activities have been undertaken for a particular NMC. See EPA's *Combined Sewer Overflows Guidance for Nine Minimum Controls* (EPA 832-B-95-003) for examples of NMC activities and for further guidance on NMC documentation (http://www.epa.gov/npdes/pubs/owm0030.pdf).

## Sensitive Areas

Permittees are expected to give the highest priority to controlling CSOs to sensitive areas. (CSO Control Policy Section II.C.3.) Permittees should identify all sensitive waterbodies and the CSO outfalls that discharge to them. The identification of sensitive areas can direct the selection of CSO control alternatives. In accordance with the CSO Control Policy, the LTCP should give the highest priority to the prohibition of new or significantly increased overflow (whether treated or untreated) to designated sensitive areas.

Sensitive areas, as identified in the CSO Control Policy, include:

- **Outstanding National Resource Waters.** These are waters that have been designated by some (but not all) states: "[w]here high quality waters constitute an outstanding National resource, such as waters of National Parks, State parks and wildlife refuges, and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected" (40 CFR 122.12(a)(3)). Tier III Waters and Class A Waters are sometimes used to designate Outstanding National Resource Waters. State water quality standards authorities are the best source of information on the presence of identified Outstanding National Resource Waters.
- **National Marine Sanctuaries.** The National Oceanic and Atmospheric Administration (NOAA) is the trustee for the nation's system of marine protected areas, to conserve, protect, and enhance their biodiversity, ecological integrity and cultural legacy. Information on the location of National Marine Sanctuaries can be found at: http://sanctuaries.noaa.gov/.
- **Waters with Threatened or Endangered Species and their Habitat.** Information on threatened and endangered species can be identified by contacting the Fish and Wildlife Service (FWS), NOAA Fisheries, or State or Tribal Heritage Center or by checking resources such as the FWS website at http://www.fws.gov/endangered/wildlife.html. If there are listed species in the area, contact the appropriate local agency to determine if the listed species could be affected or if any critical habitat areas have been designated in waterbodies that receive CSO discharges.
- **Waters with Primary Contact Recreation**: State water quality standards authorities are the best source of information on the location of waters designated for primary contact recreation.
- **Public Drinking Water Intakes or their Designated Protection Areas.** State water quality standards and water supply authorities are the best source of information on the location of public drinking water intakes or their designated protection areas. EPA's *Report to Congress – Impacts and Control of CSOs and SSOs* identified 59 CSO outfalls in seven states located within one mile upstream of a drinking water intake (EPA 2004).
- **Shellfish Beds.** Shellfish harvesting can be a designated use of a waterbody. State water quality standards authorities are a good source of information on the location of waterbodies that are protected for shellfish harvesting. In addition, the National Shellfish Register of Classified Estuarine Waters provides a detailed analysis of the shellfish growing areas in coastal waters of the United States. Information on the location of shellfish beds can be found at http://gcmd.nasa.gov/records/GCMD_NOS00039.html.

Contact the appropriate state and federal agencies to determine if sensitive areas are present in the area of the CSO. EPA recommends that the permittee attach all documentation of research regarding sensitive areas and/or contacts with agencies providing that information (including research on agency websites) to the LTCP-EZ Template forms. In addition, the permittee is encouraged to attach maps or other materials that provide back-up information regarding the evaluation of sensitive areas.

**Line 6a –** Indicate if sensitive areas are present. Answer Yes or No. If sensitive areas are present, proceed to Line 6b and answer questions 6b, 6c, and 6d. Also provide an explanation of how the determination was made that sensitive areas are present. If sensitive areas are not present, proceed to Line 7.

**Line 6b –** Enter the type(s) of sensitive areas present (e.g., public beach, drinking water intake) for each CSO receiving water.

**Line 6c –** List the permitted CSO outfall(s) that may be impacting the sensitive areas. Add detail on impacts where available (e.g., CSO outfall is located within a sensitive area, beach closures have occurred due to overflows, etc.).

**Line 6d –** Are sensitive areas impacted by CSO discharges? Answer Yes or No. If sensitive areas are present but not impacted by CSO discharges, then provide documentation on how the determination was made and proceed to Line 7.

STOP More detailed study may be necessary if sensitive areas are present and are impacted by CSO discharges. Under these circumstances, use of the "presumption approach" in the LTCP-EZ Template may not be appropriate. The permittee should contact the permitting authority for further instructions on use of the LTCP-EZ Template and/or the "presumption approach".

## Water Quality Considerations

The main impetus for implementation of CSO controls is attainment of water quality standards, including designated uses. Permittees are expected to be knowledgeable about water quality conditions in local waterbodies that receive CSO discharges. At a minimum, permittees should check to see if the local waterbodies have been assessed under the 305(b) program by the state water quality standards agency as being “good”, “threatened” or “impaired”.

Waters designated as impaired are included on a state’s 303(d) list. A total maximum daily load (TMDL) is required for each pollutant causing impairment. EPA’s recent *Report to Congress* **–** *Impacts and Control of CSOs and SSOs* (EPA 833-R-04-001) identified the three causes of reported 303(d) impairment most likely to be associated with CSOs:

- Pathogens
- Organic enrichment leading to low dissolved oxygen (DO)
- Sediment and siltation

Some states identify sources of impairment, and the activities or conditions that generate the pollutants causing impairment (e.g., WWTPs or agricultural runoff). CSOs are tracked as a source of impairment in some but not all CSO states.

If local waterbodies receiving CSO discharges are impaired, permittees should check with the permitting authority to determine whether or not the pollutants associated with CSOs are cited as a cause of impairment, or if CSOs are listed as a source of impairment. In addition, permittees should check with the permitting authority to see if a TMDL study is scheduled for local waterbodies to determine the allocation of pollutant loads, including pollutant loads in CSO discharges.

The 305(b) water quality assessment information can be found at http://www.epa.gov/waters/305b/index.html. Note that not all waters are assessed under state programs.

A national summary on the status of the TMDL program in each state can be found at http://www.epa.gov/owow/tmdl/. Note that not all waters are listed.

**Line 7a –** Indicate if local waterbodies are listed by the permitting authority as impaired. Answer Yes or No. If No, then the permittee may continue to Line 8.

**Line 7b –** Indicate the causes or sources of impairment for each impaired waterbody.

**Line 7c** – Indicate if a TMDL has been scheduled to determine the allocation of pollutant loads. Answer Yes or No. If yes, provide the date.

STOP If the identified waterbodies have been assessed as threatened or impaired under the 305(b) program, and if CSOs are cited as a source of impairment or if the pollutants found in CSOs are listed as a cause of impairment, then CSOs likely cause or contribute to a recognized water quality problem. Under these circumstances, permittees should check with the permitting authority to confirm that use of the LTCP-EZ Template and/or the “presumption approach” is appropriate.

If the waterbodies are not designated by the permitting authority as impaired or if the water body is impaired but the CSO discharges are not viewed as a cause of the impairment, then the permittee may continue with the LTCP-EZ Template.

## System Characterization

CSO control planning involves consideration of the site-specific nature of CSOs. The amount of combined sewage flow that can be conveyed to the WWTP in a CSS depends on a combination of regulator capacity, interceptor capacity, pump station capacity, and WWTP capacity. The LTCP-EZ Template uses the term “CSO hydraulic control capacity” as a generic reference to these types of flow controls. In any particular system, one or more of these CSO hydraulic control capacities may be the limiting factor. If the community has not previously carried out an analysis of the peak capacity of each portion of its CSS, it is strongly suggested that the determination of each CSO hydraulic control capacity be carried out by individual(s) experienced in such hydraulic analyses. Communities are particularly cautioned against evaluating CSO regulator capacity without considering interceptor capacity as well, as the nominal capacity of a given CSO regulator may exceed that of its receiving interceptor under the same peak wet weather conditions.

To develop an adequate control plan, the permittee needs to have a thorough understanding of the following:

- The extent of the CSS and the number of CSO outfalls
- The interconnectivity of the system
- The response of the CSS to rainfall
- The water quality characteristics of the CSOs
- The water quality impacts that result from CSOs.

Of these, the first three considerations are the most important for small communities. Communities using the LTCP-EZ Template are encouraged to obtain at least limited rainfall and system flow data to allow the runoff response calculated by the LTCP-EZ approach to be checked against actual system flow data.

Line 8 is used to indicate that a map has been attached to the LTCP-EZ Template. Lines 9-11 provide more specific information about the CSS. Information on Lines 9 through 11 is organized by CSO outfall and sub-sewershed.

**Line 8** – **General Location.** Please check the box on Line 8 to indicate Schedule 2 – MAP is attached to FORM LTCP-EZ. Schedule 2 –

MAP should include a map or sketch of the CSS that shows the following:

- Boundaries of the CSS service area and, if different, total area served by the sewer system
- CSO outfall locations
- Boundaries of individual sub-sewersheds within the CSS that drain to a CSO outfall
- Location of major hydraulic control points such as CSO regulators (weirs, diversion structures, etc.) and pump stations
- Location of major sewer interceptors (show as pathways to the WWTP)
- WWTP, if present
- Waterbodies

Delineation of the boundaries of the CSS and individual sub-sewersheds is very important. Delineation is most often done by hand with sewer maps, street maps, contours, and the location of key hydraulic control points such as regulators and sewer interceptors. The measurement of CSS and sub-sewershed area is also very important. Area can be measured directly with GIS or CAD systems, or it can be measured by hand by overlaying graph paper and counting squares of known dimension within the CSS or sub-sewershed boundary.

**Line 9 – CSO Information.** Use one column in Line 9 for each CSO outfall in the CSS (e.g., CSO A, CSO B, etc). Space is provided for up to four CSO outfalls in FORM LTCP-EZ. Add additional columns if needed. See the example for Line 9.

- **Line 9a – Permitted CSO number.** Enter an identifying number for each CSO outfall.
- **Line 9b – Description of location.** Enter a narrative description of the location for each CSO outfall.
- **Line 9c – Latitude/Longitude.** Enter the latitude and longitude for each CSO outfall, where available.
- **Line 9d – Receiving water.** Enter the name of the receiving water for each CSO outfall.

**Line 10 – CSS Information.** Most (though not all) CSOs have a defined service area, and surface runoff in this area enters the CSS. For the purpose of the LTCP-EZ Template, "sub-sewershed area" is used to describe the defined service area for each CSO in a CSS.

Use one column in Line 10 to describe the following information for each sub-sewershed area in the CSS. Space is provided for up to four sub-sewersheds. Add additional columns if needed. See the example for Line 10.

- **Line 10a – Sub-sewershed area.** Enter the area (in acres) for the contributing sub-sewershed. Note 1: the sum of sub-sewershed areas in CSS should be consistent with Line 3a. Note 2: this information is also used in Schedule 4-CSO VOLUME.
- **Line 10b – Principal land use.** Enter the principal land use for the sub-sewershed (i.e., business - downtown, residential – single family, etc. See Table 1 in Schedule 4-CSO VOLUME).

**Line 11 – CSO Hydraulic Control Capacity.** The amount of combined sewage that can be conveyed to the WWTP in a CSS depends on a combination of regulator, interceptor, pump station, and WWTP capacity. The volume and rate of combined sewage that can be conveyed in a CSS depends on dry weather flows and these capacities. In any particular system, one or more of these capacities may be the limiting factor.

The CSO hydraulic control capacity defines the amount of combined sewage that is diverted to the interceptor. Interceptors are large sewer pipes that convey dry weather flow and a portion of the wet weather-generated combined sewage flow to WWTPs.

The CSO hydraulic control capacity of passive structures such as weirs and orifices can be calculated or estimated as long as drawings are

## Example: Line 9 – CSO Information

| | | | | |
|---|---|---|---|---|
| **a.** Permitted CSO number | **9a** | 001 | 002 | 003 |
| **b.** Description of location | **9b** | Foot of King Street | Near Main Street | Near Water Street |
| **c.** Latitude/Longitude | **9c** | 374637N 870653W | 374634N 870632W | 374634N 870633W |
| **d.** Receiving Water | **9d** | Green River | Green River | Green River |

## Example: Line 10 – CSS Information

| | | CSO 001 | CSO 002 | CSO 003 |
|---|---|---|---|---|
| **a.** Sub-sewershed area (acres) | **10a** | 105 | 85 | 112 |
| **b.** Principal land use | **10b** | Medium Density Residential | High Density Residential | Mixed Use |

available and the dimensions of the structures are known. The use of standard weir or orifice equations is recommended if they are appropriate for the structures that are present. As a general rule, the diversion rate is often three to five times greater than dry weather flow. Permittees should consult a standard hydraulics handbook or professional engineer familiar with the design and operation of regulators if the CSO hydraulic control capacity is unknown, and the permittee is unable to determine regulator capacity with the resources available.

Use one column in Line 11 to describe the following information for each CSO and sub-sewershed. See the example for Line 11.

- **Line 11a – Type of CSO hydraulic control.** Enter the type of hydraulic control used for this CSO, e.g., weir.
- **Line 11b – CSO hydraulic control capacity.** Enter the capacity in MGD of the CSO hydraulic control. Note: this information is also used in Schedule 4-CSO VOLUME.
- **Line 11c – Name of interceptor or downstream pipe.** Enter the name of the interceptor that receives the diverted flow.

## Public Participation

The CSO Control Policy states that "in developing its long-term CSO control plan, the permittee will employ a public participation process that actively involves the affected public in the decision-making to select the long-term CSO controls" (II.C.2). Given the potential for significant expenditures of public funds for CSO control, public support is key to CSO program success.

Public participation can be viewed as interaction between the permittee (the utility or municipality), the general public, and other stakeholders. Stakeholders include civic groups, environmental interests, and users of the receiving waters. The general public and stakeholders need to be informed about the existence of CSOs and the plan for CSO abatement and control. Informing the public about potential CSO control alternatives is one part of the public participation process.

Public meetings are typically used for describing and explaining alternatives. Technical solutions should be presented in a simple, concise manner, understandable to diverse groups. The discussion should include background on the project, description of proposed facilities/projects, the level of control to be achieved, temporary and permanent impacts, potential mitigation measures, and cost and financial information. Presentations to the public should explain the benefits of CSO control. A key objective of the public education process is to build support for increases in user charges and taxes that might be required to finance CSO control projects.

The extent of the public participation program generally depends on the amount of resources available and the size of the CSO community. Public participation is typically accomplished through one or more activities, such as:

*CSO Awareness*:

- Placement of informational and warning signs at CSO outfalls
- Media advisories for CSO events

*Public Education:*

- Media coverage
- Newsletters/Information booklet
- Educational inserts to water and sewer bills
- Direct mailers
- CSO project websites

*Public Involvement:*

- Public meetings
- Funding task force
- Local river committee
- Community leader involvement
- General public telephone survey
- Focus groups

Successful public participation occurs when the discussion of CSO control has involved ratepayers and users of CSO-impacted waterbodies.

For more information on public participation activities, see EPA's Combined Sewer Overflows Guidance for Long-Term Control

### Example: Line 11 – Pipe Capacity and Flow Information

| | | CSO 001 | CSO 002 | CSO 003 |
|---|---|---|---|---|
| **a.** Type of CSO hydraulic control | **11a** | Weir | Weir | Pump station |
| **b.** CSO hydraulic control capacity (MGD) | **11b** | 1.5 | 1.5 | 3.0 |
| **c.** Name of interceptor or downstream pipe | **11c** | South Street Interceptor | South Street Interceptor | Central Force Main |

Plan (EPA 832-B-95-002, September 1995) (http://www.epa.gov/npdes/pubs/owm0272.pdf).

Examples of public participation can also be viewed at the following CSO project websites:

- City of Lansing, Michigan. (http://publicservice.cityoflansingmi.com/PubEng/cso.jsp)
- City of Manchester, New Hampshire. (http://www.manchesternh.gov/CityGov/DPW/EPD/CSO.html)
- City of St. Joseph, Missouri. (http://www.ci.st-joseph.mo.us/publicworks/wpc_cso.cfm)
- City of Wilmington, Delaware. (http://www.wilmingtoncso.com/CSO_home.htm)

**Line 12 – Public Participation.** Please check the box on Line 12 to indicate Schedule 3 – PUBLIC PARTICIPATION is attached to FORM LTCP-EZ. Use Schedule 3 – PUBLIC PARTICIPATION to document public participation activities undertaken (or planned) to involve the public and stakeholders in the decision process to evaluate and select CSO controls.

## Use of Schedules

The LTCP-EZ Template provides an organizational framework for the collection and presentation of information and analysis that is essential for a draft LTCP. Once complete, FORM LTCP-EZ (with accompanying schedules) can serve as a draft LTCP for a small community under appropriate circumstances. Each of the following three sections on CSO Volume, Evaluation of CSO Controls, and CSO Affordability include schedules with calculation procedures that are potentially valuable for small communities. However, although the types of information used in, and generated by, these schedules is necessary for a draft LTCP, use of these schedules is optional. Permittees with extremely simple systems, permittees that have already completed an evaluation of CSO controls, and permittees that have previously conducted separate analyses may choose not to use these schedules. Under these circumstances, documentation of the evaluation of CSO control alternatives and selection of the recommended CSO Control Plan may be provided in another format.

## CSO Volume

The LTCP-EZ Template applies the “presumption approach” described in the CSO Control Policy. The LTCP-EZ Template uses a design storm approach to identify the volume of combined sewage that needs to be stored, treated, or eliminated to reduce CSOs to no more than an average of four overflow events per year. In accordance with the “presumption approach” described in the CSO Control Policy, a program meeting this criterion is conditionally presumed to provide an adequate level of control to meet water quality-based requirements, provided that the permitting authority determines the presumption is reasonable, based upon data and analysis provided in the LTCP.

Use of other criteria under the “presumption approach” is valid, but need to be documented separately (not in Schedule 4 – CSO VOLUME).

**Line 13 – CSO Volume**. Please check the appropriate box on Line 13 to indicate whether Schedule 4 – CSO VOLUME or separate documentation is attached to FORM LTCP-EZ. Schedule 4 – CSO VOLUME is used to quantify the volume of combined sewage that needs to be stored, treated, or eliminated. This is called the “CSO volume” throughout the LTCP-EZ Template. Specific instructions for completion of Schedule 4 – CSO VOLUME are provided.

## Evaluation of CSO Controls

LTCPs should contain site-specific, cost-effective CSO controls. Small communities are expected to evaluate a simple mix of controls to assess their ability to provide cost-effective CSO control. The LTCP-EZ Template considers the volume of combined sewage calculated in Schedule 4 – CSO VOLUME that needs to be stored, treated, or eliminated when evaluating alternatives for CSO controls.

Schedule 5 – CSO CONTROL provides an evaluation of CSO control alternatives for the CSO volume calculated in Schedule 4 – CSO VOLUME. Specific instructions for completion of Schedule 5 – CSO CONTROL are provided. Please note that Schedule 5 – CSO CONTROL can be used in an iterative manner to identify the most promising CSO control plan with respect to CSO volume reduction and cost.

**Line 14 – CSO Controls.** Please check the appropriate box on Line 14 to indicate whether Schedule 5 – CSO CONTROL or separate documentation is attached to FORM LTCP-EZ.

## Affordability

The CSO Control Policy recognizes the need to address the relative importance of environmental and financial issues when developing an implementation schedule for CSO controls. The ability of small communities to afford CSO control influences CSO control priorities and implementation schedule.

Schedule 6 – CSO AFFORDABILITY provides an assessment of financial capability in a two-step process. Step One involves determination of a residential indicator to assess the ability of the resident and the community to afford CSO controls. Step Two involves determination of a permittee financial indicator to assess the financial capability of the permittee to fund and implement CSO controls. Information from both Step One and Step Two is used to determine affordability.

**Line 15 – Affordability.** Permittees are encouraged to assess their financial capability and the affordability of the LTCP. Please check the box in Line 15 if Schedule 6 – CSO AFFORDABILITY is attached to FORM LTCP-EZ, and enter the appropriate affordability burden in Line 15a. Otherwise, proceed to Line 16.

**Line 15a – Affordibility Burden.** Enter the appropriate affordability burden (low, medium, or high) from Schedule 6 – CSO AFFORDABILITY.

## Recommended CSO Control Plan

The LTCP-EZ Template guides permittees through a series of analyses and evaluations that form the basis of a draft LTCP for small communities. The recommended CSO controls need to be summarized so that the permitting authority and other interested parties can review them. Line 16 is used for this purpose.

**Line 16 – Recommended CSO Control Plan.** Documentation of the evaluation of CSO control alternatives is required (CSO Control Policy Section II.C.4.). Permittees that have used Schedule 5 - CSO CONTROL to select CSO controls should bring the information from Schedule 5 – CSO CONTROL forward to Line 16 in FORM LTCP-EZ. Permittees who have completed their own evaluation of CSO alternatives (that is, permittees that did not use Schedule 5 – CSO CONTROL) need to summarize the selected CSO control on Line16 and attach the appropriate documentation.

**Line 16a –** Provide a summary of the CSO controls selected. This information can come from the controls selected on Schedule 5 – CSO CONTROL, or from other analyses. Section 3.3.5, Identification of Control Alternatives, of EPA's *Combined Sewer Overflows Guidance for Long-Term Control Plan* document, lists the various source controls, collection system controls, and storage and treatment technologies that may be viable. This document also discusses preliminary sizing considerations, cost/performance considerations, preliminary siting issues, and preliminary operating strategies, all of which should be discussed on Line 16a of the LTCP-EZ Template.

**Line 16b –** Provide a summary of the cost of CSO controls selected. Project costs include capital, annual O&M, and life-cycle costs. Capital costs should include construction costs, engineering costs for design and services during construction, legal and administrative costs, and typically a contingency. Annual O&M costs reflect the annual costs for labor, utilities, chemicals, spare parts, and other supplies required to operate and maintain the facilities proposed as part of the project. Life-cycle costs refer to the total capital and O&M costs projected to be incurred over the design life of the project.

At the facilities planning level, cost curves are usually acceptable for estimating capital and O&M costs. When used, cost curves should be indexed to account for inflation, using an index such as the Engineering News Record Cost Correction Index.

**Line 16c –** Provide a description of how the CSO controls selected will be financed. Discuss self-financing including fees, bonds, and grants. Section 4.3, Financing Plan, of EPA's *Combined Sewer Overflows Guidance for Long-Term Control Plan* document, states that the LTCP should identify a specific capital and annual cost funding approach. EPA's guidance on funding options presents a detailed description of financing options and their benefits and limitations, as well as case studies on different approaches municipalities took to fund CSO control projects. It also includes a summary of capital funding options, including bonds, loans, grants, and privatization, as well as annual funding options for O&M costs for CSO controls, annual loan payments, debt service on bonds, and reserves for future equipment replacement.

**Line 16d –** Describe the proposed implementation schedule for the CSO controls selected. The implementation schedule describes the planned timeline for accomplishing all of the program activities and construction projects contained in the LTCP. Section 4.5.1.5 of EPA's *Combined Sewer Overflow Guidance for Permit Writers* document (EPA 832-B-95-008) summarizes criteria that should be used in developing acceptable implementation schedules, including:

- Phased construction schedules should consider elimination of CSOs to sensitive areas and use impairment.
- Phased schedules should also include an analysis of financial capability (see Schedule 6 – CSO AFFORDABILITY).
- The permittee should evaluate financing options and data, including grant and loan availability, previous and current sewer user fees and rate structures, and other viable funding mechanisms and sources of funding.
- The schedule should include milestones for all major

implementation activities, including environmental reviews, siting of facilities, site acquisition, and permitting.

- The implementation schedule is often negotiated with the permitting authority, and incorporating the information listed above in the schedule provides a good starting point for schedule negotiations.

# INSTRUCTIONS: SCHEDULE 4 – CSO VOLUME

## Introduction

Understanding the response of the CSS to rainfall is critical for evaluation of the magnitude of CSOs and control needs. Small CSO communities do not typically have the resources to conduct the detailed monitoring and modeling necessary to make this determination easily. Schedule 4 – CSO VOLUME of the LTCP-EZ Template provides a simple, conservative means for assessing CSO control needs. The technical approach contained in Schedule 4 – CSO VOLUME builds upon the general information and CSS characteristics provided in FORM LTCP-EZ. It rests upon a simple interpretation of the "presumption approach" described in the CSO Control Policy. Under the "presumption approach", a CSO community controlling CSOs to no more than an average of four overflow events per year is presumed to have an adequate level of control to meet water quality standards.

The volume of combined sewage that needs to be treated, stored, or eliminated is calculated within Schedule 4 – CSO VOLUME. This is called the "CSO volume." CSO volume is calculated with a "design storm", application of the Rational Method (described below) to determine generated runoff, and use of an empirical equation to estimate excess combined sewage and conveyance within the CSS. Once construction of controls is completed, it is expected that compliance monitoring will be used to assess the ability of the controls to reduce CSO frequency to meet the average of four overflow events per year criterion.

## Design Storm for Small Communities

The volume of runoff and combined sewage that occurs due to "design storm" conditions must be controlled to limit the occurrence of CSOs to an average of four overflow events per year. The LTCP-EZ Template uses two design storm values, each of which represents a rainfall intensity that, on average, occurs four times per year. These are:

- The statistically-derived one-hour, three-month rainfall. This design storm represents a peak flow condition. It is reasonably intense, delivers a fairly large volume of rainfall across the CSS, and washes off the "first flush." In addition, the one-hour, three-month rainfall facilitates a simple runoff calculation in the Rational Method. The LTCP must provide control to eliminate the occurrence of CSOs for hourly rainfall up to this intensity.
- The statistically-derived 24-hour, three-month rainfall. This design storm complements the one-hour, three-month rainfall in the LTCP-EZ Template. The longer 24-hour storm delivers a larger volume of rainfall with the same three-month return interval. The LTCP must provide control to eliminate the occurrence of CSOs for rainfall up to this amount over a 24-hour period.

The use of both of these design storms in conjunction with one another ensures that CSO control needs are quantified based on both rainfall intensity and rainfall volume associated with the return frequency of four times per year.

## The Rational Method

The Rational Method is a standard engineering calculation that is widely used to compute peak flows and runoff volume in small urban watersheds. The Rational Method with a design storm approach is used in the LTCP-EZ Template to quantify the amount of runoff volume (the "CSO volume") that needs to be controlled for each CSO outfall and contributing sub-sewershed area. The Rational Method equation is given as:

**$Q = kCiA$**

where:
- $Q$ = runoff (MGD)
- $k$ = conversion factor (acre-inches/hour to MGD)
- $C$ = runoff coefficient (based on land use)
- $i$ = rainfall intensity (in/hr)
- $A$ = sub-sewershed area (acres)

The Rational Method is applied twice within the LTCP-EZ Template: once to determine the peak runoff rate associated with the one-hour, three-month rainfall, and once to determine the total volume of runoff associated with the 24-hour, three-month rainfall. When applied properly, the Rational Method is inherently conservative.

## Calculation of CSO Volume

CSO volume is calculated within sub-sewersheds at individual CSO hydraulic controls (i.e., weir, orifice) and at the WWTP. The procedures used to calculate CSO volume are documented in Appendix B. The following operations are central to these calculations:

- The average dry weather flow rate of sanitary sewage is added to runoff to create a peak hourly flow rate, and is also used to calculate a total volume of flow over the 24-hour period.
- The ratio of the CSO hydraulic control capacity to the peak flow rate based upon the one-hour, three-month rainfall determines the fraction of overflow within sub-sewersheds. (Note: Identification of realistic hydraulic control capacities is an important part of the LTCP-EZ Template. Permittees may need to seek assistance from qualified professionals to successfully complete this part of the Template. In addition, it is important that interceptor capacity limitations be taken into account when identifying regulator capacities.)
- The overflow fraction is applied to the total volume of flow associated with the 24-hour, three-month rainfall to quantify the volume of excess combined sewage at CSO hydraulic controls. This is the "CSO volume" at the CSO hydraulic control.
- Diversions to the WWTP at CSO hydraulic controls are governed by an empirical relationship based upon the ratio of the CSO hydraulic control capacity to the peak flow rate and conveyance. The diversions to the WWTP at CSO hydraulic controls are a component of the peak sewage conveyed to the WWTP.
- The ratio of primary capacity to peak sewage conveyed to the WWTP determines the fraction of combined sewage untreated at the WWTP. This is the "CSO volume" at the WWTP.

The Schedule 4 – CSO VOLUME results identify the "CSO volume," which is the volume of excess combined sewage that needs to be stored, treated, or eliminated in order to comply with the "presumption approach." The results of the calculations, the excess CSO volumes, are linked to Schedule 5 – CSO CONTROL where control alternatives are evaluated at the sub-sewershed level and/or at the WWTP.

## Summary

The LTCP-EZ Template is designed to provide a very simple assessment of CSO control needs. Prior to entering data into the LTCP-EZ Template, permittees should collect good information on the characteristics of the CSS, including reliable information on CSO hydraulic control capacities.

Additional detail and documentation on the approach used to identify overflow, diversion and WWTP overflow fractions is provided in Appendix B.

## Sub-Sewershed Area

This section characterizes the contributing area of each CSO sub-sewershed area, the predominant land use, and a runoff coefficient. These values are critical inputs to the runoff calculation developed in this schedule (the Rational Method). Schedule 4 – CSO VOLUME is set up to accommodate up to four sub-sewersheds. Additional columns can be added to the schedule as needed if there are more than four CSO sub-sewersheds. The number of sub-sewersheds evaluated on this schedule needs to correspond to the system characterization information included under Form LTCP-EZ and the map on Schedule 2 – MAP.

**Line 1 – Sub-sewershed area (acres).** Enter the area in acres for each sub-sewershed in the CSS (Line 10a on FORM LTCP-EZ. If you are using the electronic version of the form, this value will have been filled in automatically). Add additional columns if needed.

**Line 2 – Principal land use.** Enter the principal land use for each sub-sewershed area (Line 10b on FORM LTCP-EZ. If you are using the electronic version of the form, this value will have been filled in automatically).

**Line 3 – Sub-sewershed runoff coefficient.** Enter the runoff coefficient that is most appropriate for the sub-sewershed on Line 3. Runoff coefficients represent land use, soil type, design storm, and slope conditions. The range of runoff coefficients associated with different types of land use is presented in Table 1. Use the lower end of the range for flat slopes or permeable, sandy soils. Use the higher end of the range for steep slopes or impermeable soils such as clay or firmly packed soils. The higher end of the range can also be used to add an additional factor of safety into the calculation.

The runoff coefficient selected should be representative of the entire sub-sewershed. Permittees should consider the distribution of land use within the sub-sewershed and develop a weighted runoff coefficient if necessary. For example, a sub-sewershed that is half residential single family (C=0.40) and half light industrial (C=0.65) would have a composite runoff coefficient of C=0.525 [(0.40+0.65)/2].

At a minimum, the runoff coefficient should be equivalent to the percent imperviousness for the sub-sewershed as a decimal fraction. The percent imperviousness is the fraction of each sub-sewershed area that is covered by impervious surfaces (such as pavement, rooftops, and sidewalks) that is directly connected to the CSS through catch basins, area drains or roof leaders.

## Runoff

**Line 4 Design storm rainfall.** The one-hour, three-month rainfall intensity (inches per hour) is the design storm used in the LTCP-EZ Template to estimate peak runoff rate. The 24-hour, three-month rainfall is used to estimate total volume of runoff generated over a 24-hour period.

Recommended one-hour, three-month rainfall values by state and county are provided in Appendix A. These values are based on research and products provided by the Midwest Climate Center (1992). Values for the Midwestern states are very specific. Values for other states in the Northeast have been approximated based upon procedures developed by the Midwest Climate Center. A statistically derived multiplication factor of 2.1 is used to convert these one-hour, three–month design rainfall conditions into the 24-hour, three–month rainfall conditions.

**Table 1. Runoff Coefficients for Rational Formula**

| Type of Area (Principal Land Use) | Runoff Coefficient (C) |
|---|---|
| Business – downtown | 0.70 -0.95 |
| Business – Neighborhood | 0.50-0.70 |
| Residential - Single family | 0.30-0.50 |
| Residential – Multi units, detached | 0.40-0.75 |
| Residential – Multi units, attached | 0.60-0.75 |
| Residential - Suburban | 0.25-0.40 |
| Residential – Apartments | 0.50-0.70 |
| Industrial - Light | 0.50-0.80 |
| Industrial - Heavy | 0.60-0.90 |
| Parks, cemeteries | 0.10-0.25 |
| Playgrounds | 0.20-0.35 |
| Railroad yard | 0.20-0.35 |
| Unimproved | 0.10-0.30 |

Source: ASCE (2006)

Site-specific rainfall values or other design storm intensities may be used to assess the response of the CSS to rainfall. However, use of different rainfall periods may require a separate analysis outside of Schedule 4-CSO VOLUME.

Enter the one-hour design storm rainfall intensity in inches for each sub-sewershed on Line 4. (Note: this information is also used in Schedule 5-CSO CONTROL).

**Line 5 – Calculated runoff rate.** Multiply Line 1 by Line 3 and then this product by Line 4 for each sub-sewershed area and enter the result (acre-inches per hour) on Line 5**.**

**Line 6 – Peak runoff rate in MGD.** Multiply Line 5 by the conversion factor (k) of 0.6517 and enter the result for each sub-sewershed area on Line 6. This is the one-hour design storm runoff in MGD.

## Dry Weather Flow Within the CSS

**Line 7 – Dry weather flow rate (MGD).** Enter the average dry weather flow rate as a rate in MGD for each sub-sewershed on Line 7. If dry weather flow is unknown on a sub-sewershed basis, develop an estimate supported by 1) direct measurement of dry weather flow based on the average of a series of observations made at different times of the day; or 2) allocation of the dry weather flow reported on the DMR for the WWTP for the entire sewer service area. Use of the allocation estimation approach should take into consideration characteristics of each sub-sewershed that influence the rate of dry weather flow including population, employment, and infiltration if known. The sum of dry weather flow from the CSS plus the dry weather flow from non-CSO areas and satellite communities, if present, should equal the dry weather flow at the WWTP.

## Peak Wet Weather Flow

**Line 8 – Peak flow rate (MGD).** The peak flow rate is the sum of the peak runoff rate and dry weather flow in MGD. Add Lines 6 and 7 and enter the sum for each sub-sewershed area on Line 8.

## Overflow

**Line 9 – CSO hydraulic control capacity (MGD).** CSO hydraulic control capacity is the maximum flow that the sub-sewershed area sewer can deliver to the interceptor sewer. Enter the CSO hydraulic control capacity in MGD for each CSO sub-sewershed area on Line 9 (Line 11b on FORM LTCP-EZ. If you are using the electronic version of the form, this value will have been filled in automatically).

**Line 10 – Ratio of CSO hydraulic control capacity to peak flow rate.** Enter 1.0 on Line 10 if Line 9 is greater than Line 8. Otherwise, divide Line 9 by Line 8 and enter the quotient (result) on Line 10.

**Line 11 – Overflow fraction of combined sewage.** This is the overflow fraction of combined sewage within the sub-sewershed. It is based on the ratio of CSO hydraulic control capacity to peak flow rate. Take the square of (1 minus the value on Line 10) and enter it on Line 11. For example, if the ratio of CSO hydraulic control capacity to peak flow rate on Line 10 is 0.15, the overflow fraction is $(1\text{-}0.15)^2$, or 0.7225.

**Line 12 – 24-hour rainfall.** Multiply Line 4 by 2.1 to obtain the 24-hour design rainfall and enter the product on Line 12.

**Line 13 – Volume of runoff (MG).** The volume of runoff for the 24-hour rainfall is obtained by multiplying Line 1 by Line 3 and Line 12 and converting to MG by applying the conversion factor 0.02215. Enter the product on Line 13.

**Line 14 – Volume of dry weather flow (MG)**. This is the total dry weather flow in MG for the 24-hour design rainfall period. It is calculated by multiplying the dry weather flow rate in MGD on line 7 by 24 hours. Enter this value on Line 14.

**Line 15 – Total volume of flow (MG).** This is the total volume of flow in MG within each sub-sewershed for the 24-hour design rainfall period. Add Lines 13 and 14 and enter the sum on Line 15.

**Line 16 – Volume of excess combined sewage at individual CSO hydraulic controls during 24-hour rainfall period.** This is also the “CSO volume” at the CSO hydraulic control and is the combined sewage that exceeds the diversion capacity determined by the CSO hydraulic control in each sub-sewershed. Multiply Line 11 by Line 15 and enter the product on Line 16.

## Diversion

**Line 17 – Diversion fraction of combined sewage.** This is the fraction of runoff within each subsewershed that is collected and diverted to the WWTP over the 24-hour design storm period. The diversion fraction is based on the ratio of CSO hydraulic control capacity to peak flow rate and conveyance. Determine the diversion fraction of combined sewage from Line 10 using Table 2, and enter on Line 17.

**Line 18 – Volume of runoff diverted to WWTP.** This is the volume of runoff within each sub-sewershed that is collected and diverted to the WWTP over the 24-hour design storm period. Multiply Line 13 by Line 17 and enter the product on Line 18.

**Line 19 – Total volume of combined sewage conveyed to WWTP during 24-hour rainfall period (MG).** Add Lines 14 and 18 and enter the sum on Line 19.

## Conveyance

**Line 20 – Peak rate of collected combined sewage diverted to the WWTP within sub-sewersheds.** Identify the smaller of Line 8 and Line 9 within each sub-sewershed and enter the peak rate in MGD on Line 20.

**Line 21 – Peak rate of combined sewage conveyed to WWTP (MGD).** This peak rate represents the sum of the peak rates of collected combined sewage diverted to the WWTP from individual sub-sewersheds in MGD. Add up sub-sewershed values on Line 20 and enter on Line 21.

**Line 22 – Peak rate of sewage from non-CSO areas (MGD).** Non-CSO areas can be affected by wet weather conditions due to I/I. the degree to which the peak rate of sewage in non-CSO areas is higher than the average dry weather flow rate depends on site-specific conditions. Direct measurement of the peak rate of sewage during wet weather is the

**Table 2. Diversion Fraction of Combined Sewage from 24-Hour Storm**

| Ratio of CSO Hydraulic Control Capacity to Peak Flow Rate | Diversion Fraction |
|---|---|
| 0.01 to 0.02 | 0.04 |
| 0.02 to 0.03 | 0.06 |
| 0.03 to 0.04 | 0.09 |
| 0.04 to 0.05 | 0.11 |
| 0.05 to 0.06 | 0.14 |
| 0.06 to 0.07 | 0.16 |
| 0.07 to 0.08 | 0.19 |
| 0.08 to 0.09 | 0.21 |
| 0.09 to 0.10 | 0.24 |
| 0.10 to 0.12 | 0.28 |
| 0.12 to 0.14 | 0.33 |
| 0.14 to 0.16 | 0.38 |
| 0.16 to 0.18 | 0.42 |
| 0.18 to 0.20 | 0.47 |
| 0.20 to 0.24 | 0.54 |
| 0.24 to 0.28 | 0.62 |
| 0.28 to 0.32 | 0.68 |
| 0.32 to 0.36 | 0.72 |
| 0.36 to 0.40 | 0.76 |
| 0.41 to 0.50 | 0.81 |
| 0.51 to 0.60 | 0.87 |
| 0.61 to 0.70 | 0.91 |
| 0.71 to 0.80 | 0.95 |
| 0.81 to 0.90 | 0.98 |
| 0.91 to 1.0 | 0.99 |

best approach for determining this rate. Estimation based on flow measured at the WWTP and local knowledge of the distribution of flow in the service area provides another approach. Peaking factors can also be used to adjust the average dry weather flow upward. Newer "tight" sewer systems may have peaking factors between 1.0 and 1.5. Older, leakier systems may have peaking factors between 1.5 and 3.0, or even higher. Enter the peak rate of sewage conveyed to the WWTP from non-CSO areas in the community in MGD on Line 22.

**Line 23 – Peak rate of sewage from satellite communities (MGD).** Satellite communities can be affected by wet weather conditions due to I/I. the degree to which the peak rate of sewage in satellite communities is higher than the average dry weather flow rate depends on site-specific conditions. Direct measurement of the peak rate of sewage during wet weather is the best approach for determining this rate. Estimation based on flow measured at the WWTP and local knowledge of the distribution of flow in the service area provides another approach. Peaking factors can also be used to adjust the average dry weather flow upward. Newer "tight" sewer systems may have peaking factors between 1.0 and 1.5. Older, leakier systems may have peaking factors between 1.5 and 3.0, or even higher. The maximum rate of flow from capacity agreements may also be used and may be more appropriate than measurements or estimates. Enter the peak rate of sewage conveyed to the WWTP from satellite communities in MGD on Line 23.

**Line 24 – Peak rate of sewage conveyed to the WWTP (MGD).** This is the peak rate of sewage flow in MGD received at the WWTP from the CSS and adjacent non-CSO areas in the community and satellite communities. Add Lines 21, 22 and 23 and enter the sum on Line 24.

## Treatment

**Line 25 – Primary treatment capacity (MGD).** Enter the primary treatment capacity in MGD on Line 25 (Line 4a on FORM LTCP-EZ. If you are using the electronic version of the form, this value will have been filled in automatically).

Use of primary treatment capacity for CSO control is a viable option where approval of the regulatory agency has been obtained. The CSO Control Policy indicates that combined sewer flows remaining after implementation of the NMCs and within the criteria under the "presumption approach" at a minimum should receive:

- Primary clarification (removal of floatables and settleable solids may be achieved by any combination of treatment technologies or methods that are shown to be equivalent to primary clarification);
- Solids and floatables disposal; and
- Disinfection of effluent, if necessary, to meet WQS, protect designated uses and protect human health, including removal of harmful disinfection residuals, where necessary.

The Combined Sewer Overflows Guidance for Long-Term Control Plan document, Section 3.3.3.5, Utilization of POTW Capacity and CSO-Related Bypass, addresses the specific case where existing primary treatment capacity exceeds secondary treatment capacity and it is not possible to utilize the full primary treatment capacity without overloading the secondary facilities. For such cases, the CSO Control Policy states that at the request of the municipality, EPA may allow an NPDES permit "…to authorize a CSO-related bypass of the secondary treatment portion of the POTW treatment plant for combined sewer overflows in certain identified circumstances" (II.C.7). Under this provision, flows to the POTW within the capacity of primary treatment facilities but in excess of the capacity of secondary treatment facilities may be diverted around the secondary facilities provided that "…all wet weather flows passing the headworks of the POTW treatment plant will receive at least primary clarification and solids and floatables removal and disposal, and disinfection, where necessary, and any other treatment that can be reasonably provided" (II.C.7). In addition, the CSO-related bypass should not cause exceedance of WQS.

**Line 26 – Ratio of primary treatment capacity to peak rate of sewage conveyed to WWTP.** Enter 1.0 on Line 26 if Line 25 is greater than Line 24. Otherwise, divide Line 25 by Line 24 and enter the quotient (result) on Line 26.

**Line 27 –Fraction of combined sewage untreated at WWTP.** This is the fraction of sewage delivered to the WWTP during the 24-hour rainfall period that does not received primary treatment. It is based on the ratio of primary treatment capacity to peak rate of sewage conveyed to the WWTP. Take the square of (1 minus the value on Line 26) and enter it on Line 27. For example, if the ratio of primary treatment capacity to peak rate of sewage conveyed to the WWTP on Line 26 is 0.80, the overflow fraction is $(1\text{-}0.80)^2$, or 0.04.

**Line 28 – Sum of combined sewage conveyed to WWTP during 24-hour rainfall period (MG).** Add up the sub-sewershed values in MG on Line 19 and enter on Line 28.

**Line 29 – Dry weather flow from the non-CSO area (MGD).** Enter the dry weather flow rate from the non-CSO area in MGD on Line 29. If dry weather flow for the non-CSO area is unknown, develop an estimate supported by 1) direct measurement of dry weather flow based on the average of a series of observations made at different times of the day; or 2) allocation of the dry weather flow reported on the DMR for the WWTP for the entire sewer service area.

**Line 30- Volume of sewage from non-CSO areas during 24-hour rainfall period (MG).** The volume of sewage from non-CSO areas during the 24-hour rainfall period is likely to be higher than the average dry weather flow rate (Line 29) because of I/I, but less than the peak rate of sewage (Line 22). Typical daily wet weather volumes should be used if measurements are available. Alternatively, an estimate based on the peak rate of sewage (Line 22) and the dry weather flow rate (Line 29) can be used. Under this approach, it is assumed that flow to the WWTP from the non-CSO area over the course of the 24-hour rainfall period has a triangular shape. The volume is calculated by adding one-half the difference between Line 22 and 29 and adding this value to the dry weather flow rate. Subtract Line 29 from Line 22, divide by 2, add the remainder to Line 29, and enter this value as a volume in MG on Line 30.

**Line 31 – Dry weather flow from the satellite communities (MGD).** Enter the dry weather flow rate from the satellite communities in MGD on Line 29. If dry weather flow for the satellite communities is unknown, develop an estimate supported by 1) direct measurement of dry weather flow based on the average of a series of observations made at different times of the day; or 2) allocation of the dry weather flow reported on the DMR for the WWTP for the entire sewer service area.

**Line 32- Volume of sewage from satellite communities during 24-hour rainfall period (MG).** The volume of sewage from satellite communities during the 24-hour rainfall period is likely to be higher than the average dry weather flow rate (Line 31) because of I/I, but less than the peak rate of sewage (Line 23). Typical daily wet weather volumes should be used if measurements are available. Alternatively, an estimate based on the peak rate of sewage (Line 23) and the dry weather flow rate (Line 31) can be used. Under this approach, it is assumed that flow to the WWTP from the satellite communities over the course of the 24-hour rainfall period has a triangular shape. The volume is calculated by adding one-half the difference between Line 23 and 31 and adding this value to the dry weather flow rate. Subtract Line 31 from Line 23, divide by 2, add the remainder to Line 31, and enter this value as a volume in MG on Line 32.

**Line 33 – Total volume of sewage during 24-hour rainfall event (MG).** Add Lines 28, 30 and 32 and enter the volume in MG on Line 33.

**Line 34 – Volume of combined sewage untreated at WWTP (MG).** This is also the “CSO volume” at the WWTP. Enter 0.0 on Line 34 if Line 25 is greater than Line 24. Otherwise, multiply Line 31 by Line 27 and enter the volume in MG on Line 34.

## CSO Volume

The CSO volume that needs to be stored, treated or eliminated is calculated in SCHEDULE 4- CSO Volume. These CSO volumes are identified within individual sub-sewersheds at CSO hydraulic controls, and at the WWTP.

**Line 35 – Volume of combined sewage overflows at CSO outfalls (MG).** This represents the volume of excess combined sewage in MG that is discharged at CSO outfalls. Sum all sub-sewershed volumes in MG on Line 16 and enter on Line 35.

**Line 36 – Volume of combined sewage overflow at WWTP (MG).** This represents the volume of excess combined sewage in MG that is collected and conveyed to the WWTP that does not receive at least primary treatment. Enter the value on Line 34 on Line 36.

# INSTRUCTIONS: SCHEDULE 5 – CSO CONTROL

The calculation in Schedule 4 – CSO VOLUME quantifies the volume of combined sewage generated by a storm that occurs no more than four times per year (once every three months). This is the volume of combined sewage that needs to be stored, treated, or eliminated under the "presumption approach" so that there are no more than an average of four overflow events per year. The calculation leads the permittee to identify the rate and volume of combined sewage conveyed to the WWTP. It also identifies the rate and volume of combined sewage at sub-sewershed outfalls governed by CSO hydraulic controls. This schedule is intended to help the permittee evaluate the ability of a limited number, but widely used, set of CSO controls to store, treat, or eliminate excess combined sewage.

The permittee is expected to develop a simple LTCP based upon CSS characterization, the hydraulic response of the CSS to rainfall established in Schedule 4 – CSO VOLUME, information presented on CSO controls, and an understanding of local conditions and circumstances. Schedule 5 – CSO CONTROL provides a simple approach to organize and evaluate control needs, performance, and costs. Small communities can use this schedule in an iterative manner to identify the mix of CSO controls needed.

Four general methods for CSO control are considered in this schedule. They are:

- Conveyance and treatment at the WWTP
- Inflow reduction for residential properties
- Sewer separation
- Off-line storage

It is recommended that permittees evaluate these controls in the order presented. Use of more than one CSO control in a LTCP is common. Use of other controls not described herein is valid, but would have to be documented separately in a similar effort to what is presented in this schedule.

Schedule 5 – CSO CONTROL should be used in an iterative manner in order to identify the most appropriate mix of CSO controls with respect to CSO reduction and cost. The volumes of combined sewage at CSO outfalls and at the WWTP that need to be controlled (Lines 33 and 34 on Schedule 4 – CSO VOLUME) serve as the reduction targets for this schedule.

## Conveyance and Treatment at the WWTP

Maximization of treatment at the existing WWTP is emphasized in the CSO Control Policy, and it is an important feature of many LTCPs. In some CSO communities, the ability to convey combined sewage to the WWTP exceeds the primary capacity of the WWTP. The presence of this condition is assessed in Schedule 4 – CSO VOLUME, and the use of additional storage or treatment capacity at the WWTP is included in this schedule. The schedule is not set up to evaluate the opposite situation, where the WWTP has excess primary treatment capacity. Permittees with this situation can potentially make use of available primary treatment capacity at the WWTP by adjusting CSO hydraulic controls, increasing interceptor conveyance capacity, or increasing pumping capacity. This analysis needs to be documented separately and attached to this schedule.

## Inflow Reduction

Inflow reduction is a widely used CSO control practice centered on removal of direct sources of storm water connected to the CSS. Roof leader redirection and down spout disconnection are the only inflow reduction measure considered in this schedule. This practice has been implemented successfully in many CSO communities. It is applicable in small CSO communities where lawns and green space are abundant and are underlain with permeable soils.
Citywide surveys are often necessary to determine the extent of roof leader connections to the CSS. Inflow control through roof leader disconnection can be voluntary or mandatory. The best results are achieved where disconnection programs are widely implemented in a community. Some communities have offered financial incentives to property owners to encourage participation, while others have linked roof leader disconnection efforts with efforts to redirect area drains, foundation drains, and sump pumps. Roof leader and down spout disconnection programs are most successful

when they are accompanied by an educational component so that homeowners fully understand the importance of keeping flows from roof leaders and downspouts out of the collection system. In addition, most successful programs include continued municipal surveys or inspections to ensure that the program is working. This evaluation of CSO control alternatives is limited to roof leaders and down spouts from residential buildings because the design storm calculation lends itself to control of the volume of rain that falls on a rooftop. The analysis of other forms of inflow reduction such as basement sump pump redirection and low impact development practices is not possible in this schedule, but can be documented separately and appended to this schedule.

Note: the LTCP-EZ Template contains calculations for inflow reduction, which is the component of I/I that is associated with wet weather and directly-connected impervious area. Infiltration is accounted for in the dry weather flow entered on Line 7 of Schedule 4 – CSO VOLUME. If communities wish to examine infiltration reduction and its effect on reducing CSO volumes, they can adjust the dry weather flow rate to incorporate infiltration reduction and re-examine the results of the Schedule 4 – CSO VOLUME calculations.

## Sewer Separation

Sewer separation is the practice of replacing the single pipe system of a CSS with separate pipes for sanitary and storm water flows. Sewer separation is highly effective and widely used. However, it can be expensive relative to other CSO controls. While sewer separation can be implemented on a broad basis across an entire CSS, it is most often implemented in selective portions of the CSS where localized circumstances make it less disruptive and more economical. It should also be noted that while sewer separation can help to mitigate CSO issues, it can increase the burden on the storm sewer system.

## Off-Line Storage

"Off-line storage" is a phrase used to describe facilities that store combined sewage in added tanks, basins, tunnels or other structures. During dry weather, wastewater is passed around, not through, off-line storage facilities. During wet weather, combined sewage flows are diverted from the CSS to the off-line facility by gravity drainage or with pumps. The stored combined sewage is temporarily detained in the storage facility and returned to the CSS once conveyance and treatment capacity become available.

Off-line storage facilities can be expensive relative to other CSO controls. Near surface storage facilities probably have the most utility because space may be more readily available in small communities, and design, construction and O&M costs are less than the cost of deep underground tanks and tunnels.

## Cost of CSO Control

Generalized cost information for CSO controls is provided. Background information or the derivation of this cost information is contained in Appendix C. Permittees should realize that CSO control costs are highly variable and dependent on site-specific conditions. Use of actual or local cost data is always preferable where it is available. Permittees should verify the appropriateness of default cost values where they are used. Permittees should also note that cost estimates are for the construction of facilities. Additional operational costs and treatment costs are not expressly included in cost estimates for controls where primary capacity is added or where combined sewage is temporarily stored on-site at the WWTP or off-line and released for treatment following the rainfall event.

## Summary

More information can be found in EPA's CSO control technology description at
http://www.epa.gov/npdes/pubs/csossoRTC2004_AppendixL.pdf

## Conveyance and Treatment at the WWTP

This section of Schedule 5 – CSO CONTROL considers conveyance and treatment of combined sewage at the WWTP. Additional treatment or storage can be added at the WWTP if the ability of the CSS to convey combined sewage to the WWTP exceeds primary capacity. Conversely, excess primary capacity at the WWTP provides an opportunity to maximize flow of combined sewage to the WWTP for treatment.

Skip to Line 10 if you are not evaluating control alternatives at the WWTP.

**Line 1 – Peak rate of sewage conveyed to WWTP (MGD).** Enter the peak rate of sewage conveyed to the WWTP in MGD on Line 1 (Line 24 on Schedule 4 – CSO VOLUME. If you are using the electronic version of the form, this value will have been filled in automatically).

**Line 2 – Primary treatment capacity (MGD).** Enter the primary treatment capacity in MGD on Line 2 (Line 25 of Schedule 4 – CSO VOLUME. If you are using the electronic version of the form, this value will have been filled in automatically).

**Line 3 – Difference between primary treatment capacity and peak rate of sewage conveyed to WWTP (MGD).** Enter the combined sewage untreated at the WWTP in MGD (Line 32 on Schedule 4 – CSO VOLUME. If you are using the electronic version of the form, this value will have been filled in automatically).

Untreated combined sewage at the WWTP can be controlled by adding additional treatment capacity (Line 4) or by adding storage (Line 7) to allow collected combined sewage to be retained temporarily until treatment capacity becomes available following the rainfall event. Permittees can estimate costs for both options and determine which is most appropriate for their facility.

Note: If Line 2 is greater than Line 1, the difference represents primary treatment capacity that may be available for treatment of combined sewage. Maximization of flow to the WWTP should be pursued under these circumstances. This could be done iteratively in Schedule 4 – CSO VOLUME by adjusting hydraulic control capacities, or assessed in worksheets to supplement the LTCP-EZ Template.

**Line 4 – Additional primary treatment capacity required (MGD).** Additional primary treatment capacity may be added to the system in order to treat the combined flows that reach the WWTP during wet weather. Line 3 represents the minimal additional primary treatment capacity that will be required to treat these flows. Permittees may either enter the value from Line 3 on Line 4, or they may enter a larger number if they want to increase primary treatment capacity even further.

**Line 5 – Unit cost of primary treatment per MGD.** The unit cost of primary treatment varies greatly. Enter a cost that reflects local site-specific conditions, or use the default value of $2,000,000 per MGD.

**Line 6 – Estimated cost of new primary treatment capacity at WWTP.** Multiply the unit cost on Line 5 by the additional capacity required on Line 4.

**Line 7 – Volume of storage required at WWTP (MG).** The volume of storage required is determined by converting the flow rate in MGD on Line 3 to a volume in MG by multiplying Line 3 by 24 hours. Enter this value on Line 7.

**Line 8 – Unit cost of additional storage at WWTP.** The unit cost of storage varies greatly. Enter a cost that reflects local site-specific conditions, or use the default value of $1,000,000 per MG.

**Line 9 – Estimated cost for storage at WWTP.** Multiply the additional storage volume required on Line 7 by the unit cost on Line 8.

## Inflow Reduction – Residential

Inflow reduction refers to techniques used to reduce the amount of storm water that enters a CSS. Roof leader redirection and downspout disconnection are featured in the LTCP-EZ Template because they have been used successfully by many CSO communities. Roof leader redirection and downspout disconnection are most applicable in urban neighborhoods where roof leaders and downspouts on residential dwellings currently draining to the CSS are redirected to lawns and yards. Redirected flow then infiltrates into the soil.

**Line 10 – 24-hour design rainfall (inches).** Enter the 1-hour design rainfall in inches on Line 10 (Line 12 on Schedule 4—CSO VOLUME. If you are using the electronic version of the form, this value will have been filled in automatically).

**Line 11 – Number of residential dwellings participating in inflow reduction.** Enter the number of residential dwellings within each sub-sewershed that are considered for roof leader redirection as an inflow reduction measure. Permittees should consider reducing this number slightly to account for implementation inefficiency.

**Line 12 – Average roof area of residential dwellings (Sq. Ft.)**. The roof area of residential dwellings varies greatly between the range of 1,000 and 4,000 square feet. Roof areas tend to be smaller in highly urban areas with town houses and row houses, and larger in suburban or small town settings. Enter a value that is characteristic of dwellings in the sub-sewershed(s) or use a default value of 1,200 square feet. This can sometimes be estimated from GIS or from real estate aerial photographs.

**Line 13 – Runoff to CSS eliminated due to inflow reduction (Gal.).** Multiply Lines 10, 11 and 12. Multiply the product by 0.6234 to convert to gallons.

**Line 14 – Volume reduction (MG).** Enter the volume reduction achieved through inflow reduction. Divide Line 13 by one million.

**Line 15 – Unit cost per dwelling unit for residential inflow reduction.** The unit cost of roof leader redirection varies depending on incentives and homeowner investment. Enter a cost that reflects local site-specific conditions, or use the default value of $250 per dwelling unit.

**Line 16 – Estimated cost of residential inflow reduction.** Multiply the number of dwellings considered for roof leader redirection on Line 11 by the unit cost per dwelling on Line 15.

## Sewer Separation

Sewer separation is the practice of separating the single pipe system of a CSS into separate pipe systems for sanitary and storm water flows. Sewer separation is widely used as a CSO control. It is often applied opportunistically in small sub-areas to minimize disruption. Some small communities also invest in sewer separation on a system-wide basis.

**Line 17 – Sub-sewershed area to be separated (acres).** Enter the area to be separated in each sub-sewershed.

**Line 18 – Runoff coefficient of area to be separated.** Enter the runoff coefficient entered on Line 3 on Schedule 4 – CSO VOLUME.

**Line 19 – Runoff to CSS eliminated due to sewer separation (Gal.).** Multiply Lines 10, 17 and 18. Multiply the product by 27,156 to convert to gallons.

**Line 20 – Volume reduction (MG).** Enter the volume reduction achieved through sewer separation. Divide Line 19 by one million.

**Line 21 – Unit cost of sewer separation per acre.** The unit cost of sewer separation is highly variable. Estimates range from less than $10,000 to over $200,000 per acre. Enter a cost that reflects local site-specific conditions, or use the default value of $40,000 per acre.

**Line 22 – Estimated cost of sewer separation.** Multiply the number of acres to be separated on Line 17 by the unit cost on Line 21 and enter on Line 22.

## Off-Line Storage

The use of storage facilities to store and attenuate peak combined sewage flows is widely used as a CSO control. Off-line storage is the term used to describe facilities that store excess combined sewage in tanks, basins, tunnels, or other structures located adjacent to the CSS.

**Line 23 – Volume reduction to be achieved with storage (MG).** Enter the proposed volume of storage in each sub-sewershed. This can be established as the original volume of excess combined sewage at individual CSO hydraulic controls (Line 16 on Schedule 4 – CSO VOLUME) minus reductions achieved through inflow reduction and sewer separation.

**Line 24 – Unit cost per MG of storage.** The unit cost of off-line storage is highly variable and ranges from less than $100,000 per MG to several million dollars per MG. Enter a cost that reflects local site-specific conditions, or use the default value of $1,000,000 per MG.

**Line 25 – Estimated cost of storage.** Multiply Line 23 by Line 24.

## Summary of Controls and Costs

The final CSO control alternatives selected on this schedule (and on supporting analysis if used) represent the CSO controls proposed for the draft LTCP. The level of CSO control proposed must be consistent with the CSO volumes determined to require control on Line 23 and 24 of Schedule 4 – CSO VOLUME.

Complete the following summary of recommended CSO controls and costs below and on FORM LTCP-EZ.

**Line 26 – Volume reduction from CSO controls in sub-sewersheds (MG).** Add Lines 14, 20 and 23.

**Line 27– Cost of CSO controls in sub-sewersheds.** Add Lines 16, 22 and 25.

**Line 28 – Total volume reduction in sub-sewersheds (MG).** Add up volumes across Line 26.

**Line 29 – Total cost of CSO controls in sub-sewersheds.** Add up costs across Line 27.

**Line 30 – Total cost of additional treatment or storage at WWTP.** Select cost on Line 6 or Line 9. Enter 0.0 if no additional control is planned at the WWTP.

# INSTRUCTIONS: SCHEDULE 6 – CSO AFFORDABILITY

The CSO Control Policy recognizes the need to address the relative importance of environmental and financial issues when developing an implementation schedule for CSO controls. The ability of small communities to afford CSO control influences control priorities and the implementation schedule. Schedule 6 – CSO AFFORDABILITY uses EPA's affordability analysis approach to develop a financial capability indicator for the community. This financial capability indicator is not to be interpreted as an indicator of whether or not communities can afford CSO controls; rather, the affordability analysis is used as part of the planning process to determine the potential burden on the community for implementing the controls over a specific schedule. Thus, one of the primary uses of the affordability analysis is in the negotiation of the CSO control implementation schedule.

The affordability analysis standardizes the determination of financial burden by using standard "big-picture" measures of a community's financial capability (e.g., property tax rates, median household incomes, bond ratings, etc.) so that it can be compared across municipalities without regard to a community's individual method for funding wastewater and collection system projects. Once the overall financial capability is determined for a community, it can be used in discussions with regulators to determine a realistic schedule for implementing CSO controls that takes into account the financial burden to the community in implementing those controls.

This Schedule presents a two-phase approach to assessing a permittee's financial capability. The first phase identifies the combined impact of wastewater and CSO control costs on individual households. The second phase examines the debt, socioeconomic, and financial conditions of a permittee. The results of the two-phase analysis are combined in a Financial Capability Matrix. As discussed above, permittees and the water quality standards and NPDES authorities can then use the matrix to assess the financial burden of the CSO control costs and establish a reasonable schedule to implement the CSO controls.

Phase I determines a Residential Indicator. This indicator is the permittee's average costs per household (CPH) for wastewater treatment (WWT) and CSO controls as a percentage of the local median household income (MHI). It reflects the residential share of current and planned WWT and CSO control needs to meet the requirements of the Clean Water Act. A value for this indicator characterizes whether costs will impose a "low', "mid-range", or "high" financial impact on residential users.

Phase II develops the permittee's Financial Capability Indicators. Six indicators are used to evaluate the debt, socioeconomic and financial conditions that affect a permittee's financial capability to implement the CSO controls. These indicators serve as the basis for a second phase analysis that characterizes the permittee's financial capability as "weak", "mid-range", or "strong". Schedule 6 – CSO AFFORDABILITY is based on EPA's *Combined Sewer Overflows–Guidance for Financial Capability Assessment and Schedule Development*. This guidance is located at http://www.epa.gov/npdes/pubs/csofc.pdf.

## Phase I Residential Indicator

In Phase I of the analysis of the permittee's financial capability, a Residential Indicator is calculated. The Residential Indicator measures the financial impact of the current and proposed wastewater treatment (WWT) and CSO controls on residential users. Development of this indicator starts with the determination of the current and proposed WWT and CSO control costs per household (CPH). Next, the service area's CPH estimate and the median household income (MHI) are used to calculate the Residential Indicator. Finally, the Residential Indicator is compared to established financial impact ranges to determine whether CSO controls will produce a possible high, mid-range or low financial impact on the permittee's residential users.

The first step in developing the CPH is to determine the permittee's total WWT and CSO costs by adding together the current costs for existing wastewater treatment operations and the projected costs for any proposed WWT and CSO controls. The next step is to calculate the residential share of the total WWT and CSO costs. The final step is to calculate the CPH by dividing the residential share of total WWT and CSO costs by the number of households in the permittee's total wastewater service area.

The permittee's latest financial reports should be used to develop the current wastewater treatment operations costs. In order to comply with accounting requirements, most permittees develop a combined statement of revenues, expenses, and changes in fund balance. These reports should be available directly from the accounting or financial departments in the permittee's community, or, in some states, from central records kept by the state auditor or other state offices (many states conduct audits and generate financial reports - i.e., balance sheet, statement of revenues, expenses, changes in fund balances, and statement of cash flows, for each permittee.) Projected costs and the number of households in the wastewater service area should be available through planning documents.

The Bureau of Labor Statistics website at http://factfinder.census.gov/home/saff/main.html?_lang=en has data that can be used to estimate the number of households in a specific service area. The Consumer Price Index rate (CPI) is used in several calculations. The value used should be the average rate for the previous five years. The CPI is available through the Bureau of Labor Statistics website at http://www.bls.gov/cpi/.

The first step in developing the Residential Indicator is to determine the Cost Per Household of total WWT and CSO Costs. In order to do this, permittees must first calculate current WWT and CSO costs, and then projected costs of future WWT and CSO treatment. These steps are completed in Lines 1-17 below.

## Current Costs

Current WWT costs are defined as current annual wastewater operating and maintenance expenses (excluding depreciation) plus current annual debt service (principal and interest). This is a fair representation of cash expenses for current wastewater treatment operations (expenses for funded depreciation, capital replacement funds, or other types of capital reserve funds are not included in current WWT costs, because they represent a type of savings account rather than an actual operation and maintenance expense).

**Line 1 – Annual operations and maintenance expenses (excluding depreciation).** Enter the annual operation and maintenance costs -including all significant cost categories, such as labor, chemicals, utilities, administration, and equipment replacement. Do not include depreciation.

**Line 2 – Annual debt service (principal and interest).** Enter the annual debt service paid on WWT debts.

**Line 3 – Current costs.** Add together the annual operations and maintenance expenses from Line 1 and the annual debt service from Line 2 and enter on Line 3.

## Projected Costs (Current Dollars)

Estimates of projected costs are made for proposed WWT projects and for CSO controls. Any concerns about including specific proposed WWT projects or CSO controls in the projected costs, or the length of the planning period, should be discussed with the appropriate NPDES permitting and enforcement authorities. These costs should include projected operation and maintenance expenses plus projected debt service costs for any proposed WWT and CSO controls. The residential or household costs (Lines 12 -17) exclude the portion of expenses attributable to commercial, governmental and industrial wastewater discharges. These costs are adjusted to current dollars (i.e., deflated).

**Line 4 – Projected annual operations and maintenance expenses (excluding depreciation).** Enter the projected annual WWT and costs for new CSO-related facilities.

**Line 5 – Present value adjustment factor.** The present value adjustment factor may be calculated using the formula presented below. The formula converts projected costs to current dollars using the average annual national Consumer Price Index (CPI) inflation rate (available from the Bureau of Labor Statistics website at http://www.bls.gov/cpi/) for the past five years. The CPI is used as a simple and reliable method of indexing projected WWT costs and household income. For example, if the most recent five year average CPI is 4 percent, and the projected annual O&M and debt service costs will begin in 2 years, calculate the adjustment factor as follows:

$$\textit{Adjustment Factor} = \frac{1}{(1+CPI)^{years}} = \frac{1}{(1+.04)^{2}} = .925$$

**Line 6 – Present value of projected costs.** Multiply the projected annual operations and maintenance expenses on Line 4 by the present value adjustment factor on Line 5 and enter on Line 6.

**Line 7 – Projected debt costs.** Enter the projected debt costs for the proposed WWT projects and CSO controls on Line 7.

**Line 8 – Annualization factor.** Enter an annualization factor (AF) that reflects the local borrowing interest rate (IR) and borrowing term of the permittee. Calculate the factor using the following formula:

$$AF = \frac{IR}{(1+IR)^{years} - 1} + IR$$

**Line 9 – Projected annual debt service (principal and interest).** Multiply the projected debt cost on Line 7 by the annualization factor on Line 8, and enter the result on Line 9.

**Line 10 – Projected costs.** Add the present value of projected costs on Line 6 to the projected annual debt service on Line 9, and enter the result on Line 10.

**Line 11 – Total current and projected WWT and CSO costs**. Add the current costs on Line 3 to the projected costs on Line 10. Enter the result on Line 11.

## Cost Per Household

**Line 12 – Residential WWT flow (MGD).** Enter the portion of wastewater flow (including infiltration and inflow) in MGD attributable to residential users.

**Line 13 – Total WWT flow (MGD).** Enter the total wastewater flow at the wastewater treatment plant in MGD.

**Line 14 – Fraction of total WWT flow attributable to residential users.** Divide the residential flow on Line 12 by the total flow on Line 13 and enter the result on Line 14. The result should be between 0 and 1.

**Line 15 – Residential share of total WWT and CSO costs.** Multiply the total current and projected WWT and CSO costs on Line 11 by the fraction of total WWT flow attributable to residential users on Line 14, and enter the result on Line 15.

**Line 16 – Number of households in service area.** Enter the number of households associated with the residential flow.

**Line 17 - Cost per household (CPH).** Calculate the CPH by dividing the residential share of total WWT and CSO costs on Line 15 by the number of households in the service area on Line 16.

## Median Household Income (MHI)

The second step in developing the Residential Indicator is to determine the adjusted median household income (MHI) for the permittee's entire wastewater service area.

MHI is available for most communities from the latest census. In the few cases where a local jurisdiction's MHI is not available, the surrounding county's MHI may be sufficient. Each state has a state data center that serves as a local source of census data for public use.

**Line 18 – Census Year MHI.** Enter the MHI value from the most recent census year for the service area. The Census Bureau’s designated MHI areas generally encompass most permittees' service areas. If the permittee's service area includes more than one jurisdiction, a weighted MHI for the entire service area may be needed. Additional instructions on development of a weighted MHI can be found in EPA’s previously referenced *Combined Sewer Overflows–Guidance for Financial Capability Assessment and Schedule Development.*

**Line 19 - MHI adjustment factor.** The MHI adjustment factor adjusts the MHI from the latest census year to current dollars based upon the consumer price index (CPI) inflation rate from the latest census year to the present. The MHI adjustment factor can be taken from Table CAF-3 or calculated using the formula below:

$$\text{MHI Adjustment Factor} = (1 + \text{CPI})^{\text{Current Year} - \text{Census Year}}$$

For example, if a permittee's MHI was taken for the 1990 census year, the average annual CPI since 1990 was 4 percent and the current year is 1992, the adjustment factor would be 1.0816:

$$\text{MHI Adjustment Factor} = (1 + .04)^{1992-1990} = 1.0816$$

**Line 20 - Adjusted MHI.** Multiply the Census Year MHI in Line 18 by the MHI adjustment factor in Line 19 and enter the result in Line 20.

## Residential Indicator

**Line 21 – Annual WWT and CSO control CPH as a percent of adjusted MHI.** Divide the cost per household on Line 17 by the adjusted MHI in Line 20 and then multiply by 100. Enter the result on Line 21.

**Line 22 – Residential Indicator.** Enter the appropriate Financial Impact according to the value of CPH as % MHI in Line 21. The appropriate Financial Impacts are defined below:

| CPH as % of MHI | Financial Impact |
|---|---|
| <1 | Low |
| 1 to 2 | Mid-Range |
| >2 | High |

*Analyzing the Residential Indicator*

The Residential Indicator is used to help permittees, EPA, and state NPDES authorities determine reasonable and workable long-term CSO and WWT control schedules.

The Residential Indicator is compared to the financial impact ranges that reflect EPA's previous experience with water pollution control programs. When the Residential Indicator is less than 1, between 1 and 2, and greater than 2, the financial impact on residential users to implement the CSO and WWT controls will be characterized as "low," "mid-range," and "high," respectively. Unless there are significant weaknesses in a permittee's financial and socioeconomic conditions, second phase reviews for permittees that have a low residential indicator score (CPH as % of MHI less than 1) are unlikely to result in longer implementation schedules. Permittees with low residential indicators may wish to forego the second phase analysis of the permittee Financial Capability Indicators and proceed with the normal engineering and construction implementation schedule developed as part of the CSO planning process.

In situations where a permittee believes that there are unique circumstances that affect the conclusion of the first phase, the permittee may submit documentation of its unique financial conditions to the appropriate state NPDES and EPA authorities for consideration.

## Phase II Permittee Financial Capability Indicators

In Phase II of the analysis of the permittee's financial capability, selected indicators are assessed to evaluate the financial capability of the permittee. These indicators examine the permittee's debt burden, socioeconomic conditions, and financial operations. The second-phase review examines three general categories of financial capability indicators for the permittee:

- **Debt Indicators** – Assesses current debt burden of the permittee or the communities within the permittee's service area and their ability to issue additional debt to finance the WWT and CSO control costs. The indicators selected for this purpose are:
  - Bond Ratings (General Obligation and/or Revenue Bond Fund)
  - Overall Net Debt as a Percent of Full Market Property Value

- **Socioeconomic Indicators** – Assesses the general economic well-being of residential users in the permittee's service area. The indicators selected for this purpose are:
  - Unemployment Rate
  - MHI

- **Financial Management Indicators** – Evaluates the permittee's overall ability to manage financial operations. The indicators selected for this purpose are:
  - Property Tax Revenue Collection Rate
  - Property Tax Revenues as a Percent of Full Market Property Value

Even though the financial capability analysis reflects current conditions, pending changes in the service area should be considered in development of the second phase indicators. For example, if the current unemployment rate is high, but there is a new industry opening that will stimulate economic growth, the unemployment indicators for the service area would need to be modified to reflect the projected impact of the new plant. The permittee should submit documentation of such conditions to the appropriate EPA and state NPDES authorities for consideration. When the permittee is a sanitary district, sewer authority or similar entity, the second phase indicators related to property values and tax revenues may not be applicable. In those circumstances, the permittee may simply use the remaining indicators or submit other related documentation that will help assess its financial capability to implement the CSO controls.

## Debt Indicators

The debt indicators described below are used to assess the current debt burden conditions and the ability to issue new debt. These indicators are the bond rating and overall net debt as a percent of full market property value. When these indicators are not available for the permittee, other financial data that illustrates debt burden and debt issuing capacity may be used to assess the permittee's financial capability in this area.

*Bond Rating*

Recent bond ratings summarize a bond rating agency's assessment of a permittee's or community's credit capacity. General obligation (G.O.) bonds are bonds issued by a local government and repaid with taxes (usually property taxes). They are the primary long-term debt funding mechanism in use by local governments. General obligation bond ratings reflect financial and socioeconomic conditions experienced by the community as a whole.

"Revenue bond" ratings, by comparison, reflect the financial conditions and management capability of the wastewater utility. They are repaid with revenues generated from user fees. Revenue bonds are sometimes referred to as water or sewer bonds. In some cases these bonds may have been issued by the state on behalf of local communities.

Bond ratings normally incorporate an analysis of many financial capability indicators. These analyses evaluate the long term trends and current conditions for the indicators. The ultimate bond ratings reflect a general assessment of the current financial conditions. However, if security enhancements like bond insurance have been used for a revenue bond issue, the bond rating may be higher than justified by the local conditions.

Many small and medium-sized communities and permittees have not used debt financing for projects, and, as a result, have no bond rating. The absence of bond rating does not indicate strong or weak financial health. When a bond rating is not available, this indicator may be excluded from the financial analysis.

Municipal bond reports from rating agencies (e.g., Moody's Bond Record, Standard & Poor's Corporation) provide recent ratings.

**Line 23a – Date of most recent general obligation bond.** Enter the date of issuance for the permittee's most recent general obligation bond.

**Line 23b – Rating agency.** Enter the name of the rating agency for the most recent general obligation bond.

**Line 23c – Rating.** Enter the rating provided by the rating agency for the most recent general obligation bond.

**Line 24a – Date of most recent revenue (water or sewer) bond.** Enter the date of issuance for the permittee's most recent revenue obligation bond.

**Line 24b – Rating agency.** Enter the name of the rating agency for the most recent revenue bond.

**Line 24c – Bond insurance.** Indicate whether bond insurance was required.

**Line 24d – Rating.** Enter the rating provided by the rating agency for the most recent revenue bond.

**Line 25 – Bond rating.** For the more recent of the bonds entered in Lines 23 and 24, enter a bond rating benchmark according to the schedule below:

If the rating agency is Moody's Investor Services, enter "Strong" for a rating of Aaa, AA, or A; "Mid-Range" for a rating of Baa; "Weak" otherwise.

If the rating agency is Standard & Poor's, enter "Strong" for a rating of AAA, AA, or A; "Mid-Range" for a rating of BBB; "Weak" otherwise.

Note: this information is also used in Line 48a of Schedule 6–CSO AFFORDABILTY.

## Overall Net Debt

Overall net debt is debt repaid by property taxes in the permittee's service area. It excludes debt which is repaid by special user fees (e.g. revenue debt). This indicator provides a measure of the debt burden on residents within the permittee's service area, and it assesses the ability of local governmental jurisdictions to issue additional debt. Net debt includes the debt issued directly by the local jurisdiction and debt of overlapping entities such as school districts. This indicator compares the level of debt owed by the service area population with the full market value of real property used to support that debt, and it serves as a measure of financial wealth in the permittee's service area.

**Line 26 – Direct net debt (G.O. bonds excluding double-barreled bonds).** Enter the amount of general obligation debt outstanding that is supported by the property in the permittee's service area. General obligation bonds are secured by the "full faith and credit" of the community and are payable from general tax revenues. This debt amount excludes general obligation bonds that are payable from some dedicated user fees or specific revenue source other than the general tax revenues. These general obligation bonds are called "double-barreled bonds."

Debt information is available from the financial statements of each community. In most cases the most recent financial statements are on file with the state (e.g. State Auditor's Office). Overlapping debt may or may not be provided in a community's financial statements. The property assessment data should be readily available through the community or the State's assessor office. The boundary of most permittees' service areas generally conforms to one or more community boundaries. Therefore, prorating community data to reflect specific service area boundaries is not normally necessary for evaluating the general financial capability of the permittee.

**Line 27 – Debt of overlapping entities (proportionate share of multi-jurisdictional debt).** Calculate the permittee's service area's share of any debt from overlapping entities using the process described. For each overlapping entity,

1. Identify the total amount of tax-supported outstanding debt for each overlapping entity in Column A and enter it in Column B. Money in a sinking fund is not included in the outstanding debt since it represents periodic deposits into an account to ensure the availability of sufficient monies to make timely debt service payments.

2. Identify the percentage of each overlapping entity's outstanding debt charged to persons or property in the permittee's service area and enter it in Column C. The percentage is based on the estimated full market value of real property of the respective jurisdictions.

3. Multiply the total outstanding debt of each overlapping entity by the percentage identified for the permittee's service area (Column B x C).

4. Add the figures and enter in Column D to arrive at total overlapping debt for permittee's service area.

**Line 28 – Overall net debt.** Add the direct net debt on Line 26 to the overlapping entities debt on Line 27.

**Line 29 – Full market property value (MPV).** The MPV reflects the full market value of property within the permittee's service area. It is possible that the tax assessed property value will not reflect full market value. This occurs when the tax assessment ratio is less than one. In such cases the full market value of property is computed by dividing the total tax assessment value by the assessment ratio (the assessment ratio represents the percentage of the full market value that is taxed at the established tax rate), For example, if the assessed value is $1,000,000 and the assessment ratio is 50 percent then the full market value of real property is $1,000,000/.50= $2,000,000.

**Line 30 – Overall net debt as a percent of full market value of property.** Divide Line 28 by Line 29, then multiply by 100, and enter this value on Line 30.

**Line 31 – Net debt benchmark.** If the value in Line 30 is greater than 5, enter “Weak”. If the value is less than 2, enter “Strong”. Otherwise, enter “Mid-Range”. Note: this information is also used in Line 48b of Schedule 6–AFFORDABILTY.

## Socioeconomic Indicators

The socioeconomic indicators are used to assess the general economic well-being of residential users in the permittee's service area. The indicators used to assess economic conditions are unemployment rate and MHI. When the permittee has additional socioeconomic data, it may want to submit the data to the appropriate EPA and state NPDES authorities to facilitate a better understanding of the permittee's unique economic conditions. Several examples of this type of socioeconomic data could be poverty rate, population growth, and employment projections.

## Unemployment Rate

The unemployment rate is defined as the percent of a permittee's service area residents on the unemployment rolls. The Bureau of Labor Statistics (BLS) maintains current unemployment rate figures for municipalities and counties over 25,000 population. National and state unemployment data are also available for comparison purposes.

**Line 32 – Unemployment rate for permittee service area.** Enter the unemployment rate for the permittee's service area. Please be sure to use the correct value to represent the percentage. The spreadsheet interprets the number entered as that percent, so the permittee would enter 6 for 6 percent, etc. If doing the calculations by hand, use 0.06 for 6 percent. Please indicate the source in the line below the question.

**Line 33 – Unemployment rate for permittee's county.** Enter the unemployment rate for the permittee's county. Please be sure to use the correct value to represent the percentage. The spreadsheet interprets the number entered as that percent, so the permittee would enter 6 for 6 percent, etc. If doing the calculations by hand, use 0.06 for 6 percent. This will only be used when the unemployment rate for a permittee's service area is not available. Please indicate the source in the line below the question.

**Line 34 – Average national unemployment rate.** Enter the current average national unemployment rate. Be sure to use the correct value to represent the percentage. The spreadsheet interprets the number entered as that percent, so the permittee would enter 6 for 6 percent, etc. If doing the calculations by hand, use 0.06 for 6 percent. Please indicate the source of this number on the line below the question.

**Line 35 – Unemployment Rate Benchmark.** If the local unemployment rate is 1% or more below the national average, enter "Strong." If the local rate is 1% or more above the national average, enter "Weak." Otherwise, enter "Mid-Range."

For example, if the national average unemployment rate is 6 percent, and the unemployment rate for the permittee service area was 7 percent, the unemployment rate benchmark would be "weak." If the unemployment rate for the permittee service area was 5 percent, the unemployment rate benchmark would be "strong."

Note: this information is also used in Line 48c of Schedule 6–AFFORDABILTY.

## Median Household Income

MHI is defined as the median amount of total income dollars received per household during a calendar year in a given area. It serves as an overall indicator of community earning capacity.

**Line 36 – Median household income - permittee.** Copy the value already entered in Line 20.

**Line 37 – Census Year national MHI.** Enter the most recent census value for National Median Household Income. The National Average MHI in 2004 was $44,389 (http://www.census.gov/Press-Release/www/releases/archives/income_wealth/005647.html).

**Line 38 – MHI adjustment factor.** Copy the value from Line 19.

**Line 39 - Adjusted MHI.** Multiply the national MHI from Line 37 by the MHI adjustment factor in Line 38.

**Line 40 – MHI Benchmark.** If the permittee MHI in Line 36 is less than 75% of the adjusted national MHI in Line 39, enter "Weak". If the permittee MHI is more than 125% of the adjusted national MHI, enter "Strong"; otherwise, enter "Mid-Range". Note: this information is also used in Line 48d of Schedule 6–AFFORDABILTY.

## Financial Management Indicators

The financial management indicators used to evaluate a permittee's financial management ability are property tax revenue as a percent of full market value of real property and property tax revenue collection rate.

*Property Tax Revenues as a Percent of Full Market Property Value*

This indicator can be referred to as the "property tax burden" since it indicates the funding capacity available to support debt based on the wealth of the community. It also reflects the effectiveness of management in providing community services.

The property assessment data should be readily available through the community or the State's assessor office (see instructions for Line 29). Property tax revenues are available in communities' annual financial statements. Occasionally, the assessment and tax revenue data of communities partially serviced by the permittee may need to be prorated to provide a clearer picture of the permittee's property tax burden.

**Line 41 – Full market value of real property.** Copy the value from Line 29.

**Line 42 – Property tax revenues.** Enter the most recent year's property tax revenue. General fund revenues are primarily property tax receipts.

**Line 43 – Property tax revenues as a percent of full MPV**. Divide Line 42 by Line 41, then multiply by 100 and enter the result on Line 43.

**Line 44 – Property Tax Benchmark.** If the value in Line 43 is above 4%, enter "Weak". If the value is below 2%, enter "Strong". Otherwise, enter "Mid-Range". Note: this information is also used in Line 48e of Schedule 6–AFFORDABILTY.

## Property Tax and Collection Rate

The property tax revenue collection rate is an indicator of the efficiency of the tax collection system and the acceptability of tax levels to residents.

Property taxes levied can be computed by multiplying the assessed value of real property by the property tax rate, both of which are available from a community's financial statements or the state assessor's office. Property tax revenues are available in communities' annual financial statements. Occasionally, the assessment and tax revenue data of communities partially serviced by the permittee may have to be prorated to provide a clearer picture of the permittee's property tax revenue collection rate.

**Line 45 – Property taxes levied.** Enter the property taxes levied on Line 45.

**Line 46 – Property tax revenue collection rate.** Divide Line 42 by Line 45, and then multiply by 100 to present the collection rate as a percentage. Enter this value on Line 46.

**Line 47 – Collection Rate Benchmark**. If the value in Line 46 is below 94, enter "Weak." If the value is above 98, enter "Strong". Otherwise, enter "Mid-Range." Note: this information is also used in Line 48f of Schedule 6–AFFORDABILTY.

## Matrix Score: Analyzing Permittee Financial Capability Indicators

This section describes how the indicators in the second phase may be used to generate an overall score of a permittee's financial capability. The indicators are compared to national benchmarks to form an overall assessment of the permittee's financial capability and its effect on implementation schedules in the long-term CSO control plan or on long-term plans for wastewater treatment.

In situations where a permittee has unique circumstances that may affect financial capability, the permittee may submit documentation of the unique financial conditions to the appropriate EPA and state NPDES authorities for consideration. The purpose of additional information is to clarify unique circumstances that are not adequately represented by the overall scores of the selected indicators. An example of a unique financial situation might be where a state or community imposes restrictions on the property taxes that are used to fund sewer service.

**Line 48 – Scoring of Financial Capability Benchmarks.** For each benchmark completed in this form, enter the benchmark and the corresponding score ("Weak" = 1, "Mid-Range" = 2, "Strong" = 3), then sum the scores to Line 48g. Each line is described below.

**Line 48a – Bond Rating.** Enter the bond rating on Line 48a (Line 25 on Schedule 6 – AFFORDABILITY. If you are using the electronic version of the form, this value will have been filled in automatically).

**Line 48b – Net Debt.** Enter the net debt on Line 48b (Line 31 on Schedule 6 – AFFORDABILITY. If you are using the electronic version of the form, this value will have been filled in automatically).

**Line 48c – Unemployment Rate.** Enter the unemployment rate on Line 48c (Line 35 on Schedule 6 – AFFORDABILITY. If you are using the electronic version of the form, this value will have been filled in automatically).

**Line 48d – Median Household Income.** Enter the median household income on Line 48d (Line 40 on Schedule 6 – AFFORDABILITY. If you are using the electronic version of the form, this value will have been filled in automatically).

**Line 48e – Property Tax.** Enter the property tax on Line 48e (Line 44 on Schedule 6 – AFFORDABILITY. If you are using the electronic version of the form, this value will have been filled in automatically).

**Line 48f – Collection Rate.** Enter the collection rate on Line 48f (Line 47 on Schedule 6 – AFFORDABILITY. If you are using the electronic version of the form, this value will have been filled in automatically).

**Line 48g – Sum.** Enter the total by adding 48a through 48f together.

**Line 49 – Permittee indicators score.** Divide the result in Line 48g by the number of benchmarks completed to determine the average financial capability score.

**Line 50 – Permittee Financial Capability Indicators Descriptor.** If the value in Line 49 is less than 1.5, enter "Weak". If the value is greater than 2.5, enter "Strong". Otherwise, enter "Mid-Range".

**Line 51 – Permittee Residential Indicator Benchmark.** Copy from Line 22.

**Line 52 – Financial Capability.** Using Table CAF 4, cross-index the Financial Capability benchmark result in Line 50 with the Residential Indicator benchmark result in Line 51 to determine overall financial capability.

Table CAF 4 – Financial Capability

| Permittee Capability (Socioeconomic, Debt, and Financial Indicators) | Residential (Cost per Household as %MHI) | | |
|---|---|---|---|
| | Low | Mid-Range | High |
| Weak | Medium Burden | High Burden | High Burden |
| Mid-Range | Low Burden | Medium Burden | High Burden |
| Strong | Low Burden | Low Burden | Medium Burden |

# GLOSSARY OF TERMS

This glossary includes a collection of the terms used in this manual and an explanation of each term. To the extent that definitions and explanations provided in this glossary differ from those in EPA regulations or other official documents, they are intended to assist in understanding this manual only and have no legal effect.

**Biochemical Oxygen Demand (BOD)** – A measure of the amount of oxygen consumed by microorganisms from the decomposition of organic material in water over a specified time period (usually five days, indicated as $BOD_5$). The $BOD_5$ value is used in many applications, most commonly to indicate the effects of sewage and other organic wastes on dissolved oxygen in water.

**Cause of Impairment** – Where possible, states, tribes and other jurisdictions identify the pollutants or stressors causing water quality impairment. These causes of impairment keep waters from meeting the water quality standards adopted by the states to protect designated uses. Causes of impairment include chemical contaminants (such as PCBs, metals, and oxygen-depleting substances), physical conditions (such as elevated temperature, excessive siltation, or alterations of habitat), and biological contaminants (such as bacteria and noxious aquatic weeds).

**Class A Waters** – A Use Classification used by some states in their water quality standards to designate high quality waters.

**Combined Sewer Overflow (CSO)** – A discharge of untreated wastewater from a combined sewer system at a point prior to the headworks of a publicly owned treatment work (POTW) treatment plant.

**Combined Sewer System (CSS)** – A municipal wastewater collection system that conveys domestic, commercial, and industrial wastewaters and stormwater through a single pipe system to a publicly owned treatment work treatment plant.

**Combined Sewage** – Wastewater and storm water carried in the same pipe by design.

**Consumer Price Index (CPI) -** A statistical time-series measure of a weighted average of prices of a specified set of goods and services purchased by consumers.

**CSO Control Policy** – EPA published the CSO Control Policy on April 19, 1994 (59 FR 18688). The Policy includes provisions for developing appropriate, site-specific NPDES permit requirements for combined sewer systems that overflow as a result of wet weather events.

**Dissolved Oxygen (DO)** – The oxygen freely available in water, which is vital for sustaining fish and other aquatic life as well as for preventing odors. DO levels are considered one of the most important indicators of a waterbody's ability to support desirable aquatic life. Secondary treatment and advanced waste treatment are generally designed to ensure adequate DO in the water that receives WWTP effluent.

**Dry Weather Flow Conditions** – Hydraulic flow conditions within the combined sewer system resulting from one or more of the following: flows of domestic sewage; ground water infiltration; and commercial and industrial wastewaters.

**Dry Weather CSO** – An unauthorized discharge from a combined sewer system that occurs during dry weather conditions.

**First Flush** – The occurrence of higher concentrations of pollutants in storm water or CSO discharges at the beginning of a storm.

**Floatables and Trash** – Visible buoyant or semi-buoyant solids including organic matter, personal hygiene items, plastics, styrofoam, paper, rubber, glass and wood.

**Headworks of a Wastewater Treatment Plant** – The initial structures, devices, and processes receiving flows from the sewer system at a wastewater treatment plant, including screening, pumping, measuring, and grit removal facilities.

**Hyetograph –** A graphical representation of the distribution of rainfall over time.

**Imperviousness** – The fraction (%) of a sub-sewershed that is covered by non-infiltrating surfaces such as concrete, asphalt, and buildings.

**Infiltration** – Storm water and groundwater that enter a sewer system through such means as defective pipes, pipe joints, connections, or manholes. (Infiltration does not include inflow.)

**Infiltration/Inflow (I/I)** – The total quantity of water from both infiltration and inflow.

**Inflow** – Water, other than wastewater, that enters a sewer system from sources such as roof leaders, cellar drains, yard drains, area drains, foundation drains, drains from springs and swampy areas, manhole covers, cross connections between storm drains and sanitary sewers, catch basins, cooling towers, storm waters, surface runoff, street wash waters, or other drainage. (Inflow does not include infiltration).

**Interceptor Sewers** – A sewer without building sewer connections which is used to collect and carry flows from main and trunk sewers to a central point for treatment and discharge.

**Long-Term Control Plan (LTCP)** – A water quality-based CSO control plan that is ultimately intended to result in compliance with the Clean Water Act. As described in the 1994 CSO Control Policy, long-term control plans should consider the site-specific nature of CSOs and evaluate the cost effectiveness of a range of controls.

**Median Household Income (MHI)** - MHI is defined as the median amount of total income dollars received per household during a calendar year in a given geographical area.

**Million Gallons per Day (MGD)** – A rate of flow commonly used for wastewater discharges. One MGD is equivalent to a flow rate of 1.547 cubic feet per second over a 24-hour period.

**National Pollutant Discharge Elimination System (NPDES)** –The national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits to control the discharge of pollutants into waters of the United States, and imposing and enforcing pretreatment requirements, under Sections 307, 318, 402, and 405 of the Clean Water Act.

**Nine Minimum Controls (NMC)** –The minimum technology-based CSO controls that can be used to address CSO problems without extensive engineering studies or significant construction costs prior to the implementation of long-term control measures. Municipalities were expected to implement the NMC and submit appropriate documentation to NPDES permitting authorities no later than January 1, 1997.

**Permittee** – An entity that holds a NPDES permit.  In the case of LTCP-EZ, the term should be interpreted to include any users of the LTCP-EZ Template.

**Permitting Authority –** The agency (state, federal, or Indian tribe) that administers the National Pollutant Discharge Elimination System (NPDES) permit program in a particular state.

**Primary Treatment** – First steps in wastewater treatment wherein screens and sedimentation tanks are used to remove most materials that float or will settle. Section 301(h) of the Clean Water Act, which addresses waivers from secondary treatment for discharges into marine waters, defines primary or equivalent treatment as that adequate to remove 30 percent of BOD and 30 percent of suspended solids.

**Publicly Owned Treatment Works (POTW)** – As defined by Section 212 of the Clean Water Act, a POTW is a treatment works that is owned by a state or municipality. This definition includes any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes, and other conveyances only if they convey wastewater to a POTW treatment plant.

**Rational Method** – A simple approach for estimating peak discharges for small drainage areas in which no significant flood storage occurs.

**Regulator** – A device in combined sewer systems for diverting wet weather flows that exceed downstream capacity in the sewer system to a CSO outfall.

**Sanitary Sewer System (SSS)** – A municipal wastewater collection system that conveys domestic, commercial and industrial wastewater and limited amounts of infiltrated ground water and storm water, to a POTW. Areas served by sanitary sewer systems often have a municipal separate storm sewer system to collect and convey runoff from rainfall and snowmelt.

**Satellite Sewer Systems** –Combined or sanitary sewer systems that convey flow to a publicly owned treatment works owned and operated by a separate entity.

**Secondary Treatment** – Technology-based requirements for direct discharging municipal sewage treatment facilities. 40 CFR 133.102 defines secondary treatment as 30 day averages of 30 mg/l $BOD_5$ and 30 mg/l suspended solids, along with maintenance of pH within 6.0 to 9.0 (except as provided for special considerations and treatment equivalent to secondary treatment).

**Sensitive Area** – An area of particular environmental significance or sensitivity that could be adversely affected by CSO discharges. Sensitive areas include Outstanding National Resource Waters, National Marine Sanctuaries, water with threatened or endangered species, waters with primary contact recreation, public drinking water intakes, shellfish beds, and other areas identified by the permittee or NPDES permitting authority, in coordination with the appropriate state or federal agencies.

**Sewer Separation** – Sewer separation is the process of separating a combined sewer system into sanitary and separate storm sewer systems. It is accomplished by constructing a new pipe system (either sanitary or separate storm) and diverting the appropriate types of flows (sanitary or storm) into the new sewers while allowing the existing sewers to carry only the other type of flow (storm or sanitary).

**Source of Impairment** – Where possible, states, tribes and other jurisdictions identify where pollutants or stressors (causes of impairment) are coming from. These sources of impairment are the activities, facilities, or conditions that generate the pollutants that keep waters from meeting the criteria adopted by the states to protect designated uses. Sources of impairment include, for example, municipal sewage treatment plants, factories, storm sewers, CSOs, modification of hydrology, agricultural runoff, and runoff from city streets.

**Sub-Sewershed Area** – An area within a CSS that drains to one CSO outfall.

**Tier III Waters -** Federal guidance establishes three levels or tiers of nondegradation, which is the model states are to use when adopting nondegradation provisions. Tier III provides the highest level of protection from pollution to waters specifically identified as very high quality, important recreational resources, ecologically sensitive or unique.

**Total Suspended Solids (TSS)** – A measure of the filterable solids present in a sample of water or wastewater (as determined by the method specified in 40 CFR Part 136).

**Wastewater Treatment Plant (WWTP)** – A facility containing a series of tanks, screens, filters, and other processes by which pollutants are removed from water.

**Water Quality Standards** –Standards established by regulatory agencies that consist of the beneficial use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular waterbody, and an antidegradation statement.

**Wet Weather Event** – A discharge from a combined sewer that occurs in direct response to rainfall or snowmelt.

**Wet Weather Flow** – Dry weather flow combined with stormwater introduced into a combined sewer.

**Wet Weather Flow Conditions** – Hydraulic flow conditions within the combined sewer system resulting from a wet weather event.

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# Appendix A

ONE-HOUR THREE-MONTH RAINFALL INTENSITIES,
SCHEDULE 4 – CSO VOLUME

| State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CT | Fairfield | 0.87 | IL | Johnson | 0.90 | IL | Will | 0.76 | IN | Miami | 0.71 |
| CT | Hartford | 0.87 | IL | Kane | 0.76 | IL | Williamson | 0.90 | IN | Monroe | 0.81 |
| CT | Litchfield | 0.87 | IL | Kankakee | 0.76 | IL | Winnebago | 0.78 | IN | Montgomery | 0.79 |
| CT | Middlesex | 0.87 | IL | Kendall | 0.76 | IL | Woodford | 0.76 | IN | Morgan | 0.74 |
| CT | New Haven | 0.87 | IL | Knox | 0.84 | IN | Adams | 0.65 | IN | Newton | 0.73 |
| CT | New London | 0.87 | IL | La Salle | 0.76 | IN | Allen | 0.65 | IN | Noble | 0.65 |
| CT | Tolland | 0.87 | IL | Lake | 0.76 | IN | Bartholomew | 0.74 | IN | Ohio | 0.74 |
| CT | Windham | 0.87 | IL | Lawrence | 0.79 | IN | Benton | 0.73 | IN | Orange | 0.81 |
| DE | Kent | 0.87 | IL | Lee | 0.78 | IN | Blackford | 0.69 | IN | Owen | 0.79 |
| DE | New Castle | 0.87 | IL | Livingston | 0.74 | IN | Boone | 0.74 | IN | Parke | 0.79 |
| DE | Sussex | 0.87 | IL | Logan | 0.76 | IN | Brown | 0.81 | IN | Perry | 0.81 |
| DC | DC | 0.87 | IL | Macon | 0.76 | IN | Carroll | 0.74 | IN | Pike | 0.83 |
| IL | Adams | 0.84 | IL | Macoupin | 0.79 | IN | Cass | 0.71 | IN | Porter | 0.73 |
| IL | Alexander | 0.90 | IL | Madison | 0.81 | IN | Clark | 0.74 | IN | Posey | 0.83 |
| IL | Bond | 0.81 | IL | Marion | 0.79 | IN | Clay | 0.79 | IN | Pulaski | 0.73 |
| IL | Boone | 0.78 | IL | Marshall | 0.76 | IN | Clinton | 0.74 | IN | Putnam | 0.79 |
| IL | Brown | 0.76 | IL | Mason | 0.76 | IN | Crawford | 0.81 | IN | Randolph | 0.69 |
| IL | Bureau | 0.78 | IL | Massac | 0.90 | IN | Daviess | 0.83 | IN | Ripley | 0.74 |
| IL | Calhoun | 0.79 | IL | McDonough | 0.84 | IN | Dearborn | 0.74 | IN | Rush | 0.74 |
| IL | Carroll | 0.78 | IL | McHenry | 0.76 | IN | Decatur | 0.74 | IN | Scott | 0.74 |
| IL | Cass | 0.79 | IL | McLean | 0.76 | IN | DeKalb | 0.65 | IN | Shelby | 0.74 |
| IL | Champaign | 0.74 | IL | Menard | 0.79 | IN | Delaware | 0.69 | IN | Spencer | 0.83 |
| IL | Christian | 0.79 | IL | Mercer | 0.78 | IN | Dubois | 0.83 | IN | St. Joseph | 0.71 |
| IL | Clark | 0.77 | IL | Monroe | 0.81 | IN | Elkhart | 0.71 | IN | Starke | 0.73 |
| IL | Clay | 0.79 | IL | Montgomery | 0.79 | IN | Fayette | 0.69 | IN | Steuben | 0.65 |
| IL | Clinton | 0.81 | IL | Morgan | 0.79 | IN | Floyd | 0.81 | IN | Sullivan | 0.83 |
| IL | Coles | 0.77 | IL | Moultrie | 0.77 | IN | Fountain | 0.79 | IN | Switzerland | 0.74 |
| IL | Cook | 0.76 | IL | Ogle | 0.78 | IN | Franklin | 0.74 | IN | Tippecanoe | 0.79 |
| IL | Crawford | 0.77 | IL | Peoria | 0.76 | IN | Fulton | 0.71 | IN | Tipton | 0.74 |
| IL | Cumberland | 0.77 | IL | Perry | 0.81 | IN | Gibson | 0.83 | IN | Union | 0.69 |
| IL | De Witt | 0.76 | IL | Piatt | 0.76 | IN | Grant | 0.74 | IN | Vanderburgh | 0.83 |
| IL | DeKalb | 0.76 | IL | Pike | 0.79 | IN | Greene | 0.83 | IN | Vermillion | 0.79 |
| IL | Douglas | 0.77 | IL | Pope | 0.90 | IN | Hamilton | 0.74 | IN | Vigo | 0.79 |
| IL | DuPage | 0.76 | IL | Pulaski | 0.90 | IN | Hancock | 0.74 | IN | Wabash | 0.71 |
| IL | Edgar | 0.77 | IL | Putnam | 0.78 | IN | Harrison | 0.81 | IN | Warren | 0.79 |
| IL | Edwards | 0.79 | IL | Randolph | 0.81 | IN | Hendricks | 0.74 | IN | Warrick | 0.83 |
| IL | Effingham | 0.77 | IL | Richland | 0.79 | IN | Henry | 0.69 | IN | Washington | 0.81 |
| IL | Fayette | 0.77 | IL | Rock Island | 0.78 | IN | Howard | 0.74 | IN | Wayne | 0.69 |
| IL | Ford | 0.74 | IL | Saline | 0.90 | IN | Huntington | 0.65 | IN | Wells | 0.65 |
| IL | Franklin | 0.79 | IL | Sangamon | 0.79 | IN | Jackson | 0.81 | IN | White | 0.73 |
| IL | Fulton | 0.76 | IL | Schuyler | 0.76 | IN | Jasper | 0.73 | IN | Whitley | 0.65 |
| IL | Gallatin | 0.90 | IL | Scott | 0.79 | IN | Jay | 0.69 | IA | Adair | 0.83 |
| IL | Greene | 0.79 | IL | Shelby | 0.77 | IN | Jefferson | 0.74 | IA | Adams | 0.83 |
| IL | Grundy | 0.76 | IL | St. Clair | 0.81 | IN | Jennings | 0.74 | IA | Allamakee | 0.70 |
| IL | Hamilton | 0.79 | IL | Stark | 0.76 | IN | Johnson | 0.74 | IA | Appanoose | 0.75 |
| IL | Hancock | 0.84 | IL | Stephenson | 0.78 | IN | Knox | 0.83 | IA | Audubon | 0.75 |
| IL | Hardin | 0.90 | IL | Tazewell | 0.76 | IN | Kosciusko | 0.71 | IA | Benton | 0.72 |
| IL | Henderson | 0.84 | IL | Union | 0.90 | IN | Lagrange | 0.65 | IA | Black Hawk | 0.70 |
| IL | Henry | 0.78 | IL | Vermilion | 0.74 | IN | Lake | 0.73 | IA | Boone | 0.72 |
| IL | Iroquois | 0.74 | IL | Wabash | 0.79 | IN | LaPorte | 0.73 | IA | Bremer | 0.70 |
| IL | Jackson | 0.90 | IL | Warren | 0.84 | IN | Lawrence | 0.81 | IA | Buchanan | 0.70 |
| IL | Jasper | 0.77 | IL | Washington | 0.81 | IN | Madison | 0.74 | IA | Buena Vista | 0.67 |
| IL | Jefferson | 0.79 | IL | Wayne | 0.79 | IN | Marion | 0.74 | IA | Butler | 0.71 |
| IL | Jersey | 0.79 | IL | White | 0.79 | IN | Marshall | 0.71 | IA | Calhoun | 0.75 |
| IL | Jo Daviess | 0.78 | IL | Whiteside | 0.78 | IN | Martin | 0.83 | IA | Carroll | 0.75 |

**Appendix A: One-Hour Three-Month Rainfall Intensities, SCHEDULE 4 – CSO VOLUME**

| State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IA | Cass | 0.83 | IA | Muscatine | 0.72 | KY | Clinton | 0.88 | KY | Meade | 0.88 |
| IA | Cedar | 0.72 | IA | O'Brien | 0.67 | KY | Crittenden | 0.93 | KY | Menifee | 0.80 |
| IA | Cerro Gordo | 0.71 | IA | Osceola | 0.67 | KY | Cumberland | 0.88 | KY | Mercer | 0.77 |
| IA | Cherokee | 0.67 | IA | Page | 0.83 | KY | Daviess | 0.93 | KY | Metcalfe | 0.88 |
| IA | Chickasaw | 0.70 | IA | Palo Alto | 0.67 | KY | Edmonson | 0.88 | KY | Monroe | 0.88 |
| IA | Clarke | 0.75 | IA | Plymouth | 0.67 | KY | Elliott | 0.80 | KY | Montgomery | 0.77 |
| IA | Clay | 0.67 | IA | Pocahontas | 0.67 | KY | Estill | 0.80 | KY | Morgan | 0.80 |
| IA | Clayton | 0.70 | IA | Polk | 0.72 | KY | Fayette | 0.77 | KY | Muhlenberg | 0.93 |
| IA | Clinton | 0.72 | IA | Pottawattamie | 0.83 | KY | Fleming | 0.77 | KY | Nelson | 0.88 |
| IA | Crawford | 0.75 | IA | Poweshiek | 0.72 | KY | Floyd | 0.80 | KY | Nicholas | 0.77 |
| IA | Dallas | 0.72 | IA | Ringgold | 0.75 | KY | Franklin | 0.77 | KY | Ohio | 0.93 |
| IA | Davis | 0.75 | IA | Sac | 0.75 | KY | Fulton | 0.93 | KY | Oldham | 0.77 |
| IA | Decatur | 0.75 | IA | Scott | 0.72 | KY | Gallatin | 0.77 | KY | Owen | 0.77 |
| IA | Delaware | 0.70 | IA | Shelby | 0.75 | KY | Garrard | 0.77 | KY | Owsley | 0.80 |
| IA | Des Moines | 0.75 | IA | Sioux | 0.67 | KY | Grant | 0.77 | KY | Pendleton | 0.77 |
| IA | Dickinson | 0.67 | IA | Story | 0.72 | KY | Graves | 0.93 | KY | Perry | 0.80 |
| IA | Dubuque | 0.70 | IA | Tama | 0.72 | KY | Grayson | 0.88 | KY | Pike | 0.80 |
| IA | Emmet | 0.67 | IA | Taylor | 0.83 | KY | Green | 0.88 | KY | Powell | 0.80 |
| IA | Fayette | 0.70 | IA | Union | 0.75 | KY | Greenup | 0.80 | KY | Pulaski | 0.80 |
| IA | Floyd | 0.71 | IA | Van Buren | 0.75 | KY | Hancock | 0.93 | KY | Robertson | 0.77 |
| IA | Franklin | 0.71 | IA | Wapello | 0.75 | KY | Hardin | 0.88 | KY | Rockcastle | 0.80 |
| IA | Fremont | 0.83 | IA | Warren | 0.75 | KY | Harlan | 0.80 | KY | Rowan | 0.80 |
| IA | Greene | 0.75 | IA | Washington | 0.75 | KY | Harrison | 0.77 | KY | Russell | 0.88 |
| IA | Grundy | 0.72 | IA | Wayne | 0.75 | KY | Hart | 0.88 | KY | Scott | 0.77 |
| IA | Guthrie | 0.75 | IA | Webster | 0.72 | KY | Henderson | 0.93 | KY | Shelby | 0.77 |
| IA | Hamilton | 0.72 | IA | Winnebago | 0.71 | KY | Henry | 0.77 | KY | Simpson | 0.93 |
| IA | Hancock | 0.71 | IA | Winneshiek | 0.70 | KY | Hickman | 0.93 | KY | Spencer | 0.77 |
| IA | Hardin | 0.72 | IA | Woodbury | 0.75 | KY | Hopkins | 0.93 | KY | Taylor | 0.88 |
| IA | Harrison | 0.75 | IA | Worth | 0.71 | KY | Jackson | 0.80 | KY | Todd | 0.93 |
| IA | Henry | 0.75 | IA | Wright | 0.71 | KY | Jefferson | 0.88 | KY | Trigg | 0.93 |
| IA | Howard | 0.70 | KY | Adair | 0.88 | KY | Jessamine | 0.77 | KY | Trimble | 0.77 |
| IA | Humboldt | 0.71 | KY | Allen | 0.88 | KY | Johnson | 0.80 | KY | Union | 0.93 |
| IA | Ida | 0.75 | KY | Anderson | 0.77 | KY | Kenton | 0.77 | KY | Warren | 0.88 |
| IA | Iowa | 0.72 | KY | Ballard | 0.93 | KY | Knott | 0.80 | KY | Washington | 0.77 |
| IA | Jackson | 0.72 | KY | Barren | 0.88 | KY | Knox | 0.80 | KY | Wayne | 0.80 |
| IA | Jasper | 0.72 | KY | Bath | 0.77 | KY | Larue | 0.88 | KY | Webster | 0.93 |
| IA | Jefferson | 0.75 | KY | Bell | 0.80 | KY | Laurel | 0.80 | KY | Whitley | 0.80 |
| IA | Johnson | 0.72 | KY | Boone | 0.77 | KY | Lawrence | 0.80 | KY | Wolfe | 0.80 |
| IA | Jones | 0.72 | KY | Bourbon | 0.77 | KY | Lee | 0.80 | KY | Woodford | 0.77 |
| IA | Keokuk | 0.75 | KY | Boyd | 0.80 | KY | Leslie | 0.80 | ME | Androscoggin | 0.75 |
| IA | Kossuth | 0.71 | KY | Boyle | 0.77 | KY | Letcher | 0.80 | ME | Aroostook | 0.62 |
| IA | Lee | 0.75 | KY | Bracken | 0.77 | KY | Lewis | 0.80 | ME | Cumberland | 0.75 |
| IA | Linn | 0.72 | KY | Breathitt | 0.80 | KY | Lincoln | 0.77 | ME | Franklin | 0.75 |
| IA | Louisa | 0.75 | KY | Breckinridge | 0.88 | KY | Livingston | 0.93 | ME | Hancock | 0.75 |
| IA | Lucas | 0.75 | KY | Bullitt | 0.88 | KY | Logan | 0.93 | ME | Kennebec | 0.75 |
| IA | Lyon | 0.67 | KY | Butler | 0.88 | KY | Lyon | 0.93 | ME | Knox | 0.75 |
| IA | Madison | 0.75 | KY | Calloway | 0.93 | KY | Madison | 0.77 | ME | Lincoln | 0.75 |
| IA | Mahaska | 0.75 | KY | Campbell | 0.77 | KY | Magoffin | 0.80 | ME | Oxford | 0.87 |
| IA | Marion | 0.75 | KY | Carlisle | 0.93 | KY | Marion | 0.88 | ME | Penobscot | 0.75 |
| IA | Marshall | 0.72 | KY | Carroll | 0.77 | KY | Marshall | 0.93 | ME | Piscataquis | 0.75 |
| IA | Mills | 0.83 | KY | Carter | 0.80 | KY | Martin | 0.80 | ME | Sagadahoc | 0.75 |
| IA | Mitchell | 0.71 | KY | Casey | 0.88 | KY | Mason | 0.77 | ME | Somerset | 0.75 |
| IA | Monona | 0.75 | KY | Christian | 0.93 | KY | McCracken | 0.93 | ME | Waldo | 0.75 |
| IA | Monroe | 0.75 | KY | Clark | 0.77 | KY | McCreary | 0.80 | ME | Washington | 0.75 |
| IA | Montgomery | 0.83 | KY | Clay | 0.80 | KY | McLean | 0.93 | ME | York | 0.75 |

| State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MD | Allegany | 0.75 | MI | Clare | 0.56 | MI | Saginaw | 0.52 | MO | Howard | 0.76 |
| MD | Anne Arundel | 0.87 | MI | Clinton | 0.61 | MI | Sanilac | 0.52 | MO | Howell | 0.84 |
| MD | Baltimore | 0.87 | MI | Crawford | 0.51 | MI | Schoolcraft | 0.50 | MO | Iron | 0.84 |
| MD | Baltimore City | 0.87 | MI | Delta | 0.50 | MI | Shiawassee | 0.61 | MO | Jackson | 0.76 |
| MD | Calvert | 0.87 | MI | Dickinson | 0.59 | MI | St. Clair | 0.56 | MO | Jasper | 0.90 |
| MD | Caroline | 0.87 | MI | Eaton | 0.61 | MI | St. Joseph | 0.61 | MO | Jefferson | 0.84 |
| MD | Carroll | 0.87 | MI | Emmet | 0.49 | MI | Tuscola | 0.52 | MO | Johnson | 0.84 |
| MD | Cecil | 0.87 | MI | Genesee | 0.56 | MI | Van Buren | 0.59 | MO | Knox | 0.75 |
| MD | Charles | 0.87 | MI | Gladwin | 0.56 | MI | Washtenaw | 0.56 | MO | Laclede | 0.90 |
| MD | Dorchester | 0.87 | MI | Gogebic | 0.59 | MI | Wayne | 0.56 | MO | Lafayette | 0.76 |
| MD | Frederick | 0.87 | MI | Grand Traverse | 0.49 | MI | Wexford | 0.49 | MO | Lawrence | 0.90 |
| MD | Garrett | 0.75 | MI | Gratiot | 0.56 | MO | Adair | 0.75 | MO | Lewis | 0.75 |
| MD | Harford | 0.87 | MI | Hillsdale | 0.61 | MO | Andrew | 0.76 | MO | Lincoln | 0.75 |
| MD | Howard | 0.87 | MI | Houghton | 0.59 | MO | Atchison | 0.76 | MO | Linn | 0.76 |
| MD | Kent | 0.87 | MI | Huron | 0.52 | MO | Audrain | 0.75 | MO | Livingston | 0.76 |
| MD | Montgomery | 0.87 | MI | Ingham | 0.61 | MO | Barry | 0.90 | MO | Macon | 0.75 |
| MD | Prince George's | 0.87 | MI | Ionia | 0.61 | MO | Barton | 0.90 | MO | Madison | 0.84 |
| MD | Queen Anne's | 0.87 | MI | Iosco | 0.51 | MO | Bates | 0.84 | MO | Maries | 0.84 |
| MD | Somerset | 1.00 | MI | Iron | 0.59 | MO | Benton | 0.84 | MO | Marion | 0.75 |
| MD | St. Mary's | 0.87 | MI | Isabella | 0.56 | MO | Bollinger | 0.84 | MO | McDonald | 0.90 |
| MD | Talbot | 0.87 | MI | Jackson | 0.61 | MO | Boone | 0.75 | MO | Mercer | 0.76 |
| MD | Washington | 0.75 | MI | Kalamazoo | 0.59 | MO | Buchanan | 0.76 | MO | Miller | 0.84 |
| MD | Wicomico | 0.87 | MI | Kalkaska | 0.49 | MO | Butler | 0.84 | MO | Mississippi | 0.90 |
| MD | Worcester | 1.00 | MI | Kent | 0.59 | MO | Caldwell | 0.76 | MO | Moniteau | 0.84 |
| MA | Barnstable | 0.87 | MI | Keweenaw | 0.59 | MO | Callaway | 0.75 | MO | Monroe | 0.75 |
| MA | Berkshire | 0.75 | MI | Lake | 0.53 | MO | Camden | 0.84 | MO | Montgomery | 0.75 |
| MA | Bristol | 0.87 | MI | Lapeer | 0.56 | MO | Cape Girardeau | 0.84 | MO | Morgan | 0.84 |
| MA | Dukes | 0.87 | MI | Leelanau | 0.49 | MO | Carroll | 0.76 | MO | New Madrid | 0.90 |
| MA | Essex | 0.87 | MI | Lenawee | 0.56 | MO | Carter | 0.84 | MO | Newton | 0.90 |
| MA | Franklin | 0.75 | MI | Livingston | 0.56 | MO | Cass | 0.84 | MO | Nodaway | 0.76 |
| MA | Hampden | 0.87 | MI | Luce | 0.50 | MO | Cedar | 0.84 | MO | Oregon | 0.84 |
| MA | Hampshire | 0.75 | MI | Mackinac | 0.50 | MO | Chariton | 0.76 | MO | Osage | 0.75 |
| MA | Middlesex | 0.87 | MI | Macomb | 0.56 | MO | Christian | 0.90 | MO | Ozark | 0.90 |
| MA | Nantucket | 0.87 | MI | Manistee | 0.49 | MO | Clark | 0.75 | MO | Pemiscot | 0.90 |
| MA | Norfolk | 0.87 | MI | Marquette | 0.59 | MO | Clay | 0.76 | MO | Perry | 0.84 |
| MA | Plymouth | 0.87 | MI | Mason | 0.53 | MO | Clinton | 0.76 | MO | Pettis | 0.84 |
| MA | Suffolk | 0.87 | MI | Mecosta | 0.56 | MO | Cole | 0.84 | MO | Phelps | 0.84 |
| MA | Worcester | 0.87 | MI | Menominee | 0.59 | MO | Cooper | 0.84 | MO | Pike | 0.75 |
| MI | Alcona | 0.51 | MI | Midland | 0.56 | MO | Crawford | 0.84 | MO | Platte | 0.76 |
| MI | Alger | 0.50 | MI | Missaukee | 0.49 | MO | Dade | 0.90 | MO | Polk | 0.90 |
| MI | Allegan | 0.59 | MI | Monroe | 0.56 | MO | Dallas | 0.90 | MO | Pulaski | 0.84 |
| MI | Alpena | 0.51 | MI | Montcalm | 0.56 | MO | Daviess | 0.76 | MO | Putnam | 0.76 |
| MI | Antrim | 0.49 | MI | Montmorency | 0.51 | MO | DeKalb | 0.76 | MO | Ralls | 0.75 |
| MI | Arenac | 0.52 | MI | Muskegon | 0.53 | MO | Dent | 0.84 | MO | Randolph | 0.75 |
| MI | Baraga | 0.59 | MI | Newaygo | 0.53 | MO | Douglas | 0.90 | MO | Ray | 0.76 |
| MI | Barry | 0.61 | MI | Oakland | 0.56 | MO | Dunklin | 0.90 | MO | Reynolds | 0.84 |
| MI | Bay | 0.52 | MI | Oceana | 0.53 | MO | Franklin | 0.75 | MO | Ripley | 0.84 |
| MI | Benzie | 0.49 | MI | Ogemaw | 0.51 | MO | Gasconade | 0.75 | MO | Saline | 0.76 |
| MI | Berrien | 0.59 | MI | Ontonagon | 0.59 | MO | Gentry | 0.76 | MO | Schuyler | 0.75 |
| MI | Branch | 0.61 | MI | Osceola | 0.56 | MO | Greene | 0.90 | MO | Scotland | 0.75 |
| MI | Calhoun | 0.61 | MI | Oscoda | 0.51 | MO | Grundy | 0.76 | MO | Scott | 0.90 |
| MI | Cass | 0.59 | MI | Otsego | 0.51 | MO | Harrison | 0.76 | MO | Shannon | 0.84 |
| MI | Charlevoix | 0.49 | MI | Ottawa | 0.59 | MO | Henry | 0.84 | MO | Shelby | 0.75 |
| MI | Cheboygan | 0.51 | MI | Presque Isle | 0.51 | MO | Hickory | 0.84 | MO | St. Charles | 0.75 |
| MI | Chippewa | 0.50 | MI | Roscommon | 0.51 | MO | Holt | 0.76 | MO | St. Clair | 0.84 |

**Appendix A: One-Hour Three-Month Rainfall Intensities, SCHEDULE 4 – CSO VOLUME**

| State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MO | St. Francois | 0.84 | NY | Chenango | 0.75 | OH | Allen | 0.61 | OH | Montgomery | 0.70 |
| MO | St. Louis | 0.75 | NY | Clinton | 0.62 | OH | Ashland | 0.63 | OH | Morgan | 0.61 |
| MO | St. Louis City | 0.75 | NY | Columbia | 0.75 | OH | Ashtabula | 0.61 | OH | Morrow | 0.65 |
| MO | Ste. Genevieve | 0.84 | NY | Cortland | 0.75 | OH | Athens | 0.61 | OH | Muskingum | 0.61 |
| MO | Stoddard | 0.90 | NY | Delaware | 0.75 | OH | Auglaize | 0.65 | OH | Noble | 0.61 |
| MO | Stone | 0.90 | NY | Dutchess | 1.00 | OH | Belmont | 0.61 | OH | Ottawa | 0.60 |
| MO | Sullivan | 0.76 | NY | Erie | 0.62 | OH | Brown | 0.70 | OH | Paulding | 0.61 |
| MO | Taney | 0.90 | NY | Essex | 0.62 | OH | Butler | 0.70 | OH | Perry | 0.61 |
| MO | Texas | 0.84 | NY | Franklin | 0.62 | OH | Carroll | 0.61 | OH | Pickaway | 0.65 |
| MO | Vernon | 0.84 | NY | Fulton | 0.75 | OH | Champaign | 0.65 | OH | Pike | 0.69 |
| MO | Warren | 0.75 | NY | Genesee | 0.62 | OH | Clark | 0.65 | OH | Portage | 0.61 |
| MO | Washington | 0.84 | NY | Greene | 0.87 | OH | Clermont | 0.70 | OH | Preble | 0.70 |
| MO | Wayne | 0.84 | NY | Hamilton | 0.62 | OH | Clinton | 0.70 | OH | Putnam | 0.61 |
| MO | Webster | 0.90 | NY | Herkimer | 0.62 | OH | Columbiana | 0.61 | OH | Richland | 0.63 |
| MO | Worth | 0.76 | NY | Jefferson | 0.62 | OH | Coshocton | 0.63 | OH | Ross | 0.69 |
| MO | Wright | 0.90 | NY | Kings | 0.87 | OH | Crawford | 0.60 | OH | Sandusky | 0.60 |
| NH | Belknap | 0.75 | NY | Lewis | 0.62 | OH | Cuyahoga | 0.61 | OH | Scioto | 0.69 |
| NH | Carroll | 0.87 | NY | Livingston | 0.62 | OH | Darke | 0.65 | OH | Seneca | 0.60 |
| NH | Cheshire | 0.75 | NY | Madison | 0.75 | OH | Defiance | 0.61 | OH | Shelby | 0.65 |
| NH | Coos | 0.87 | NY | Monroe | 0.62 | OH | Delaware | 0.65 | OH | Stark | 0.61 |
| NH | Grafton | 0.75 | NY | Montgomery | 0.75 | OH | Erie | 0.60 | OH | Summit | 0.61 |
| NH | Hillsborough | 0.75 | NY | Nassau | 0.87 | OH | Fairfield | 0.65 | OH | Trumbull | 0.61 |
| NH | Merrimack | 0.75 | NY | New York | 0.87 | OH | Fayette | 0.65 | OH | Tuscarawas | 0.61 |
| NH | Rockingham | 0.75 | NY | Niagara | 0.62 | OH | Franklin | 0.65 | OH | Union | 0.65 |
| NH | Strafford | 0.75 | NY | Oneida | 0.75 | OH | Fulton | 0.61 | OH | Van Wert | 0.61 |
| NH | Sullivan | 0.75 | NY | Onondaga | 0.75 | OH | Gallia | 0.69 | OH | Vinton | 0.61 |
| NJ | Atlantic | 0.87 | NY | Ontario | 0.62 | OH | Geauga | 0.61 | OH | Warren | 0.70 |
| NJ | Bergen | 0.87 | NY | Orange | 0.87 | OH | Greene | 0.70 | OH | Washington | 0.61 |
| NJ | Burlington | 0.87 | NY | Orleans | 0.62 | OH | Guernsey | 0.61 | OH | Wayne | 0.63 |
| NJ | Camden | 0.87 | NY | Oswego | 0.62 | OH | Hamilton | 0.70 | OH | Williams | 0.61 |
| NJ | Cape May | 0.87 | NY | Otsego | 0.75 | OH | Hancock | 0.61 | OH | Wood | 0.61 |
| NJ | Cumberland | 0.87 | NY | Putnam | 0.87 | OH | Hardin | 0.65 | OH | Wyandot | 0.60 |
| NJ | Essex | 0.87 | NY | Queens | 0.87 | OH | Harrison | 0.61 | PA | Adams | 0.75 |
| NJ | Gloucester | 0.87 | NY | Rensselaer | 0.75 | OH | Henry | 0.61 | PA | Allegheny | 0.75 |
| NJ | Hudson | 0.87 | NY | Richmond | 0.87 | OH | Highland | 0.70 | PA | Armstrong | 0.75 |
| NJ | Hunterdon | 0.87 | NY | Rockland | 0.87 | OH | Hocking | 0.61 | PA | Beaver | 0.75 |
| NJ | Mercer | 0.87 | NY | Saratoga | 0.75 | OH | Holmes | 0.63 | PA | Bedford | 0.75 |
| NJ | Middlesex | 0.87 | NY | Schenectady | 0.75 | OH | Huron | 0.60 | PA | Berks | 0.87 |
| NJ | Monmouth | 0.87 | NY | Schoharie | 0.75 | OH | Jackson | 0.69 | PA | Blair | 0.75 |
| NJ | Morris | 0.87 | NY | Schuyler | 0.75 | OH | Jefferson | 0.61 | PA | Bradford | 0.75 |
| NJ | Ocean | 0.87 | NY | Seneca | 0.75 | OH | Knox | 0.63 | PA | Bucks | 0.87 |
| NJ | Passaic | 0.87 | NY | St. Lawrence | 0.62 | OH | Lake | 0.61 | PA | Butler | 0.75 |
| NJ | Salem | 0.87 | NY | Steuben | 0.75 | OH | Lawrence | 0.69 | PA | Cambria | 0.75 |
| NJ | Somerset | 0.87 | NY | Suffolk | 0.87 | OH | Licking | 0.65 | PA | Cameron | 0.75 |
| NJ | Sussex | 0.87 | NY | Sullivan | 0.87 | OH | Logan | 0.65 | PA | Carbon | 0.75 |
| NJ | Union | 0.87 | NY | Tioga | 0.75 | OH | Lorain | 0.60 | PA | Centre | 0.75 |
| NJ | Warren | 0.87 | NY | Tompkins | 0.75 | OH | Lucas | 0.61 | PA | Chester | 0.87 |
| NY | Albany | 0.75 | NY | Ulster | 1.00 | OH | Madison | 0.65 | PA | Clarion | 0.75 |
| NY | Allegany | 0.75 | NY | Warren | 0.62 | OH | Mahoning | 0.61 | PA | Clearfield | 0.75 |
| NY | Bronx | 0.87 | NY | Washington | 0.75 | OH | Marion | 0.65 | PA | Clinton | 0.75 |
| NY | Broome | 0.75 | NY | Wayne | 0.62 | OH | Medina | 0.61 | PA | Columbia | 0.75 |
| NY | Cattaraugus | 0.75 | NY | Westchester | 0.87 | OH | Meigs | 0.69 | PA | Crawford | 0.62 |
| NY | Cayuga | 0.75 | NY | Wyoming | 0.62 | OH | Mercer | 0.65 | PA | Cumberland | 0.75 |
| NY | Chautauqua | 0.62 | NY | Yates | 0.75 | OH | Miami | 0.65 | PA | Dauphin | 0.75 |
| NY | Chemung | 0.75 | OH | Adams | 0.69 | OH | Monroe | 0.61 | PA | Delaware | 0.87 |

| State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PA | Elk | 0.75 | VT | Grand Isle | 0.62 | VA | Hanover | 0.87 | VA | Suffolk | 1.00 |
| PA | Erie | 0.62 | VT | Lamoille | 0.62 | VA | Henrico | 0.87 | VA | Surry | 1.00 |
| PA | Fayette | 0.75 | VT | Orange | 0.62 | VA | Henry | 1.00 | VA | Sussex | 1.00 |
| PA | Forest | 0.75 | VT | Orleans | 0.62 | VA | Highland | 0.75 | VA | Tazewell | 0.75 |
| PA | Franklin | 0.75 | VT | Rutland | 0.75 | VA | Hopewell | 0.87 | VA | Virginia Beach | 1.00 |
| PA | Fulton | 0.75 | VT | Washington | 0.62 | VA | Isle of Wight | 1.00 | VA | Warren | 1.00 |
| PA | Greene | 0.75 | VT | Windham | 0.75 | VA | James City | 1.00 | VA | Washington | 0.75 |
| PA | Huntingdon | 0.75 | VT | Windsor | 0.75 | VA | King and Queen | 0.87 | VA | Westmoreland | 0.87 |
| PA | Indiana | 0.75 | VA | Accomack | 1.00 | VA | King George | 0.87 | VA | Williamsburg | 1.00 |
| PA | Jefferson | 0.75 | VA | Albemarle | 1.00 | VA | King William | 0.87 | VA | Wise | 0.75 |
| PA | Juniata | 0.75 | VA | Alexandria | 0.87 | VA | Lancaster | 0.87 | VA | Wythe | 0.75 |
| PA | Lackawanna | 0.75 | VA | Alleghany | 0.75 | VA | Lee | 0.75 | VA | York | 1.00 |
| PA | Lancaster | 0.87 | VA | Amelia | 0.87 | VA | Loudoun | 0.87 | WV | Barbour | 0.75 |
| PA | Lawrence | 0.62 | VA | Amherst | 1.00 | VA | Louisa | 0.87 | WV | Berkeley | 0.75 |
| PA | Lebanon | 0.75 | VA | Appomattox | 1.00 | VA | Lunenburg | 0.87 | WV | Boone | 0.75 |
| PA | Lehigh | 0.87 | VA | Augusta | 1.00 | VA | Lynchburg | 1.00 | WV | Braxton | 0.75 |
| PA | Luzerne | 0.75 | VA | Bath | 0.75 | VA | Madison | 1.00 | WV | Brooke | 0.75 |
| PA | Lycoming | 0.75 | VA | Bedford | 1.00 | VA | Manassas | 0.87 | WV | Cabell | 0.75 |
| PA | McKean | 0.75 | VA | Bland | 0.75 | VA | Manassas Park | 0.87 | WV | Calhoun | 0.75 |
| PA | Mercer | 0.62 | VA | Botetourt | 1.00 | VA | Mathews | 1.00 | WV | Clay | 0.75 |
| PA | Mifflin | 0.75 | VA | Brunswick | 0.87 | VA | Mecklenburg | 0.87 | WV | Doddridge | 0.75 |
| PA | Monroe | 0.75 | VA | Buchanan | 0.75 | VA | Middlesex | 0.87 | WV | Fayette | 0.75 |
| PA | Montgomery | 0.87 | VA | Buckingham | 1.00 | VA | Montgomery | 0.87 | WV | Gilmer | 0.75 |
| PA | Montour | 0.75 | VA | Campbell | 1.00 | VA | Nelson | 1.00 | WV | Grant | 0.75 |
| PA | Northampton | 0.87 | VA | Caroline | 0.87 | VA | New Kent | 0.87 | WV | Greenbrier | 0.75 |
| PA | Northumberland | 0.75 | VA | Carroll | 0.87 | VA | Newport News | 1.00 | WV | Hampshire | 0.75 |
| PA | Perry | 0.75 | VA | Charles City | 0.87 | VA | Norfolk | 1.00 | WV | Hancock | 0.75 |
| PA | Philadelphia | 0.87 | VA | Charlotte | 0.87 | VA | Northampton | 1.00 | WV | Hardy | 0.75 |
| PA | Pike | 0.75 | VA | Chesapeake | 1.00 | VA | Northumberland | 0.87 | WV | Harrison | 0.75 |
| PA | Potter | 0.75 | VA | Chesterfield | 0.87 | VA | Nottoway | 0.87 | WV | Jackson | 0.75 |
| PA | Schuylkill | 0.75 | VA | Clarke | 0.87 | VA | Orange | 1.00 | WV | Jefferson | 0.87 |
| PA | Snyder | 0.75 | VA | Colonial Heights | 0.87 | VA | Page | 1.00 | WV | Kanawha | 0.75 |
| PA | Somerset | 0.75 | VA | Craig | 0.75 | VA | Patrick | 1.00 | WV | Lewis | 0.75 |
| PA | Sullivan | 0.75 | VA | Culpeper | 1.00 | VA | Petersburg | 0.87 | WV | Lincoln | 0.75 |
| PA | Susquehanna | 0.75 | VA | Cumberland | 0.87 | VA | Pittsylvania | 0.87 | WV | Logan | 0.75 |
| PA | Tioga | 0.75 | VA | Dickenson | 0.75 | VA | Poquoson | 1.00 | WV | Marion | 0.75 |
| PA | Union | 0.75 | VA | Dinwiddie | 0.87 | VA | Portsmouth | 1.00 | WV | Marshall | 0.75 |
| PA | Venango | 0.75 | VA | Essex | 0.87 | VA | Powhatan | 0.87 | WV | Mason | 0.75 |
| PA | Warren | 0.75 | VA | Fairfax | 0.87 | VA | Prince Edward | 0.87 | WV | McDowell | 0.75 |
| PA | Washington | 0.75 | VA | Fairfax City | 0.87 | VA | Prince George | 0.87 | WV | Mercer | 0.75 |
| PA | Wayne | 0.75 | VA | Falls Church | 0.87 | VA | Prince William | 0.87 | WV | Mineral | 0.75 |
| PA | Westmoreland | 0.75 | VA | Fauquier | 1.00 | VA | Pulaski | 0.75 | WV | Mingo | 0.75 |
| PA | Wyoming | 0.75 | VA | Floyd | 0.87 | VA | Rappahannock | 1.00 | WV | Monongalia | 0.75 |
| PA | York | 0.87 | VA | Fluvanna | 1.00 | VA | Richmond | 0.87 | WV | Monroe | 0.75 |
| RI | Bristol | 0.87 | VA | Franklin | 1.00 | VA | Richmond City | 0.87 | WV | Morgan | 0.75 |
| RI | Kent | 0.87 | VA | Frederick | 0.75 | VA | Roanoke | 1.00 | WV | Nicholas | 0.75 |
| RI | Newport | 0.87 | VA | Fredericksburg | 0.87 | VA | Rockbridge | 1.00 | WV | Ohio | 0.75 |
| RI | Providence | 0.87 | VA | Giles | 0.75 | VA | Rockingham | 1.00 | WV | Pendleton | 0.75 |
| RI | Washington | 0.87 | VA | Gloucester | 1.00 | VA | Russell | 0.75 | WV | Pleasants | 0.75 |
| VT | Addison | 0.62 | VA | Goochland | 0.87 | VA | Scott | 0.75 | WV | Pocahontas | 0.75 |
| VT | Bennington | 0.75 | VA | Grayson | 0.75 | VA | Shenandoah | 0.87 | WV | Preston | 0.75 |
| VT | Caledonia | 0.62 | VA | Greene | 1.00 | VA | Smyth | 0.75 | WV | Putnam | 0.75 |
| VT | Chittenden | 0.62 | VA | Greensville | 1.00 | VA | Southampton | 1.00 | WV | Raleigh | 0.75 |
| VT | Essex | 0.62 | VA | Halifax | 0.87 | VA | Spotsylvania | 0.87 | WV | Randolph | 0.75 |
| VT | Franklin | 0.62 | VA | Hampton | 1.00 | VA | Stafford | 0.87 | WV | Ritchie | 0.75 |

**Appendix A: One-Hour Three-Month Rainfall Intensities, SCHEDULE 4 – CSO VOLUME**

| State | County | 1hr-3mo (in.) | State | County | 1hr-3mo (in.) |
|---|---|---|---|---|---|
| WV | Roane | 0.75 | WI | Oneida | 0.67 |
| WV | Summers | 0.75 | WI | Outagamie | 0.59 |
| WV | Taylor | 0.75 | WI | Ozaukee | 0.65 |
| WV | Tucker | 0.75 | WI | Pepin | 0.67 |
| WV | Tyler | 0.75 | WI | Pierce | 0.67 |
| WV | Upshur | 0.75 | WI | Polk | 0.67 |
| WV | Wayne | 0.75 | WI | Portage | 0.65 |
| WV | Webster | 0.75 | WI | Price | 0.67 |
| WV | Wetzel | 0.75 | WI | Racine | 0.65 |
| WV | Wirt | 0.75 | WI | Richland | 0.68 |
| WV | Wood | 0.75 | WI | Rock | 0.68 |
| WV | Wyoming | 0.75 | WI | Rusk | 0.67 |
| WI | Adams | 0.65 | WI | Sauk | 0.68 |
| WI | Ashland | 0.67 | WI | Sawyer | 0.67 |
| WI | Barron | 0.67 | WI | Shawano | 0.57 |
| WI | Bayfield | 0.67 | WI | Sheboygan | 0.59 |
| WI | Brown | 0.59 | WI | St. Croix | 0.67 |
| WI | Buffalo | 0.67 | WI | Taylor | 0.67 |
| WI | Burnett | 0.67 | WI | Trempealeau | 0.67 |
| WI | Calumet | 0.59 | WI | Vernon | 0.68 |
| WI | Chippewa | 0.67 | WI | Vilas | 0.67 |
| WI | Clark | 0.67 | WI | Walworth | 0.65 |
| WI | Columbia | 0.68 | WI | Washburn | 0.67 |
| WI | Crawford | 0.68 | WI | Washington | 0.65 |
| WI | Dane | 0.68 | WI | Waukesha | 0.65 |
| WI | Dodge | 0.68 | WI | Waupaca | 0.65 |
| WI | Door | 0.59 | WI | Waushara | 0.65 |
| WI | Douglas | 0.67 | WI | Winnebago | 0.59 |
| WI | Dunn | 0.67 | WI | Wood | 0.65 |
| WI | Eau Claire | 0.67 | | | |
| WI | Florence | 0.57 | | | |
| WI | Fond Du Lac | 0.59 | | | |
| WI | Forest | 0.57 | | | |
| WI | Grant | 0.68 | | | |
| WI | Green | 0.68 | | | |
| WI | Green Lake | 0.65 | | | |
| WI | Iowa | 0.68 | | | |
| WI | Iron | 0.67 | | | |
| WI | Jackson | 0.67 | | | |
| WI | Jefferson | 0.68 | | | |
| WI | Juneau | 0.65 | | | |
| WI | Kenosha | 0.65 | | | |
| WI | Kewaunee | 0.59 | | | |
| WI | La Crosse | 0.67 | | | |
| WI | Lafayette | 0.68 | | | |
| WI | Langlade | 0.57 | | | |
| WI | Lincoln | 0.67 | | | |
| WI | Manitowoc | 0.59 | | | |
| WI | Marathon | 0.67 | | | |
| WI | Marinette | 0.57 | | | |
| WI | Marquette | 0.65 | | | |
| WI | Menominee | 0.57 | | | |
| WI | Milwaukee | 0.65 | | | |
| WI | Monroe | 0.67 | | | |
| WI | Oconto | 0.57 | | | |

# Appendix B

HYDRAULIC CALCULATIONS WITHIN LTCP-EZ SCHEDULE 4 – CSO VOLUME AND SCHEDULE 5 CSO CONTROL

## Introduction

It is necessary to make several important estimates within Schedule 4: CSO Volume. These estimates are for quantification of the amount of combined sewage that overflows, the amount of combined sewage that is diverted to an interceptor and transported to the WWTP, and, in some instances, the amount of combined sewage that goes untreated at the WWTP. Continuous simulation hydrology and hydraulic models like SWMM are often applied for these purposes. However, in the spirit of keeping LTCP-EZ easy, simple relationships and equations were utilized instead of detailed models. This Appendix describes the method used to make these estimations within the LTCP-EZ Template.

## Overflow Fraction of Combined Sewage

The fraction of runoff volume that overflows at the CSO hydraulic control at the lower end of a sub-sewershed is dependent on peak flow rate within the sub-sewershed (runoff plus dry weather flow) and the hydraulic control capacity. The peak runoff rate ($Q_p$) for the one-hour, three-month rainfall is calculated with the rational method. Similarly, the total volume of runoff ($V_t$) for the 24-hour, three-month rainfall is also calculated with the rational method. The peak runoff rate is compared with the capacity of the hydraulic control to determine whether or not an overflow occurs. The volume of overflow ($V_o$) depends on the shape of the runoff hydrograph through the 24-hour rainfall period.

Dimensional reasoning suggests that the ratio of overflow volume to total runoff volume is a function of the ratio of hydraulic control capacity to the peak runoff rate. It can be shown that, for a triangular hydrograph, the following relationship holds:

$$\frac{V_o}{V_t} = \left(1 - \frac{Q_r}{Q_p}\right)^2 \qquad (1)$$

where $V_o$ = volume of overflow (MG);

$V_t$ = total volume of runoff (MG);

$Q_r$ = hydraulic control or pump station capacity (MGD); and

$Q_p$ = peak runoff rate (MGD).

The overflow fraction of combined sewage in Schedule 4: CSO Volume is defined as the ratio of overflow volume to total volume, and is calculated as follows:

$$f_o = \left(1 - \frac{Q_r}{Q_p}\right)^2 \qquad (2)$$

where $f_o$ = overflow fraction of combined sewage [--].

The actual overflow volume is then computed as follows:

$$V_o = f_o * V_t \qquad (3)$$

The situation from which Equation 1 was derived is depicted in Figure 1. Empirical studies show that actual runoff hydrographs are likely to be shaped more “concave up” relative to the triangular assumption, so that the fraction of overflow volume would be less than that predicted with Equation 1. To test this, the RUNOFF block within the SWMM Model was used to generate runoff hydrographs from design storms of various lengths, and for a variety of catchment characteristics. A series of fractional overflow volumes were then computed from the resulting hydrographs by varying the hydraulic control flow rate, and the fractional volumes were compared with Equation 1. Three sets of catchments (designated as set A, set B, and set C) were used. These catchments represent a wide range of CSO subsewershed conditions and are representative of the conditions that would typically be found in a CSO community. Set A consisted of 161 catchments with areas ranging from 2.7 to 174 acres, and ground slopes ranging from 0.0002 to 0.0173. Set B consisted of 161 catchments with areas ranging from 0.3 to 37 acres, and ground slopes ranging from 0.0024 to 0.129. Set C consisted of 101 catchments with areas ranging from 16 to 4630 acres, and ground slopes ranging from 0.004 to 0.100. The results are depicted in Figure 2, which shows that the observed ratios of overflow volume (represented by the individual points) are below the predicted ratios of overflow volume for all regulator flow/peak flow ratios (represented by the solid line). This suggests that the use of Equation 1 will provide conservative estimates of the volume of overflow at a CSO hydraulic control.

It should be noted that the model results from this test are dependent on the assumed shape of the design storm hyetograph. This test and the SWMM Model application were based on the third quartile distribution of heavy rainfall at a point, taken from Table 10 of "Rainfall Frequency Atlas of the Midwest" (Huff and Angel, 1992). Use of rainfall at a point was considered appropriate for the relatively small sewersheds of LTCP-EZ permittees (less than 1,000 acres). The third quartile distribution is specified for storms of 12 to 24 hours.

## Diversion Fraction of Combined Sewage

It is intuitive that the volume of runoff diverted to the interceptor and the WWTP is the difference between the total volume of runoff and the volume that overflows. However, if the estimate of overflow volume is conservatively high (using Equation 1), then calculating diversion by subtraction (that is, 1-Equation 1) will tend to underestimate the volume diverted. An alternate approach called the Hyetograph Approach was developed to determine a better and more conservative estimate of the fraction of runoff diverted to the interceptor and the WWTP. The Hyetograph Approach is also based on the ratio of hydraulic control capacity to peak runoff rate. It is recognized that a small degree of "double counting" occurs when the two approaches are used together. That is, the total estimated overflow plus the total estimated conveyance slightly exceeds the total runoff plus dry weather sanitary flow. This is acceptable, however, in that it provides a conservative estimate for both quantities, rather than forcing one quantity to be conservative at the expense of the other.

The Hyetograph Approach assumes that the runoff hydrograph has the same shape as the rainfall hyetograph, and that the total volume diverted is simply the sum of the volumes less than $Q_r$ added up over the course of the storm. This concept is graphically depicted in Figure 3, and it was tested with a simple spreadsheet model. The hyetograph is again the third quartile distribution of heavy rainfall at a point. Fractional volumes were quantified with a simple spreadsheet model for a range of $Q_r/Q_p$ ratios, and these results are shown in Figure 4 as the Hyetograph Approach. Rather than developing a regression equation from the results, a lookup table was compiled for inclusion in the LTCP-EZ form, and reproduced here as Table 1. For comparison, Figure 4 also shows the diverted fraction of runoff that would be calculated based on 1- Equation 1.

## Fraction of Combined Sewage Untreated at WWTP

Similar to what occurs at a CSO hydraulic control, the fraction of combined sewage that overflows at the WWTP is dependent on the peak rate of sewage delivered to the WWTP and the primary treatment capacity at the WWTP. The estimate of combined sewage that overflows or is untreated at the WWTP ($V_o$) is also based on Equation 1, but with $V_t$ equal to the total volume of sewage conveyed to the WWTP during the 24-hour rainfall event, $Q_r$ equal to primary treatment capacity at the WWTP, and $Q_p$ equal to the peak rate of sewage delivered to the WWTP. Use of Equation 1 for this estimation is also thought to be conservative in that it might slightly overestimate rather than underestimate the volume of combined sewage untreated at the WWTP.

**Figure 1. Conceptual Diagram of Triangular Runoff Hydrograph**

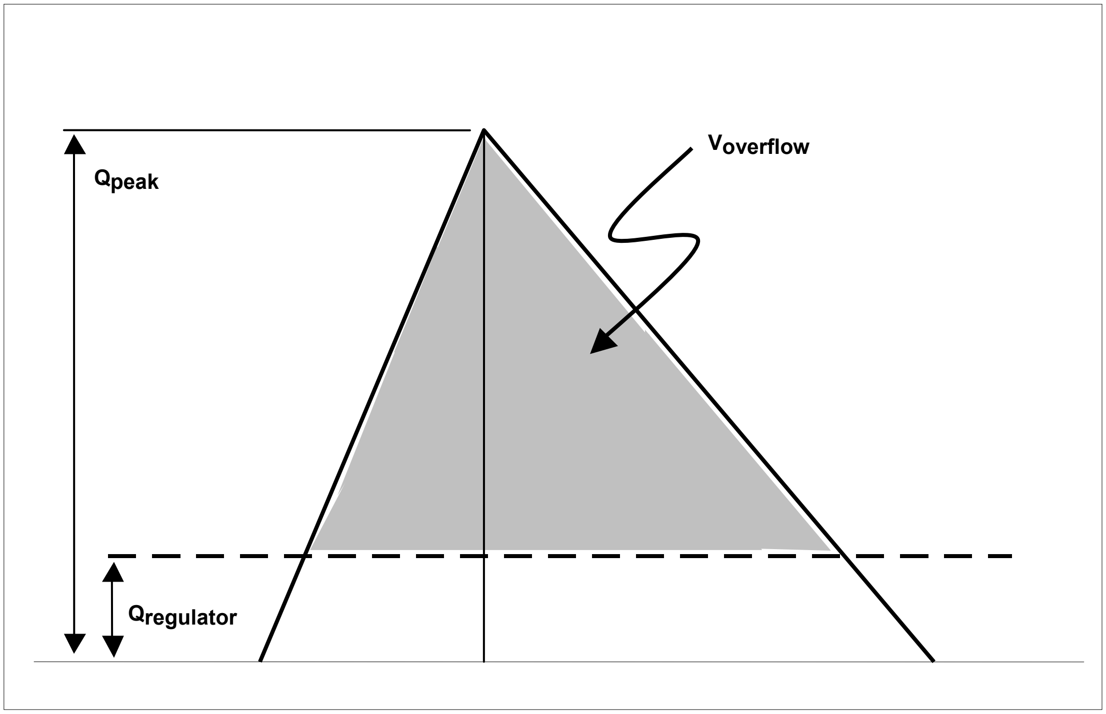


**Figure 2. Comparison of SWMM Simulated Overflow Volumes with Equation 1.**

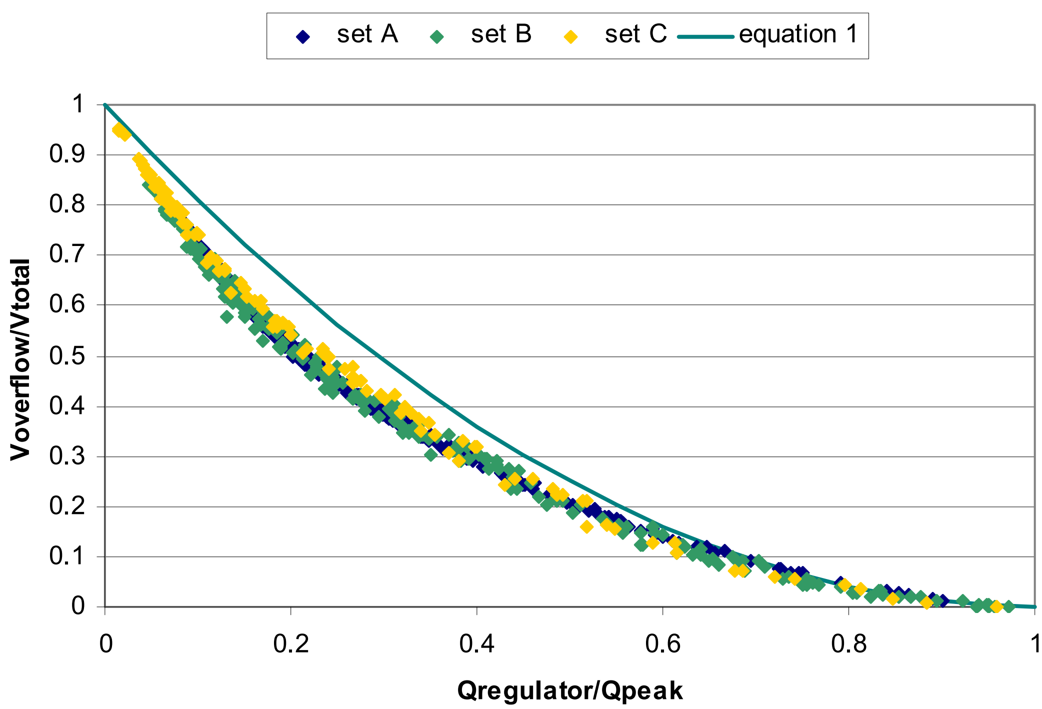

**Figure 3. Conceptual Diagram of Calculation of Fraction Diverted**

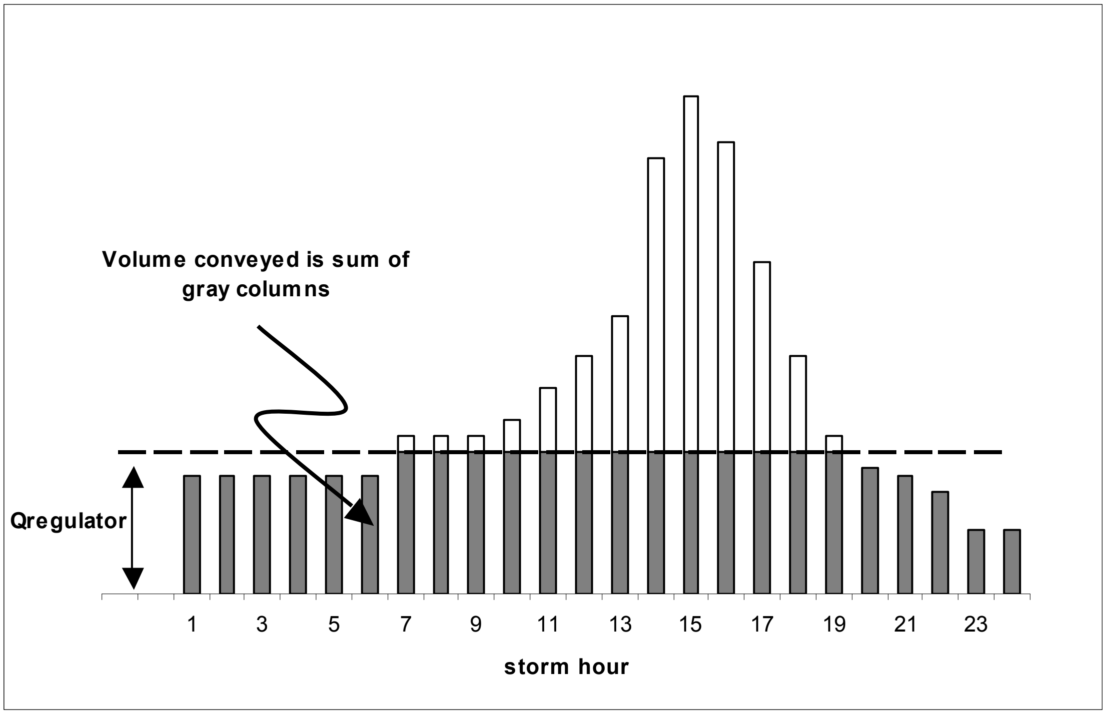


**Figure 4. Comparison of Fraction Conveyed by Hyetograph Approach versus Equation 1**

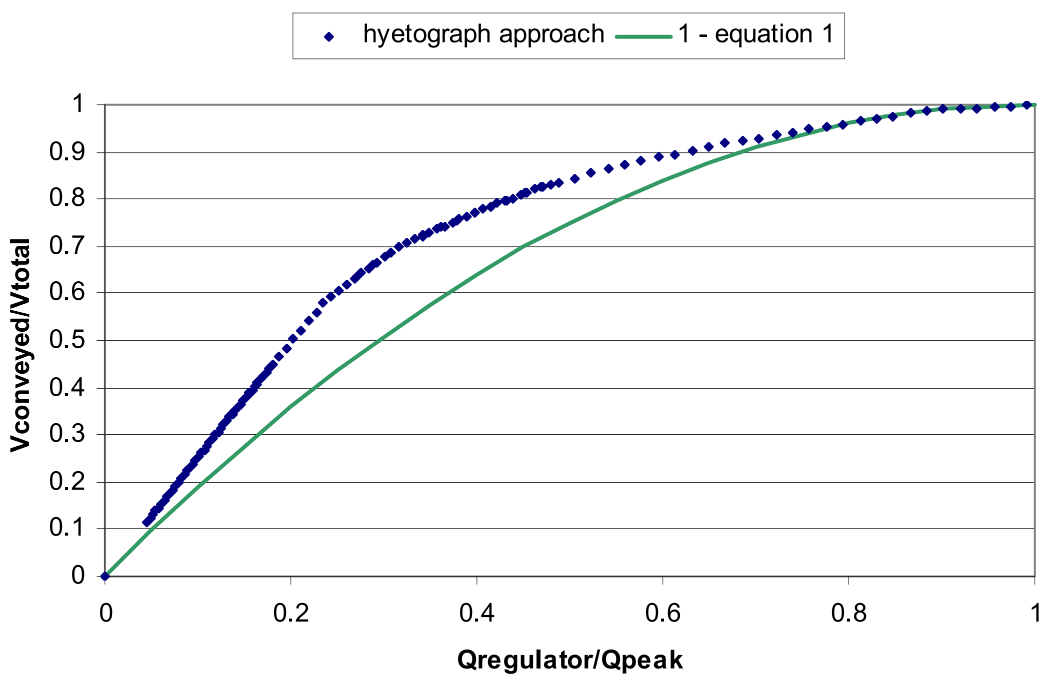

**Table 1. Fraction of Total Flow Diverted to WWTP from 24-Hour Rainfall**

| Ratio of Hydraulic control Capacity to Peak Flow Rate | Diversion Fraction |
|---|---|
| 0.01 to 0.02 | 0.04 |
| 0.02 to 0.03 | 0.06 |
| 0.03 to 0.04 | 0.09 |
| 0.04 to 0.05 | 0.11 |
| 0.05 to 0.06 | 0.14 |
| 0.06 to 0.07 | 0.16 |
| 0.07 to 0.08 | 0.19 |
| 0.08 to 0.09 | 0.21 |
| 0.09 to 0.10 | 0.24 |
| 0.10 to 0.12 | 0.28 |
| 0.12 to 0.14 | 0.33 |
| 0.14 to 0.16 | 0.38 |
| 0.16 to 0.18 | 0.42 |
| 0.18 to 0.20 | 0.47 |
| 0.20 to 0.24 | 0.54 |
| 0.24 to 0.28 | 0.62 |
| 0.28 to 0.32 | 0.68 |
| 0.32 to 0.36 | 0.72 |
| 0.36 to 0.40 | 0.76 |
| 0.41 to 0.50 | 0.81 |
| 0.51 to 0.60 | 0.87 |
| 0.61 to 0.70 | 0.91 |
| 0.71 to 0.80 | 0.95 |
| 0.81 to 0.90 | 0.98 |
| 0.91 to 1.00 | 0.99 |

# Appendix C

COST ESTIMATE FOR LTCP-EZ TEMPLATE,
SCHEDULE 5 – CSO CONTROL

This Appendix summarizes some of the cost estimate figures used in the LTCP-EZ Template Schedule 5 – CSO CONTROLS. Localized and/or site-specific costs should be used when they are available, as localized data will give the most reliable results. However, EPA recognizes that localized cost data will not always be available, and therefore EPA has provided several cost estimates based on national data. Descriptions of how these cost estimates were derived are provided below.

### *Line 5 –Unit cost of primary treatment per MGD*

EPA's document "Cost of Urban Storm Water Control" (EPA 600/R-02/021), January 2002, uses the following equation to estimate construction costs for off-line storage areas:

$C = 2980V^{0.62}$

Where

C = construction cost ($ millions), in 1999 dollars

V = volume of storage system, in MG

The document indicates that this calculation is valid where 0.15 MG < volume < 30 MG

In addition to this equation, one cost value was collected from the literature. This cost is summarized below:

1. Chamber Creek WWTP $433,500/MG for primary treatment.
   http://www.co.pierce.wa.us/xml/services/home/environ/planning/Appendix%20I.pdf

### *Line 12 - Average roof area of residential dwellings*

The Greenbuilder.com website gave charts showing roof sizes from 1,000 – 2,500 ft$^2$, which is a good range for residential roof area.

### *Line 15 – Unit cost per dwelling for residential inflow reduction*

Residential inflow reduction is handled in many different ways by different municipalities, leading to disparities in costs quoted for various reduction measures. Some communities rely on the homeowner to disconnect downspouts and redirect sump pumps (i.e., Milwaukee, Dearborn, Indianapolis), and these cost estimates tend to be lower than cost estimates for municipalities that do the work themselves (Detroit, Toronto). Costs for several downspout disconnection programs are summarized below:

Downspout disconnection

1. Dearborn, MI – up to $60/household reimbursement for residents doing it themselves.
   http://www.rougeriver.com/restoration/projDetail.cfm?ProjectID=780&CategoryID=10
2. Bremerton, WA - $25-$500/household reimbursement for voluntary disconnection, depending on complexity.
   http://www.ci.kenmore.wa.us/html/projects/SedimentaryStudy/Section6ManagementStrategies.pdf
3. Portland, OR - $63/downspout.

4. Indianapolis encourages residents to do it themselves and indicates it should cost less than $100 apiece.
   http://www.indygov.org/eGov/City/DPW/Environment/CleanStream/Help/Residents/Connect/qa.htm
5. Milwaukee MSD - $15/downspout.
   http://www.mmsd.com/programs/downspout_disconnection.cfm
6. Kenmore, WA - $150-$300 per downspout if the city performs the work; $15 if the homeowner does it.
   http://www.ci.kenmore.wa.us/html/projects/SedimentaryStudy/Section6ManagementStrategies.pdf
7. Lynn, MA - $20/downspout reimbursement.
   http://www.cdm-mich.com/AA-SSO/Public/FinalReport_6_01/Appendix%20M.pdf
8. Elkhart, IN - $150.
   http://www.elkhartindiana.org/department/division.asp?fDD=39-203
9. South Bend, Indiana - $150/property
   http://www.southbendin.gov/doc/Press_051805_downs.pdf
10. Vancouver, BC – City provided $100/downspout disconnected.
    http://www.cityfarmer.org/downspout96.html
11. Detroit, Michigan - $243-$278/property.
    http://www.wadetrim.com/resources/pub_conf_downspout.pdf (URL no longer available)
    Secondary source: http://www.mmsd.com/stormwaterweb/PDFs/Appendix_L.pdf
12. Toronto, Ontario - $180-$220/property.
    http://www.ene.gov.on.ca/envision/gp/4224e_2.htm

**Summary**: Downspout disconnection costs an approximate average of $100/property if municipalities have residents do it themselves and $250/property if municipalities do it.

<u>Sump pump redirection</u>

1. Lexington, KY - $1,700/residence.
   http://www.lfucg.com/newsreleases/newsreleases/nr_041404.asp
2. Lynn, MA - $500/residence.
   http://www.cdm-mich.com/AA-SSO/Public/FinalReport_6_01/Appendix%20M.pdf

<u>Footing Drain Redirection</u>

1. Garden City, MI - $2,000. Other SE Michigan projects have been between $500 and $6,000/home.
   http://www.wadetrim.com/resources/articles/footing_drn.htm (URL no longer available)
2. Duluth, MN – rebate of $1,800/home.
   http://www.metrocouncil.org/Environment/ProjectTeams/I-I-tool-box.pdf
3. Twin Cities, MN - $500 - $2,000.
   http://www.metrocouncil.org/Environment/ProjectTeams/I-I-tool-box.pdf
4. West Lafayette, IN - $3,500 per building.
   http://www.cdm-mich.com/AA-SSO/Public/FinalReport_6_01/Appendix%20M.pdf

5. Auburn Hills, MI - $5,000 per building.
   http://www.cdm-mich.com/AA-SSO/Public/FinalReport_6_01/Appendix%20M.pdf
6. Riverview, MI - $5,700 per building.
   http://www.cdm-mich.com/AA-SSO/Public/FinalReport_6_01/Appendix%20M.pdf
7. Cedar Rapids, IA - $3,500 per building.
   http://www.cdm-mich.com/AA-SSO/Public/FinalReport_6_01/Appendix%20M.pdf
8. Ann Arbor - $3,700 per building.
   http://www.cdm-mich.com/aa-fdd/packet.htm

### *Line 21 – Unit cost for separation per acre*

Costs/acre of sewer separated:

1. Seaford, DE: $1,750
2. Skokie/Wilmette, IL: $31,397
3. St. Paul, MN: $17,730
4. Portland, OR: $19,000
5. Providence, RI: $81,000

These costs came from EPA's Report to Congress: Impacts and Control of CSOs and SSOs, August 2004 (EPA 833-R-04-001).

6. Portland Maine - $7,352 ($5M for 680 acres)
   http://www.alcosan.com/public/WCCP/appendices.pdf
7. Nashville Phase I – $37,910 ($6,634,372 for 175 acres)
   http://www.atlantaga.gov/client_resources/mayorsoffice/special%20reports-archive/csositev.pdf
8. Nashville Phase II – $23,909 ($12,552,277 for 525 acres)
   http://www.atlantaga.gov/client_resources/mayorsoffice/special%20reports-archive/csositev.pdf
9. Boston – ranged from $60,000/acre for partially separated residential neighborhoods to $190,000/acre for completely combined downtown.
   http://books.nap.edu/books/0309048265/html/357.html
10. Atlanta - $41,000/acre.
    http://georgia.sierraclub.org/atlanta/conservation/mcwapfin.pdf
11. DCWASA - $360,000/acre.
    http://www.dcwasa.com/news/publications/Ops%20Minutes%20July%202004.pdf

**Summary:** Sewer separation costs an average of approximately $40,000/acre. This cost can be higher if the area to be separated is in a congested downtown.

Sewer separation costs per linear foot of sewer separated:

1. Harbor Brook and Clinton sewer separation projects, Syracuse, NY, 2000. Cost was $2,311,126 for 3812 feet of separated pipe, or $606/ft.
   http://www.lake.onondaga.ny.us/olpdf/ol303ad.pdf

2. Rouge River project - \$175-\$220/ft (CSO and SSO)
3. Portsmouth, NH - ~\$500/ft (personal communication with Peter Rice, City of Portsmouth).

### *Line 24 Unit cost per MG of storage*

EPA's document "Cost of Urban Storm Water Control" (EPA 600/R-02/021), January, 2002, uses the following equation to estimate construction costs for off-line storage areas:

$C = 4.546V^{0.826}$

Where

C = construction cost (\$ millions), in 1999 dollars

V = volume of storage system, in MG

The document indicates that this calculation is valid where 0.15 MG < volume < 30 MG.

In addition to this equation, a number of cost values were collected from the literature. These are summarized below:

1. EPA's Report to Congress: Impacts and Control of CSOs and SSOs, August 2004 (EPA 833-R-04-001). Costs per MG of near surface storage ranged from <\$0.10 to \$4.61/gallon, with an average of \$1.75 gallon.
2. EPA Combined Sewer Overflow Technology Fact Sheet: Retention Basins (EPA 832-F-99-032). Costs range from \$0.32 to \$0.98/gallon.
3. Decatur McKinley - \$1.09/gallon. http://books.nap.edu/openbook/0309048265/gifmid/363.gif
4. Decatur 7th Ward – \$0.76/gallon. http://books.nap.edu/openbook/0309048265/gifmid/363.gif
5. Rouge River – range from \$2.86 to \$8.53/gallon of storage for aboveground facilities. The average was \$5.18/gallon. http://www.rougeriver.com/cso/overview.html
6. Driftwood Detention Basin, Nashville - \$1.96/gallon. http://www.nashvilleoap.com/projects/driftwood.html
7. San Francisco - \$2.35/gallon. http://www.swrcb.ca.gov/rwqcb2/Agenda/07-16-03/07-16-03-fsheetattachments.doc

**Summary:** On average, near surface storage costs \$2.00 per gallon of storage.