EPA's Response to the Current Status of CSO Control Efforts: Development of New Tools and Guidance

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Abstract

EPA's combined sewer overflow (CSO) program has reached a mature stage. Some communities have completed their CSO controls, while others are in the process of constructing controls or evaluating potential alternatives. With the recent emphasis on green infrastructure, some communities are evaluating the role of natural systems and ecological processes in Long Term Control Plans (LTCPs) for controlling CSOs. The convergence of these critical milestones and issues for the national CSO program highlights the need for updated tools and guidance to facilitate future CSO control efforts. In response, EPA is developing guidance on post construction compliance monitoring for CSOs, as well as the Green LTCP-EZ, a tool that allows small CSO communities to incorporate green infrastructure as part of their LTCP efforts. This paper discusses these initiatives serves as outreach to CSO communities on these efforts.

Introduction

EPA’s CSO program under the 1994 CSO Control Policy has been in place for over 15 years. The CSO Control Policy established a consistent national approach for controlling discharges from CSOs to the nation’s waters. The Policy, which is implemented through the NPDES permit program, established a phased approach to controlling CSO discharges. Phase I permits required to include provisions for permittees to implement the Nine Minimum Controls (NMCs), while Phase II permits required to include provisions for permittees to implement LTCPs. As discussed in EPA’s *Combined Sewer Overflows Guidance for Permit Writers* (EPA 832 B-95-008) Phase ii permitting can last through multiple 5-year NPDES permitting cycles as permittees implement the CSO controls identified in their LTCPs. As part of the Phase II requirements, the *Combined Sewer Overflows Guidance for Permit Writers* states that permittees should implement a post construction compliance monitoring program to “evaluate water quality impacts from CSOs and the effectiveness of CSO controls (in cases where some of the CSO controls have been completed)…to determine compliance with permit conditions and ultimately the attainment of water quality standards.”

Many permittees are at the point in their CSO control programs where they have implemented at least some of the CSO controls identified in their LTCPs, and therefore permitting authorities are in a position to require permittees to develop and implement post construction compliance monitoring plans.

While the development and implementation of CSO controls has typically involved the construction of “gray” controls that attempt to control flows once the they have already entered the collection system, there has also been a recent focus on evaluating the potential for "green" controls, which retain and infiltrate flow before it reaches the collection system.

EPA has recognized the current needs of permittees and permit writers to move beyond the traditional planning and construction of pipes, retention basins, and other "gray" infrastructure and focus on water quality and how the current regulatory framework and guidance can be adapted to meet these needs. As a result, EPA is developing several new tools for its CSO toolbox. These new tools include guidance on how to develop and implement a post construction compliance monitoring program, and also the "Green LTCP-EZ" tool, which allows small communities to examine the feasibility of using green infrastructure as part of their LTCP.

CSO Post Construction Compliance Monitoring Guidance

The CSO Control Policy included expectations that CSO communities would institute a post construction compliance monitoring program that was "adequate to verify compliance with water quality standards and protection of designated uses as well as to ascertain the effectiveness of CSO controls." While many communities have completed at least some of their CSO controls, and some communities have developed plans to address the post construction compliance monitoring requirement, there is little consistency in the development and implementation of post construction compliance monitoring plans to document the progress of CSO long term control planning efforts. For example, while some permittees focus on evaluating the number of overflows in their system remaining after construction, others propose evaluating water quality in receiving waters. It is often unclear what the goals of permittee's post construction compliance monitoring plans are relative to the guidance, and also to the LTCP itself. In other words, while many permittees include some discussion of post construction monitoring in their LTCPs, and they develop specific plans as needed, these plans often do not appear to meet the goals of the guidance, and they do not appear to be integrated assessments of the goals of the LTCP.

EPA is developing the CSO Post Construction Compliance Monitoring Guidance Document to provide technical assistance to permitting authorities so that the post construction compliance monitoring plans collect sufficient data to meet the goals of post construction compliance monitoring outlined in the CSO Control Policy. As described in the CSO Control Policy, the overall goals for post construction compliance monitoring can be broken into two components. These are:

- Evaluate water quality impacts from CSOs; and
- Evaluate the effectiveness of CSO controls.

Therefore, based on the CSO Control Policy, a successful post construction compliance monitoring program must do both of these things: it must include water quality sampling or other data gathering to allow an assessment of water quality impacts from CSOs; and it must include some sort of assessment to determine the effectiveness of CSO controls.

It is easiest to understand these components separately. The goal of assessing water quality impacts from CSOs is the most straightforward of the two goals – in theory if not in practice. In theory, the permittee will have evaluated water quality as part of the characterization, monitoring and modeling component of the LTCP. This phase of the LTCP establishes the baseline impacts of CSOs and serves to define the CSO-caused impairments and desired level of control to mitigate these impacts. Therefore, in theory, the post construction compliance monitoring plan should be able to build off of the work done during this phase of the LTCP. For example, a sampling program may already have been implemented during LTCP development, and this program may be able to be modified to collect post construction data on water quality. Similarly, if water quality impacts were modeled prior to construction, they can be modeled after construction.

It is critical to ensure that any water quality monitoring be done to ensure that adequate samples are collected for comparison with water quality standards. For example, if the permittee has a limit for fecal coliform water quality standard that is expressed as a geometric mean, then the permittee must ensure that they collect enough samples to calculate a geometric mean (e.g., five samples per month). The permittee should also ensure that the sampling is appropriate to characterize the implementation of the LTCP (i.e., if the LTCP has reduced, but not eliminated CSOs, then the post construction compliance monitoring plan should be adequate to capture the impacts of remaining CSOs).

There has been much debate as to the responsibilities of the permittee versus the permitting authority in water quality monitoring and assessment. The post construction compliance monitoring guidance lays out a simple delineation of responsibilities. The permittee is responsible for designing an effective water quality monitoring program and for collecting the data and presenting it to the permitting authority. The permitting authority is responsible for approving the water quality monitoring program and for assessing the permittee's compliance with water quality standards. This allows the permitting authority to consider the water quality in the watershed as a whole, and to evaluate other potential contributions to any remaining water quality impairments.

The second goal of the post construction compliance monitoring plan is "to evaluate the effectiveness of CSO controls." The Post Construction Compliance Monitoring Guidance defines this goal as determining whether the controls that were designed as part of the LTCP are functioning as designed and are achieving the goals of the LTCP. In order to do this, the guidance recommends following certain steps based on whether the Presumption or the Demonstration Approach was used in developing the LTCP. For example, if the community based its CSO control efforts on criterion i of the Presumption Approach (i.e., to achieve, on average, no more than four overflows per year, with the option of the permitting authority allowing up to two additional overflows per year), then the CSO community would need to develop a post construction compliance monitoring program that evaluated whether, on average, it achieved this number of overflows. The Guidance provides potential options for developing this type of monitoring program, ranging from monitoring the number of overflows through simple "block tests" or "chalk tests," metering, or the use of models. The guidance also provides example calculations that can be included in permits to assist permittees with the challenges of reporting compliance.

The guidance also includes helpful discussions and graphics that demonstrate compliance concepts. For example, criterion ii of the Presumption Approach is to eliminate or capture for treatment no less than 85 percent of the total volume of flow collected in the combined sewer system during precipitation events on a system-wide, annual average basis. Like the goals of the post construction compliance monitoring program, this statement is easier to understand when it is broken into its components. It requires the permittee to determine the following:

1. For a given year, generate a flow curve that shows the total rate of flow over time in the combined sewer system;

2. For that year, determine the precipitation events;

3. Overlay the start and stop times for precipitation events determined in #2;

4. Integrate the area under the curve for all precipitation events to determine the total volume of flow captured in the CSS during precipitation events.

5. Compare the total volume of flow eliminated or captured for treatment under the LTCP to the flow volume in #4.

6. Do this calculation for several years' worth of data, and determine the annual average of these data.

7. If this number is 85 percent or higher, then the LTCP has achieved criterion ii of the Presumption Approach. If this number is less than 85 percent, then the LTCP has not achieved criterion ii of the Presumption Approach.

Figure 1 gives an example of how to identify the volume of flow collected in the combined sewer system during precipitation events on a system-wide basis for a small part of a year.

In addition to information on how to determine compliance with the various components of the post construction compliance monitoring plan, the Guidance includes case studies that highlight successful programs, as well as information on establishing appropriate stream monitoring strategies and Quality Assurance Project Plans. The Guidance also includes discussions on how the permittee and the permitting authority should work together to ensure that the post construction compliance monitoring plan is realistic and successful.

Green LTCP-EZ

EPA previously developed LTCP-EZ, a simple tool to help small communities develop acceptable LTCPs. This tool was designed to serve as a template that allowed small communities with simple, straightforward sewer systems to compile all of the information necessary for developing an acceptable LTCP. By following the instructions, filling in the forms, and attaching relevant maps and other materials, a small community permittee could evaluate CSO planning scenarios and develop a LTCP that would have the information and analysis that permitting authorities look for.

The LTCP-EZ was developed to function like a 1040-EZ tax form, with step-by-step instructions, calculations, lookup tables, etc. It consists of multiple forms, or "schedules," that are intended to parallel the requirements of a LTCP. These schedules include information on the permittee, the sewer system, receiving waters, any sensitive areas in the sewershed, a summary of public participation in the development of the LTCP, and an affordability analysis. The crux of LTCP-EZ is the calculation of a "CSO Volume" based on a 3-month design storm that needs to be controlled to meet Criterion i of the Presumption Approach (no more than four overflows per year, on average). The LTCP-EZ leads the user through an evaluation of several different options for capturing or otherwise meeting this CSO volume target to ensure that Criterion i of the Presumption Approach is met. By capturing the 3-month design storm, the LTCP-EZ aims to reduce CSOs to no more than four overflows, on average, per year.

The original LTCP-EZ included options for evaluating traditional gray infrastructure, including conveyance and treatment at the treatment plant, sewer separation, off-line storage, and inflow/infiltration reduction. However, in response to interest in using green infrastructure in CSO planning, EPA modified the LTCP-EZ to include green infrastructure-based controls. The idea was to allow users to look at green practices such as green roofs, bioretention, vegetated swales, and pervious pavement, to determine whether these practices could reduce runoff, effectively achieving the same "CSO Volume" target that was calculated in the original LTCP-EZ.

Determining the volume of runoff that green infrastructure practices would reduce, capture, or eliminate was a challenge in adding green infrastructure options to the controls in the LTCP-EZ. One option for incorporating green infrastructure in the LTCP-EZ was to focus on the individual green controls and the volume of runoff reduction that they could achieve at a certain location within the CSS. While this option had the advantage of making the user evaluate the individual green practices necessary to achieve the desired runoff reductions, it had the disadvantage of requiring a lot of site-specific data from the user, which was counter to the idea of an "easy" tool. A second option centered on achievement of a "runoff reduction standard" that could be applied to a certain portion of impervious area. Many municipalities are beginning to mandate on-site runoff retention standards (e.g. retain first one-inch of rainfall) for all development or redevelopment that exceeds a certain size, making this an attractive option, because many municipalities would have this standard readily available, and this approach would fit in well with their other planning. If a specific codified runoff retention standard does not exist, the permittee could use a runoff retention goal that the permittee will enforce or otherwise encourage landowners to meet. This option also has the advantage of requiring fewer assumptions regarding the performance of individual green infrastructure practices. However, it has the disadvantage of being less specific about the number and type of green practices that would be needed to achieve the runoff reduction standard.

To resolve this issue, EPA decided on a hybrid approach that used the runoff reduction standard method, but also required a "reality check" of evaluating the number of green practices necessary to achieve the runoff reduction standard. The final Green LTCP-EZ requires the user to use a runoff retention standard or goal that can be associated with managed directly-connected impervious areas. The calculation used to determine the volume of runoff reduction achieved for each green infrastructure category is shown in Figure 2. This provides the "big picture" volume target that the green infrastructure must achieve. The user is also required to estimate the acreage of individual green practices that would be installed. The acreage of green practices, combined with the practice-specific runoff reduction rate provided in lookup tables, provides the user with an idea as to whether or not the implementation of green practices at the planned density will achieve the runoff reduction required by the retention standard. The user then has the option to either add more green practices and re-run the calculations in the Green LTCP-EZ tool, or make up the difference with gray infrastructure. By making the user ensure that the CSO volume can be achieved through the proposed combination of green practices (potentially supplemented by gray practices), the user has a better idea as to whether green infrastructure alone can achieve the necessary runoff reductions, as well as information about how green infrastructure can play a role in the overall LTCP.

Conclusion

The Post Construction Compliance Monitoring Guidance and the Green LTCP-EZ will be valuable additions to EPA's toolbox for CSO communities. The Post Construction Compliance Monitoring Guidance will provide valuable information for communities that have completed construction on CSO controls and are ready to evaluate the effectiveness of those controls in achieving the goals of the LTCP. The Green LTCP-EZ will provide small communities with a user-friendly way to develop a LTCP that considers green controls as an option for achieving compliance with LTCP requirements.

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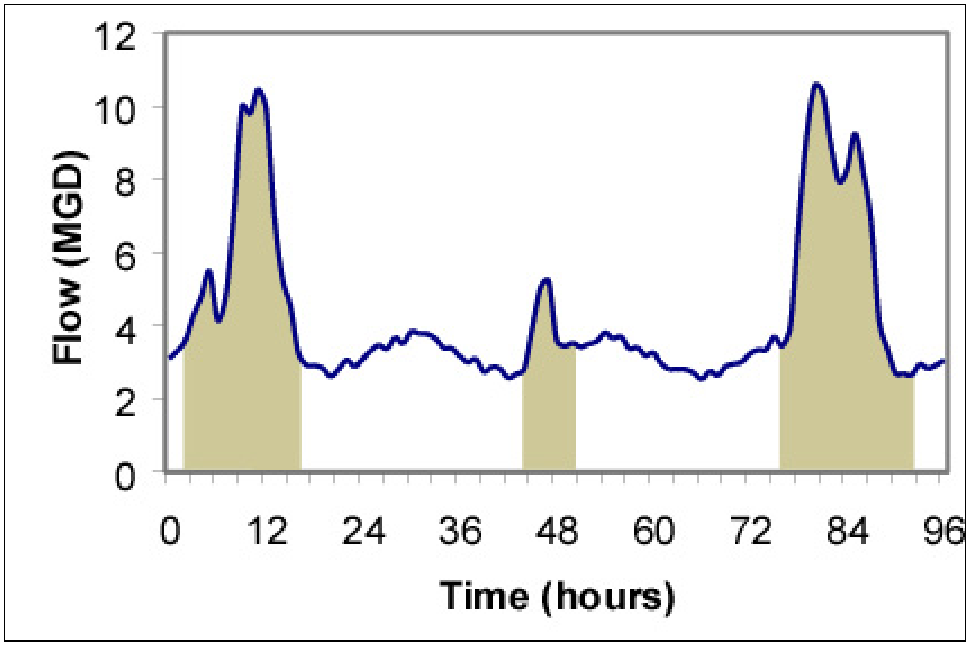

Figure 1 Type of analysis used to calculate flow in the CSS during wet weather precipitation events.

$$V = kAP_{24}E$$

where:

V = runoff reduction volume (gal or MG)

k = unit conversion factor

A = area of impervious surface managed (acres)

P_{24} = depth of 24-hour design storm rainfall (in)

E = practice performance efficiency factor

Figure 2 Calculation for runoff reduction volume of green infrastructure practices.