Chapter 6

CSO Control Policy Implementation Status: Communities

The CSO Control Policy established implementation objectives and responsibilities for CSO communities in stating:

> *[Communities] with combined sewer systems that have CSOs should immediately undertake a process to accurately characterize their sewer systems, to demonstrate implementation of the nine minimum controls, and to develop a long-term CSO control plan.*

EPA's *Guidance for Long-Term Control Plan* (EPA, 1995f) further outlines the expectations of the permittees:

- Evaluate and implement NMC.
- Submit documentation on NMC implementation by January 1, 1997.
- Develop an LTCP and submit for review to the NPDES permitting authority.
- Support the review of water quality standards in CSO-impacted receiving water bodies.
- Comply with permit conditions based on narrative water quality standards.
- Implement selected CSO controls from the LTCP.
- Perform post-construction compliance monitoring.
- Reassess overflows to sensitive areas.
- Coordinate all activities with NPDES permitting authority, state water quality standards authority, and state watershed personnel.

This chapter describes activities by CSO communities to meet these responsibilities. Specifically, the chapter provides a discussion of the following:

- National CSO demographics
- Implementation of documented CSO controls
- Implementation of the NMC
- Implementation of the LTCP

In this chapter:

Learn More About Them . . .

Additional information about a number of the community CSO programs described in this chapter can be found in Appendix C. Case study communities have this symbol ◆ next to their names.

- Financial considerations
- Obstacles and challenges
- Performance measures and environmental benefits

6.1 National CSO Demographics

Combined sewer systems vary greatly with respect to size, design and performance. Much of this diversity is attributable to site-specific conditions and the evolution of systems over time to accommodate community growth and development. This diversity was a key consideration in the development and issuance of the CSO Control Policy and the emphasis placed on the need for site-specific CSO controls. The introduction to the CSO Control Policy states:

> *The CSO Policy represents a comprehensive national strategy to ensure that municipalities, permitting authorities, water quality standards authorities and the public engage in a comprehensive and coordinated planning effort to achieve cost effective CSO controls that ultimate meet appropriate health and environmental objectives. The Policy recognizes the site-specific nature of CSOs and their impacts and provides the necessary flexibility to tailor controls to local situation.*

While no two CSSs are identical, common attributes that influence the implementation of CSO controls include: the number and location of outfalls, CSS area, treatment plant size, population served, and the characteristics of water bodies receiving CSO discharge. The following sections provide demographic comparisons in these broad areas to better characterize CSO communities nationwide.

6.1.1 CSO Permits and Types of Systems

Nationally, 859 CSO permits have been issued to 772 CSO communities in 32 states. These 859 CSO permits regulate 9,471 CSO discharge points. The geographic distribution of CSO permits and CSO communities is presented in Figure 6.1. CSO permits have been issued to the owners and operators of two types of systems with CSO outfalls:

- Combined sewer systems that include a POTW.
- Combined sewer systems that convey flows a POTW owned and operated by a separate entity under a different permit for treatment.

Communities that maintain and operate combined sewer systems but send wastewater flows to regional or remote treatment works are often termed satellite collection systems (SCSs). As shown in Figure 6.2, the 859 CSO permits include 642 combined systems with POTWs, 185 SCSs, and 32 combined systems that EPA was unable to classify due to insufficient data.

6.1.2 CSO Size

NPDES permittees are commonly classified by NPDES authorities as "major" or "minor" dischargers. Facilities are designated as "major" if the design discharge is greater than 1 mgd. Other facilities (with flows less than 1 mgd) can be classified as major on a case by case basis when NPDES authorities want a specific permit to have a stronger regulatory focus. The major classification is used to guide permitting, compliance, and enforcement activities to ensure larger sources of pollutants are given priority. Major facilities are typically inspected annually and must report monthly effluent concentrations and loadings. NPDES authorities must record monthly operating and performance data in PCS for major facilities. In addition, EPA regions review and approve issuance and reissuance of the permit for major facilities. Minor facilities generally have less stringent requirements.

Based on PCS data for the 642 CSO permits that include POTWs, EPA found that 70 percent of the CSO permits were classified as major facilities (Figure 6.3). For these same 642 CSO permits, EPA was able to obtain secondary treatment design flow data for 615. For these 615 CSO permits, EPA developed a frequency distribution based on design flows for POTWs serving CSSs (Figure 6.4).

As shown, about 50 percent of CSO permits are associated with POTW design capacities less than 2.5 mgd, and 70 percent have design capacities of less than 7.5 mgd.

Figure 6.1

Geographic Distribution of CSO Permits

CSOs are concentrated in the Northeast and Great Lakes regions.

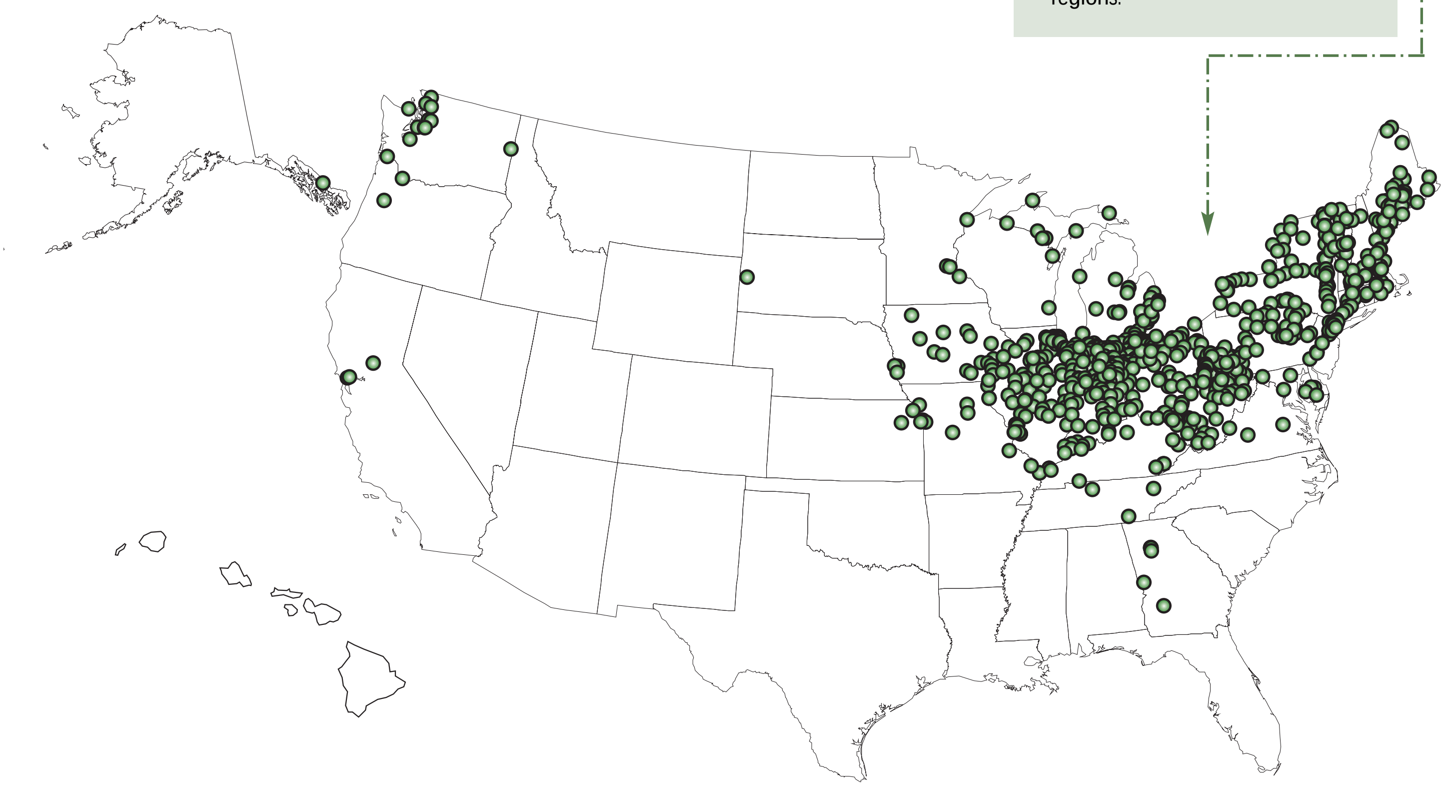


Figure 6.2

Types of CSO Facilities

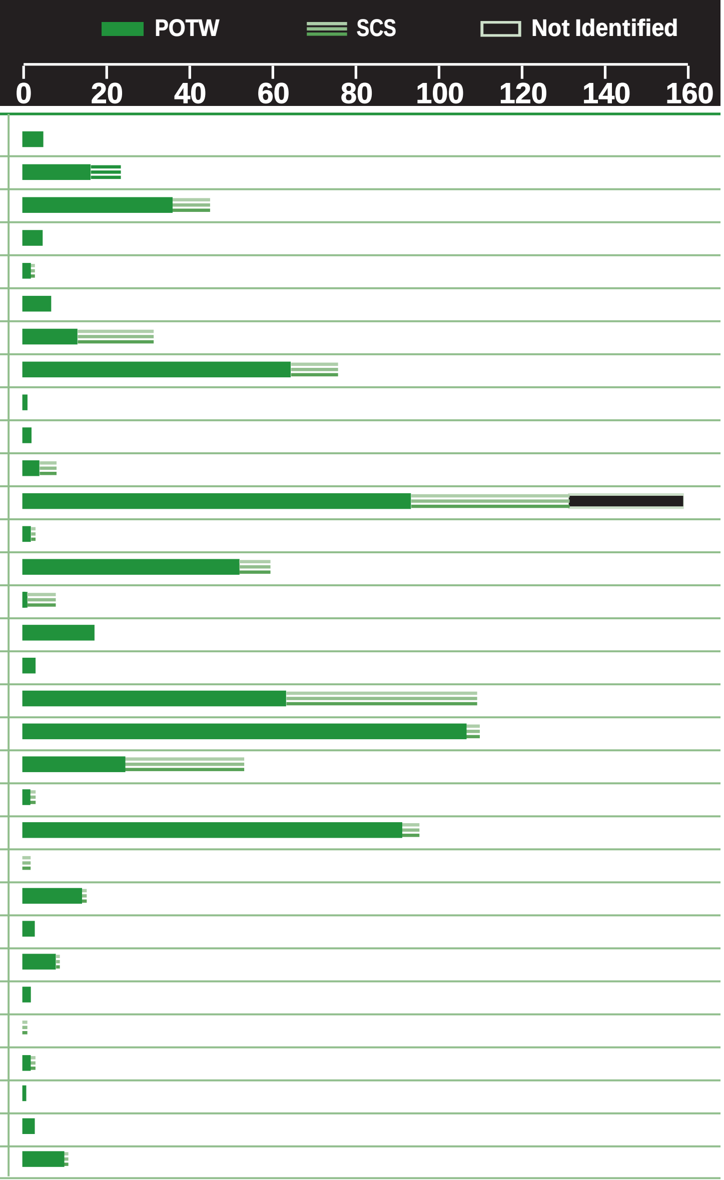
The owner/operators of nearly 80 percent of CSSs have a POTW within their jurisdiction. The remainder send their wastewater to a treatment facility owned/operated by a separate jurisdiction.

6.1.3 Small System Considerations

The CSO Control Policy recognizes that the development of an LTCP may be difficult for some small jurisdictions:

> *At the discretion of the NPDES Authority, jurisdictions with populations under 75,000 may not need to complete each 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 controls (II.B), public participation (II.C.2), and sensitive areas (II.C.3) portions of this Policy.*

Region	State	POTW	Satellite Collection System	No Information Available	Total
1	CT	5			5
	MA	16	7		23
	ME	35	9		44
	NH	5			5
	RI	2		1	3
	VT	7			7
2	NJ	13	18		31
	NY	63	11		74
3	DC	1			1
	DE	2			2
	MD	4	4		8
	PA	91	37	27	155
	VA	2	1		3
	WV	51	7		58
4	GA	1	7		8
	KY	17			17
	TN	3			3
5	IL	62	45		107
	IN	104	3		107
	MI	24	28		52
	MN	2		1	3
	OH	89	4		93
	WI			2	2
7	IA	14	1		15
	KS	3			3
	MO	8		1	9
	NE	2			2
8	SD		1		1
9	CA	2	1		3
10	AK	1			1
	OR	3			3
	WA	10	1		11
Total		**642**	**185**	**32**	**859**



Of 859 permits, 642 have POTWs, 185 are SCSs, and 32 were not identified.

Category	#of Permits	Percent
Facility Size Classification		
▽ Major	448	70%
▼ Minor	194	30%
Total Facilities	**559**	**100.0%**

Figure 6.3

POTW Facility Size Classification

The category of "major POTW" includes any facility designed to handle more than 1 mgd. More than two-thirds of CSO facilities are considered major.

EPA does not have population data by permit for CSSs, but the flow classification data presented in Figure 6.4 can be used as a surrogate measure. A common engineering standard is that 10,000 people generate 1 mgd. Using this as a guide, 70 percent of the 615 CSO permits (with available flow data) are for facilities with secondary treatment design flows less than 7.5 mgd, or a population of less than approximately 75,000.

6.1.4 CSO Receiving Waters

EPA's review of NPDES files provided data on the types of water bodies receiving CSO discharges. Names for these receiving water bodies were available in 761 of the 859 CSO permits, with many permits listing multiple receiving waters. The use of names for classifying water bodies complicates environmental analysis, as similar names may refer to very different waters. For example, the term "river" fails to distinguish free flowing waters from tidally influenced rivers, or to differentiate waters with significant differences based on geographic location. Also, names of water bodies may often reflect a historic name as opposed to a classification based on volume, flow, salinity, or other characteristics. At a national scale, however, the data allow a comparison of the distribution of CSOs relative to receiving water types, as presented in Figure 6.5. As shown, CSOs most commonly discharge to rivers and streams.

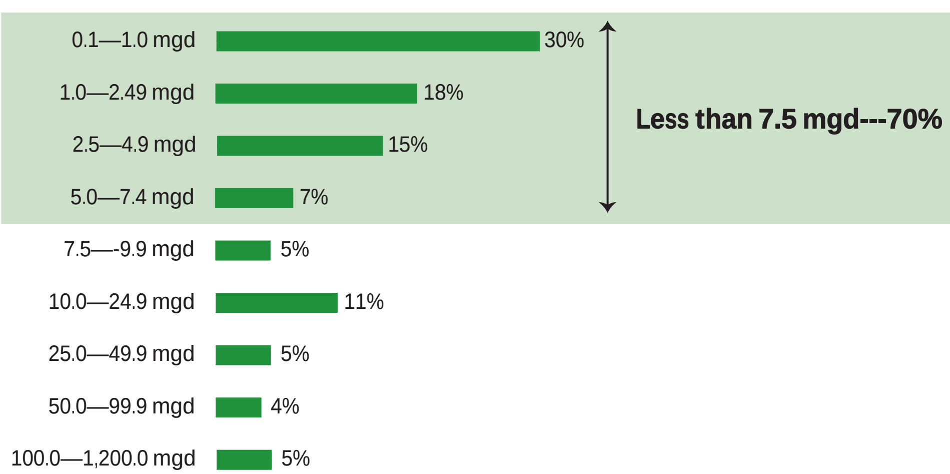


Figure 6.4

Distribution of POTW Facility Sizes

POTWs serving combined systems range in size from 0.1 mgd to 1,200 mgd, but most are designed to process less than 7.5 mgd.

6.2 Implementation of CSO Controls

Many community-level CSO programs predate the CSO Control Policy. The design and operation of CSSs has required municipalities to consider wet weather flows and system capacities in operating, upgrading, and expanding service. As more NPDES authorities initiated formalized CSO programs in the 1980s, greater attention was paid to the implementation of controls and to research, development, and testing of possible control alternatives.

Although this chapter of the report focuses on community implementation of controls in the context of the CSO Control Policy, other instances of documented controls are discussed. Documented controls include those resulting from implementation of the NMC, LTCP control alternatives, or other CSO studies or planning efforts.

Many communities have either separated their CSS or eliminated overflows (through system management or outfall elimination). Prior to this report, national tracking and estimates of communities that had separated or eliminated CSOs were not available. Data gathered for this report has established a baseline of CSO facilities (including those that have recently separated). Complete separation, full outfall elimination, or substantial completion of CSO control efforts was found for 87 CSO permits.

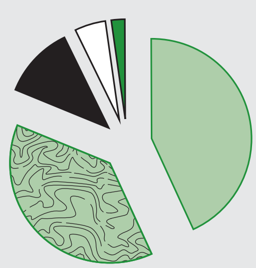
6.2.1 Assessment of Control Implementation

During visits to states and regions, NPDES files for 781 CSO permits were reviewed. Data on implemented controls for another 30 CSO permits were on file with EPA or were provided by the NPDES authority or the region. In discussing implementation, any controls documented for these 811 CSO permits are considered. Documentation types included NMC implementation reports, draft and final LTCPs, annual CSO reports, other engineering and planning documents, enforcement files, and correspondence and communication records maintained in the NPDES files. In the case of annual reports, documented controls were typically for specific reporting periods (i.e., the previous year) rather than a comprehensive set of CSO controls being considered and implemented. EPA believes that more comprehensive

Figure 6.5

Types of Waters Receiving CSO Discharges

Discharges occur to a wide variety of freshwater and marine environments, but most outfalls are located on rivers and streams.



Category	#of Waterbodies	Percent
Types of CSO Receiving Waters		
Rivers	606	43%
Streams	538	38%
Other	164	12%
Oceans/Bays/Estuaries	69	5%
Ponds/Lakes	32	2%
Total CSO Receiving Waters	**1,409**	**100.0%**

data on the implementation of CSO controls resides with CSO communities. Collection of data at the CSO community level will be a focus of the 2003 Report to Congress.

6.2.2 Documented Implementation of CSO Controls

In reviewing all data available for the 811 CSO permits, EPA found:

- 735 (91 percent) documented implementation of some BMP-type or structural control to reduce or eliminate CSOs.

EPA found that a significant number of CSO communities submitted documentation to the NPDES authority for significant structural controls implemented outside the scope of an LTCP. Specifically, 274 (34 percent) of the 811 CSO communities submitted documentation for project-specific CSO controls that do not meet all LTCP requirements, as defined by the CSO Control Policy, but surpass the minimal capital investment expectations of the NMC. These controls cover a range of activities including:

- Developing and implementing wet weather operating plans at POTWs.
- Using existing sewer system evaluation study (SSES) as the basis for a CSO control program.
- Continuing implementation of CSO facility plans that pre-date the CSO Control Policy.

The remaining sections examine CSO control implementation based on the requirements identified in the CSO Control Policy and assess the status of policy implementation at the community level.

6.3 Implementation of the NMC

Implementation of the NMC was expected to be one of the first steps taken by CSO communities in response to the CSO Control Policy. The NMC are controls that can reduce CSOs and their effects on receiving water quality, do not require significant engineering studies or major construction, and can be implemented in a relatively short period (e.g., within a few years). The CSO Control Policy states that the CSO permittee:

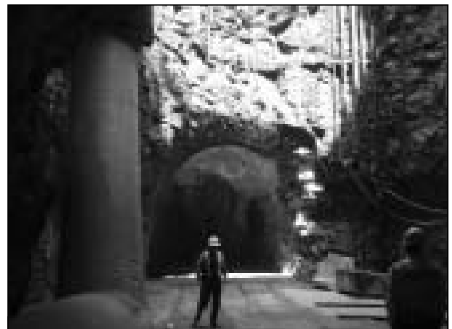
> *... should submit appropriate documentation demonstrating implementation of the nine minimum controls ...*

and

> *... this documentation should be submitted as soon as practicable, but no later than two years after the requirement to submit such documentation is included in an NPDES permit or other enforceable mechanism.*

The CSO Control Policy goes on to specify:

> *... documentation should be completed as soon as practicable but no later than January 1, 1997.*



Richmond, VA has been implementing CSO controls since the early 1980s. The storage tunnel at the Falls of the James River, shown, is part of the second phase of a plan that included increased wet weather storage and treatment capacity.

Photo: City of Richmond Department of Public Utilities

Documentation submitted to the NPDES authority on implementation of the NMC should demonstrate:

- *Alternatives considered for each minimum control*
- *Actions selected and reasons for selection*
- *Selected actions already implemented*
- *A schedule showing additional steps to be taken*
- *Effectiveness of the minimum controls in reducing/eliminating water quality impacts*

The individual NMC are not necessarily distinct and separate from each other. Controls can be paired or implemented in sequence to maximize the anticipated benefit of the controls. Many control activities can address more than one of the NMC at the same time (e.g., street sweeping can address both the "control of solids/floatables" and the "pollution prevention" controls). In the *Combined Sewer Overflows Guidance for Nine Minimum Controls* (EPA, 1995b), EPA indicated that the NMC are intended to be implemented in a holistic manner to achieve the ultimate goal of reducing CSO impacts.

6.3.1. NMC Implementation Status

EPA found documentation verifying implementation of at least one of the NMC in 627 (77 percent) of the 811 CSO permit files reviewed, as well as documentation confirming implementation of all of the NMC in 258 permit files. The number and percentage of CSO permits documenting implementation of each of the NMC is presented in Table 6.1.

Table 6.1 shows that more CSO communities have implemented the first six of the NMC than have implemented the last three. The first six controls were identified in the 1989 National CSO Control Strategy (in which they were referred to as the six minimum measures) and were to be incorporated into state-wide strategies.

The *Guidance for Nine Minimum Controls* states:

> *The NPDES permitting authority may choose to require the municipality to keep some records of NMC implementation on-site rather than requiring all documentation to be submitted.*

Given this option and the data limitations identified in Section 6.2.1, Table 6.1 likely underestimates actual implementation of the NMC.

6.3.2 Specific CSO Control Measures Implemented for the NMC

The CSO Control Policy and EPA's guidance provide considerable flexibility with respect to the type and range of activities or programs that may be undertaken to implement any one of the NMC. EPA found descriptions of specific NMC activities implemented in files associated with 381 of the 627 files with documented implementation. Table 6.2 presents the 10 most common NMC activities undertaken by CSO communities and

Table 6.1

Status of NMC Implementation Documentation

EPA reviewed 811 permit files for documentation of NMC implementation. As the table shows, the first six minimum controls are more widely implemented than the last three.

NMC Category	Number of Documented Implementations	% of 811 Permits Reviewed
1—Proper O&M	567	70%
2— Maximize use of collection system for storage	571	70%
3—Pretreatment program review and modification	526	65%
4—Maximize flow to the POTW	561	70%
5—Eliminate dry-weather overflows	567	70%
6—Solids and floatables control	478	59%
7—Pollution prevention	455	56%
8—Public notification	450	56%
9—Monitoring of CSO impacts and efficacy of controls	430	53%

the number and percentages of CSO permit files documenting use of the activity in information submitted to the NPDES authority. A more detailed list of CSO controls implemented by CSO communities to address the NMC is presented in Appendix R.

The following subsections describe the individual NMC and provide select examples of implementation activities by CSO communities.

NMC 1—Proper operation and regular maintenance programs for the sewer system and the CSOs.

The effectiveness of this control relies on a well-developed operation and maintenance (O&M) program. An O&M program generally should include the following:

- The organizations and people responsible for various aspects of the O&M program.

Table 6.2

10 Most Frequently Implemented NMC Activities

EPA found 381 permit files with descriptions of specific activities undertaken to implement one or more of the NMC. Solids and floatables control measures dominated the top five activities. Six of the NMC are represented in this list.

NMC Activity	NMC Category	Implementation Frequency	% of 381 Permits Reviewed
Street sweeping and cleaning	6	181	48%
Catch basin cleaning	6	158	41%
Public education programs	8	101	27%
Sewer flushing	1	90	24%
Screens and trash racks	6	84	22%
In-sewer storage	2	77	20%
Solid waste reduction and recycling	7	68	18%
Infiltration and inflow control	2	66	17%
Industrial pretreatment	3	61	16%
Area/foundation drain, roof leader disconnection	2	57	15%

Planning and budgeting for operations and maintenance procedures is needed to ensure that expensive capital equipment, such as this vortex separation system in Columbus, GA continues to function properly.

Photo: Columbus Water Works

- The resources (i.e., people and funding) allocated to O&M activities.
- Planning and budgeting procedures for O&M of the CSS and treatment facilities.
- A list of facilities (e.g., tide gates, overflow weirs) critical to the performance of the CSS.
- Written procedures and schedules for routine, periodic maintenance of major items of equipment and CSO diversion facilities, as well as written procedures to ensure that regular maintenance is provided.
- A process for periodic inspections of the facilities listed previously.
- Written procedures, including procurement procedures, if applicable, for responding to emergency situations.
- Policies and procedures for training O&M personnel.
- A process for periodic review and revision of the O&M program.

An example of implementation:

New York City, NY

New York City increased surveillance and maintenance of CSO regulators and pump stations and improved wet weather operations at its wastewater treatment plants. These efforts contributed to a 96-percent reduction of bypassed flow during wet weather events, from 1,845 mg in FY 1989 to 61.4 mg in FY 1998. In addition, as part of its study to reduce floatables discharge to New York Harbor, New York City found ways to adjust normal operation and maintenance activities to prevent floatables from entering the system. An ongoing two-year cycle for cleaning the more than 100,000 catch basins in the city was initiated in 1996 (NYCDEP, 1997).

NMC 2: Maximum use of the collection system for storage

This control depends on the identification of potential storage locations where simple or minor modifications can be made to increase in-system storage. Several activities are used to implement this control:

- Collection system inspection to identify deficiencies, blockages, or accumulation of debris that limit storage.
- Removal of deposits through cleaning and sewer flushing to restore full storage capacity.
- Inspection, maintenance and repair of tide gates to prevent tidal intrusions from entering the combined sewer system during dry and wet weather conditions.
- Adjustment of regulator settings to increase in-system storage.
- Modification of catch basin inlets to retard inflow.
- Elimination of direct connections from roof leaders and basement sump pumps to reduce flow to the combined sewer system.

- Detention of runoff in upstream areas (parking lots, streets, ponds) to increase storage in the combined sewer system.
- Coordination of pumping operations to maximize storage in the combined sewer system.

Examples of implementation:

Wilmington, DE

Leaking tide gates and poorly adjusted regulator settings allow substantial amounts of water to enter sewer collection systems. This unwanted inflow uses in-system storage and adds to treatment costs. The City of Wilmington observed that at high tide, river water was spilling over a regulating weir at one of its largest CSO outfall structures and into the collection system. A simple, inexpensive solution was employed to increase the weir elevation by 16 inches. Pump station records indicated that this modification reduced inflow by 5 mgd and increased in-system storage by an equivalent amount during periods of wet weather flow. A more permanent solution was implemented when the same weir was reconfigured during construction of a floatables control unit (City of Wilmington DPW, 2000).

Skokie, IL

Skokie implemented a city wide program to retard the delivery of surface runoff entering the CSS. Berms were used to increase on-street storage, and flow restrictors were used to reduce the peak rate of flow entering the CSS. Skokie constructed 871 berms on streets and installed more than 2,900 flow-restricting devices at catch basins. In addition, most of the roof drains were disconnected, resulting in a substantial reduction in wet weather flow entering the CSS (EPA,1999c).

NMC 3: Review and modification of pretreatment requirements to assure CSO impacts are minimized

For this control to be effective, municipalities must develop an inventory of non-domestic dischargers, assess potential volume and pollutant impacts, evaluate the feasibility of modifying pretreatment programs, and implement control measures.

Examples of implementation:

❖ **Richmond, VA**

The City of Richmond adapted its pretreatment program to implement this NMC. One key activity is that several industries retain storm water during wet weather events and release flow to the CSS after the event, when sewer system capacity is available. Another related activity is that the discharge of water treatment plant residuals to the combined sewer system is stopped during wet weather events (City of Richmond DPU, 2001).

To properly assess pretreatment requirements in busy industrial areas like New York Harbor, CSS operators must maintain an inventory of the volume and impact of non-domestic discharges to the system.

Photo: Photodisc

Learn More About Them . . .

Additional information about a number of the community CSO programs described in this chapter can be found in Appendix C. Case study communities have this symbol ◆ next to their names.

San Francisco's CSO Oceanside Water Pollution Control Plant treats an average of 17 mgd during dry weather and has 65 mgd peak flow capacity. During wet weather, excess flow is stored in structures that remove sediment and floatables before the flows are transported to the plant for treatment.

Photo: San Francisco Public Utilities Commission

NMC 4: Maximization of flow to the POTW for treatment

The objective of this control is to reduce the frequency, volume, and duration of CSO discharges by taking full advantage of existing facilities to transport and treat wet weather flows. The effectiveness of this control relies on a thorough understanding of the hydraulic response of the CSS and POTW during wet weather and identification of modifications that allow additional conveyance and treatment. Considerations for this control include:

- Determining the capacity of interceptors and pump stations that deliver flow to the POTW.
- Assessing POTW processed flows during wet and dry periods.
- Comparing current flows with the overall design capacity of the POTW and individual unit processes.
- Evaluating the ability of the POTW to operate acceptably at incremental increases in wet weather flow and potential impacts on the POTW's compliance with effluent limits.
- Identifying inoperative or unused treatment facilities on the POTW site that can be used to store or treat wet weather flows.
- Developing cost estimates for physical modifications and related O&M.

An example of implementation:

✦ **South Portland, ME**

South Portland installed an extensive system of real-time flow monitoring equipment to help characterize its collection system and existing CSOs. All CSO outfalls in the system are continuously monitored, and the duration, overflow rate, total volume, and time of day of each CSO is recorded. Flow monitoring has provided many benefits for South Portland's CSO abatement program. The real-time flow data provide basic information for the city to understand CSS performance, enable the progress of the CSO abatement program to be tracked, produce information for comparison of CSO control alternatives, and serve as an important component of compliance monitoring. (Appendix C–South Portland case study)

NMC 5: Prohibition of CSOs during dry weather

Dry weather overflows are illegal under the CWA. The elimination of dry weather overflows was a primary goal of the National CSO Control Strategy. The CSO Control Policy reiterated the importance of eliminating dry weather overflows and made this activity a priority for both implementation and enforcement.

CSO permits generally contain a direct prohibition on dry weather overflows and require the permittee to document and report dry weather overflows to the NPDES authority. Yet, little data on the occurrence of dry weather overflows exist for compilation at the national level. CSO communities are often required to report the annual average number of dry weather overflows observed during reissuance of their NPDES permits. CSO communities usually calculate the annual average number of dry weather overflows based upon data one to three years prior to submitting the NPDES application. Of 301 CSO permit files with associated dry weather overflow information, 278 permits (more than 90 percent) reported no dry weather overflows.

Several methods are used to alleviate dry weather overflows:

- Adjusting regulator settings to keep peak dry weather flows within the combined sewer system.
- Repairing and rehabilitating regulators to correct problems.
- Maintaining regulators to remove dry weather overflow-producing blockages caused by trash and refuse.
- Maintaining tide gates and removing debris to ensure that the gates close properly to prevent tidal intrusions from entering the combined sewer system.
- Cleaning interceptors to remove sediment, roots, and other objects that restrict flow.
- Repairing sewers to reduce groundwater infiltration.

Examples of implementation:

✦ **Massachusetts Water Resources Authority (MWRA), Boston, MA**

Through a series of "fast-track" CSO projects, MWRA was able to eliminate dry weather overflows caused by capacity problems or other structural conditions in the metropolitan Boston area. Control of dry weather overflows is currently managed through field operations, including frequent system inspections, routine maintenance, and as-needed maintenance to remove obstructions and make other repairs.
(Appendix C–MWRA case study)

✦ **South Portland, ME**

From 1996 to 1998, all of the dry weather overflows experienced by the City of South Portland resulted from power or equipment failures. The city installed backup power sources at key system locations and is utilizing its network of continuous flow monitors to quickly identify and eliminate dry weather overflows. South Portland reported no dry weather overflows during 1999.
(Appendix C–South Portland case study)

NMC 6: Control of solids and floatable materials in CSOs

Floatables controls can be implemented in several ways; effectiveness is highly dependent on design, operation, maintenance, and site-specific conditions. Principal options for the control of solids and floatables include:

Floatables control is accomplished through pollution prevention activities such as street cleaning and public education, and through physical controls, such as this netting system serving the Cleveland, Ohio area.

Photo: Northeast Ohio Regional Sewer District

- Prevention of extraneous solids and floatables from entering the CSS, by reducing the amount of street litter and encouraging households not to flush inappropriate items (such as personal hygiene products) down the toilet.

- Removal of solids and floatables from CSOs, using physical controls to keep floatables in the CSS or capture floatables before being discharged to receiving waters. Controls under this option include baffles, trash racks, screens, catch basin modifications, and end-of-pipe netting systems.

- Removal of floatables from surface waters after discharge to receiving waters. The floatables controls under this option include booms and skimmer boats.

Examples of implementation:

❖ **North Bergen, NJ**

North Bergen's solids and floatables controls consist of a netting system that captures solid and floatable material one-half inch and larger in diameter. The city has installed three end-of-pipe netting units, four in-line units, and two floating units to comply with the solids and floatables control requirements of their NJDEP permit. Each unit has either two or four disposable mesh nets which are removed and disposed when full. North Bergen estimates it captures and removes over 40 tons of solids and floatables in these nets each year that otherwise would have been discharged into the Hudson River and various tributaries of the Hackensack River.
(Appendix C–North Bergen case study).

Communities use a variety of pollution prevention techniques to keep floatables from entering the CSSs, including street sweeping.

Photo: NJ Department of Environmental Protection

❖ **South Portland, ME**

South Portland utilizes contracted sweeping services to sweep the entire 104 miles of city roadways each spring following the application of sand and salt over the winter. This process yields over 2,000 cubic yards of material annually. City streets are continually maintained by city personnel during the summer and fall, and an additional 1,000 cubic yards of material is picked up during this period. These activities prevent solids and floatables from entering the CSS.
(Appendix C–South Portland case study and EPA, 1999d).

NMC 7: Pollution prevention

The effectiveness of this minimum control relies heavily on public education and outreach. Pollution prevention activities are far reaching and provide environmental benefits that go beyond CSO control. Specific pollution prevention activities include:

- Solid waste collection and recycling

- Product ban or substitution to reduce problematic packaging waste

- Control of illegal dumping

- Bulk refuse disposal

- Hazardous waste collection

- Water conservation
- Commercial and industrial pollution prevention

Examples of implementation:

Seattle, WA

As part of its Water Smart Technology Program, Seattle Public Utilities offers financial incentives and technical assistance to commercial customers who install water conservation technologies. Incentives are available for replacement of cooling systems and cooling tower modifications, water recycling applications, cleaning processes, toilets, laundry equipment, and irrigation operations with water efficient technologies. Technical assistance is provided in the form of water bill analysis, on-site water audits, life cycle cost analysis, building design, brochures, and speaking engagements (Seattle Public Utilities website).

✥ **Rouge River Program, MI**

As part of its outreach effort, the Rouge River National Wet Weather Demonstration Project in Michigan initiated the "Rouge Friendly Business Program." The program works with small business owners to help them complete a facility management self-assessment form. The program then suggests the implementation of source controls such as storage and disposal of non-hazardous materials, grease handling, and managing outdoor work areas. The program recognizes and promotes businesses that make the suggested changes and demonstrate river-friendly pollution prevention practices. As of 2000, 25 businesses have been officially recognized. As part of the recognition, businesses receive a certificate and a window decal (EPA, 1999d).

The Detroit Water and Sewerage Division created Snoop-A-Saurus to increase participation in its Rouge-Friendly Business Program. The logo was also used by the Rouge River National Wet Weather Demonstration Project, which had more public education funding, to broaden exposure.

Photo: Detroit Water and Sewerage Division

NMC 8: Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts

Public notification programs are intended to reduce the exposure of the general public to potential health risks associated with CSO discharges. Techniques used to implement this measure depend on local circumstances and the presence or absence of CSO-impacted recreational and commercial resources. Public notification activities include:

- Posting informational signs at visible CSO outfalls and near outfalls where the public has access to the impacted shoreline.
- Posting signs at affected use areas (e.g., bathing beaches) where use restrictions occur.
- Placing notices in newspapers or on radio or television to alert the public to severe or recurring problems.
- Maintaining telephone hot lines or websites to keep the public appraised of problems and changing conditions.

Oxbow Meadows is an environmental learning center in Columbus, GA. Columbus also maintains the Uptown Park CSO Technology Demonstration Facility, which is open for public tours and educational activities.

Photo: Columbus Water Works

The Allegheny County Health Department raises orange flags labeled "CSO" near outfalls in Pittsburgh to warn waterfront visitors when CSOs cause or contribute to elevated bacteria levels.

Photo: Photodisc

The effectiveness of this minimum control relies upon the CSO community's ability to tailor programs around site-specific conditions and keep information provided to the public as current as possible. Public notification is effective only if the community is actively engaged and educated.

Examples of implementation:

King County, WA

King County works jointly with the City of Seattle and the Seattle-King County Health Department in posting signs at CSO locations and undertaking public outreach. The Health Department maintains a CSO information line and a website dedicated to CSOs that addresses the following questions:

- What is a CSO?
- Are CSOs a new problem?
- What is the CSO Public Notification Program?
- What does the warning sign look like and mean?
- Why are CSO warning signs going up now?
- What will happen if I go in the water near a CSO sign?
- What if my dog goes in the water near a CSO sign?
- Will I get sick from eating the fish I catch near these signs?
- What is being done to control CSOs?
- What can I do to keep local water safe and clean?
- How much rain does it take for a CSO discharge to occur?
- How long does water stay contaminated after a CSO discharge?
- Can CSOs be eliminated?

(King County CSO Control Program website).

Allegheny County, PA

The Allegheny County Health Department implemented a public notification program designed to warn recreational users of health risks in CSO-impacted waters in the Pittsburgh area. The program includes publishing advisories in local newspapers and producing public service announcements on local television stations to educate the public of the dangers attributable to CSO discharges. The department also places orange warning flags that read "CSO" at 30 locations near CSO outfalls. The flags are raised to warn recreational users whenever CSO discharges cause or contribute to elevated levels of bacteria. The flags are lowered when "safe" levels have returned. The Health Department also established a 24-hour phone line to provide advisory updates (CSO Partnership website).

NMC 9: Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls

Understanding the characteristics of the CSS, the hydraulic response to rainfall, and impacts of CSO discharges is critical to the success of any control program. The expectation of this control is the use of visual reconnaissance and simple monitoring methods to develop a basic understanding of the combined sewer system. More advanced monitoring and modeling during LTCP development and implementation serve to supplement this control. Examples of characterization measures include:

- Assemble maps, reports, and other existing information to provide a reference for CSO assessment.
- Monitor and record the occurrence and frequency of overflows through visual inspection, inspection aids such as chalk and wood blocks, and automatic monitoring equipment.
- Track citizen inquiries, water quality data, and other readily available information on impacts to recreational uses and other impairments.

The effectiveness of this control depends on utilizing available monitoring data and the CSO community's ability to develop and implement simple monitoring measures to characterize the combined sewer system and the magnitude of CSO impacts.

An example of implementation:

✦ **Randolph, VT**

Randolph is using block testing at its two CSO outfalls to determine whether an overflow event has taken place. Block testing is a simple and inexpensive way to evaluate the frequency of CSO discharges. Block testing involves resting a block of wood on the dam or diversion structure at the CSO outfall and checking on a regular basis to see if it has been dislodged by a CSO event. Block testing is being used to confirm the success of local sewer separation efforts and best management practices in reducing overflows at Randolph's CSO locations.
(Appendix C–Randolph case study).

6.4 Implementation of the LTCP

Concurrent with the implementation of the NMC, the CSO Control Policy expects that:

> *Permittees with CSOs are responsible for developing and implementing long-term CSO control plans that will ultimately result in compliance with the requirements of the CWA. The long-term control plans should consider the site-specific nature of CSOs and evaluate the cost effectiveness of a range of control options/strategies.*

CSO communities are generally expected to complete the development of an LTCP within two years of being required to do so in an NPDES permit or other enforceable mechanism.

6.4.1 Status of Documented Implementation of the LTCP

Based on EPA's review of 811 CSO permit files, 275 (34 percent) permittees had submitted a draft LTCP to the NPDES authority and 139 (17 percent) had documented implementation efforts. The review also revealed that NPDES authorities had approved 155 (56 percent) of 275 submitted LTCPs as sufficient to attain water quality standards. The review showed that 30 CSO permittees (11 percent of 275) had initiated implementation of the LTCP while awaiting approval by the NPDES authority. Conversely, 38 CSO permittees (14 percent of 275) with an approved LTCP have not documented with the NPDES authority that implementation has been initiated.

Nine CSO permits (3 percent of 275) had developed and submitted an LTCP despite having no requirements to do so. These nine cases reflect municipalities that are not required to develop an LTCP by their permit (see discussion in Chapter 5 on reasons for not having a requirement), but which moved ahead with development and implementation of CSO controls within the scope of the CSO Control Policy. In most of these cases, municipalities had a basis for CSO planning prior to the issuance of the CSO Control Policy and adapted planning efforts to be consistent with the CSO Control Policy without being required to do so.

6.4.2 Selected LTCP Approach

The CSO Control Policy identified two general approaches for attaining water quality standards: the "demonstration" and "presumption" approaches. Both approaches provide municipalities with targets for CSO control that may meet the water quality-based requirements of the CWA, particularly protection of designated uses.

Based on the 275 LTCPs filed with NPDES authorities:

- 95 (35 percent) followed the demonstration approach.
- 70 (25 percent) followed the presumption approach.
- 110 (40 percent) used a combination of the two approaches, submitted LTCPs prior to the issuance of the CSO Control Policy, or not enough information was obtained during the file review to classify the approach.

Additional information on the demonstration and presumption approaches is provided in Section 2.4.2 of this report.

6.4.3 Specific CSO Control Measures for LTCPs

In reviewing the NPDES authority files, EPA found descriptions of 578 specific CSO controls, beyond the NMC, that have been or will be implemented by 268 permittees as part of an LTCP, or other CSO control program. Documentation of an additional 280 specific CSO controls was found for another 171 CSO communities not required to develop an LTCP. Based upon this review, these 858 controls documented by CSO communities are classified as collection system controls, storage controls, or treatment controls. In general:

- Collection system controls are measures that remove flow from, or divert flow within, the CSS to maximize the conveyance of flow through the combined sewer system to the POTW. This category includes inflow/infiltration control, pump station capacity upgrades, expanded interceptor capacity, regulating devices and backwater gates, inflatable dams, flow diversion, real-time control, and sewer separation.
- Storage controls are measures that temporarily store combined sewage for subsequent treatment at the POTW once capacity becomes available. This category includes in-line storage, retention basins, and tunnels.
- Treatment controls are measures that reduce the pollutant load in CSO discharges. This category includes coarse screening, primary sedimentation, increased treatment plant capacity, swirl/vortex technologies, and disinfection.

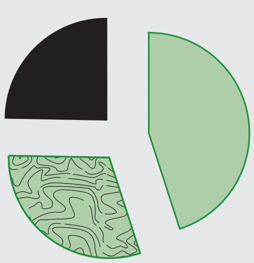
The number of CSO controls documented in the permit files for these three categories is presented in Figure 6.6. The 10 CSO controls that most frequently have been or will be implemented as part of an LTCP are presented in Table 6.3. A detailed summary of all documented CSO controls implemented by the CSO communities as part of an LTCP is presented in Appendix R. The CSO controls implemented or selected for implementation suggest that CSO communities have considered a range of controls as expected by the CSO Control Policy.

As shown in Table 6.3, sewer separation was the most widely implemented CSO control. Complete or limited sewer separation has been implemented or planned by the majority of CSO communities for which documentation of CSO controls was found in the NPDES authority files. Limited sewer separation is a prevalent solution for communities that have small areas served by combined sewers; these areas often lend themselves to separation.

Figure 6.6

Distribution of CSO Control Measures Implemented as Part of an LTCP

CSO controls used as part of an LTCP are relatively evenly distributed between treatment, storage, and collection system improvements. Notably, collection system controls are dominated by sewer separation activities.



Category	#of Permits	Percent
Controls Implemented for LTCP		
Collection System Optimization/Control	387	45.1%
Treatment	258	30.1%
Storage	213	24.8%
Total Controls	**636**	**100.0%**

6.4.4 Minimum Elements of an LTCP

The CSO Control Policy lists nine minimum elements that should be addressed, as appropriate, in the development of an LTCP. This section describes each element, discusses the types of activities to be considered, supplies supporting data where available, and provides CSO community examples for some of the elements.

Characterization, Monitoring, and Modeling

The CSO Control Policy states:

> *Permittees with combined sewer systems that have CSOs should immediately undertake a process to accurately characterize their sewer system.*

and

> *The purpose of the system characterization, monitoring and modeling program initially is to assist the permittee in developing appropriate measures to implement the nine minimum controls and, if necessary, to support development of the long-term CSO control plan.*

System characterization, monitoring, and modeling activities support the selection and implementation of cost-effective CSO controls. Hydraulic responses of the combined sewer systems to wet weather events need to be understood to enable CSO communities to estimate pollutant loadings from CSOs. When the system is properly characterized, the effect of pollutant loads in receiving water under existing conditions and under a series of CSO control options can be evaluated.

System characterizations range from simple to more complex activities that can include:

- Delineating sewershed boundaries.
- Gathering and reviewing existing data on flow, hydraulic capacity, receiving water quality, and rainfall.
- Identifying existing collection system conditions and problems.

Table 6.3

10 Most Frequently Implemented LTCP Controls

LTCPs usually employ a combination of controls. Sewer separation accounts for more than half of CSO control measures found in LTCP documentation. Other measures are more uniformly distributed in the frequency analysis.

LTCP Control	Control Category	Number of Implementations	% of 439 Permits Reviewed
Sewer separation	Collection System	222	51%
Sewer rehabilitation	Collection System	73	17%
Retention basins	Storage	71	16%
Disinfection	Treatment	71	16%
Primary sedimentation	Storage	69	16%
Storage tunnels and conduits	Storage	66	15%
Upgraded WWTP capacity	Treatment	64	15%
Outfall elimination	Collection System	63	14%
Upgraded pump station capacity	Collection System	53	12%
Swirl concentrators/vortex separators	Treatment	31	7%

- Quantifying CSO flows and pollutant loads.

EPA's review of CSO files revealed that 369 (45 percent) of the 811 CSO permit files reviewed contained information on the miles of combined sewer maintained by the CSO community and/or the acres served by combined sewers. This information was typically required as part of the NPDES permit application or included in NMC documentation. The CSO file review also revealed:

- 259 CSO files (32 percent) with documentation of the frequency of CSO events, by outfall, for one or more years.

- 197 CSO files (24 percent) with documentation of annual CSO discharge volumes, by outfall, for one or more years.

- 45 CSO files (6 percent) with receiving water monitoring data.

In addition, EPA's review of CSO files found that 121 (15 percent) contained information indicating that the CSO community intended to develop either a collection system or receiving water model to support development of an LTCP.

Examples of implementation:

Northeast Ohio Regional Sewer District (NEORSD)

NEORSD serves the greater Cleveland metropolitan area. One focus of NEORSD's CSO control is Mill Creek Watershed, the 17,000-acre service area of the Mill Creek Interceptor. System characterization activities implemented by NEORSD within the Mill Creek Watershed Study included:

- Identifying 175 CSO and storm water outfalls discharging to Mill Creek and its tributaries.

- Monitoring at 17 sites to characterize the volume and characteristics of discharges during storms.

- Monitoring at a network of four receiving water stations to characterize flow and quality during dry and wet weather conditions.

- Assessing aquatic life and habitat at 11 sites in Mill Creek for biological health indicators including the Qualitative Habitat Evaluation Index, Invertebrate Community Index, Index of Biological Integrity, and sediment quality and in-stream toxicity.

(WEF, 1999b)

New York City, NY

New York City conducts extensive combined sewer system and receiving water monitoring. The monitoring program data provide the basis for the estimation of CSO flows and loads, and for receiving water quality assessments. The major pollutants of concern are bacteria, BOD, solids, and toxics. By 1998 the city had sampled 124 CSO outfalls for up to five rainfall events, for a total of 600 outfall sampling events. The city has performed over 46,000 analyses to determine the characteristics of CSOs. In addition, the city monitors 52 stations in New York Harbor bimonthly on a year-round basis to track trends.

New York City uses three models to assess the relationship between pollutant sources and water quality response:

- A landside model of the combined sewer system that simulates CSO loads in response to rainfall inputs;
- A hydrodynamic model of circulation in New York Harbor; and
- A water quality model of the Harbor that simulates the fate and transport of pollutants.

The monitoring and modeling program has helped the city to identify priority areas and identify appropriate control measures for these locations (WEF, 1999b).

Public Participation

Coordination and communication with the public and regulatory agencies is important in establishing a basis for communicating CSO issues and in discussing proposed controls during the LTCP process. Given the potential for significant expenditures of public funds to implement CSO controls, establishing early communication with the public is an important first step in the long-term planning approach, and crucial to the success of a CSO control program. The importance of public participation is stressed in the CSO Control Policy:

> *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.*

Examples include:

Birmingham, MI

The City of Birmingham designed its public participation process to educate and involve as many citizens as possible. The process included four primary components:

- Public hearings and notification on siting and funding alternatives for CSO control and abatement projects.
- Creation of an Ad Hoc Citizens' Advisory Committee to review alternative CSO abatement plans as well as design concepts, including site planning, architectural considerations, and park restoration considerations.
- Development and distribution of press background materials (including identification of appropriate contacts within the city to respond to media inquiries) prior to and throughout the construction of a 5.5 mg retention basin.

- Direct mailing to residents in the neighborhood where construction took place.

(CSO Partnership website).

Wilmington, DE

The centerpiece of the City of Wilmington's public participation program was a series of three public meetings on the development of the LTCP. The meetings included presentations covering CSOs in the city, the LTCP process, flow monitoring, the use of computer models to evaluate alternatives, and details on CSO control alternatives under consideration by the city, including costs. Meeting attendees were given the opportunity to comment on the proposed controls and other aspects of the planning process. The city distributed questionnaires designed to encourage attendees to provide suggestions and opinions on CSO control alternatives, the appropriate level of CSO control, priority areas for CSO control, and paying for CSO control. A summary of the question-and-answer portion of each meeting was prepared and distributed to those in attendance (City of Wilmington DPW, 2000).

Consideration of Sensitive Areas

The CSO Control Policy identifies several categories of receiving waters eligible to be classified as "sensitive areas." CSO communities are expected to identify and give the highest priority to controlling CSOs that discharge to sensitive areas during the development of the LTCP. The CSO Control Policy also provides that communities discharging to sensitive areas will be targeted for priority attention from the NPDES authority.

Sensitive areas are defined by the NPDES authority in coordination with other federal and state agencies, where appropriate, and include the following:

- Outstanding National Resource Waters
- National Marine Sanctuaries
- Waters with threatened or endangered species and their critical habitat
- Waters with primary contact recreation (e.g., beaches)
- Public drinking water intakes or their designated protection areas
- Shellfish beds

EPA found information on sensitive areas in 250 (31 percent) of the 811 CSO permit files reviewed. Based on this review, the number of permits with CSOs discharging to the various types of sensitive areas is summarized in Table 6.4. As shown, primary contact recreation waters are the dominant type of sensitive area impacted by CSO discharges.

This summary may not represent a true national picture of discharges to sensitive areas for two reasons. First, CSO communities were given limited guidance on the identification of sensitive areas. Second, some states classify all water bodies as primary

The CSO Control Policy expects CSOs that discharge to sensitive areas, such as salmon spawning streams, will be given highest priority for controls.

Photo: Photodisc

contact recreation waters. Nevertheless, CSO communities do appear to be giving consideration to sensitive areas in the development and implementation of LTCPs.

Examples include:

- **Muncie, IN**
  Muncie's LTCP gives priority to eliminating discharges to sensitive areas. A subcommittee of Muncie's Citizens CSO Advisory Committee was established to determine those areas along the White River considered to be the most sensitive with respect to parks, schools, and places of public use. CSOs that discharge to identified sensitive areas are to be eliminated, relocated, or treated (Appendix C–Muncie case study).

- **San Francisco, CA**
  San Francisco's LTCP gives priority to eliminating discharges to sensitive areas. A CSO outfall at Baker Beach in the Golden Gate National Recreational Area was eliminated on the basis of the sensitivity of the habitat. (Appendix C–San Francisco case study)

- **MWRA, Boston, MA**
  MWRA identified four receiving waters with critical use areas analogous to sensitive areas. The presence of swimming or shellfishing in each receiving water made protection of these resources a priority. MWRA's goal is to reduce the frequency of overflows to zero per year in these areas through implementation of sewer separation and CSO relocation. As shown in Table 6.5, this prioritization has reduced overflows in two of the four critical use areas, with full implementation expected by 2008. (Appendix C–MWRA Case Study)

Evaluation of Alternatives

The CSO Control Policy expects that CSO communities will consider and evaluate a reasonable range of control alternatives during LTCP development. Further, it expects that LTCPs will evaluate options bounded by full control and no control, so that a reasonable assessment of cost and performance could be made. As evidenced by the top 10 CSO controls presented in Table 6.3 and the detailed summary of CSO controls contained in Appendix R, CSO communities

Table 6.4

Sensitive Areas Affected by CSO Discharges

Primary contact recreation waters are the sensitive areas most often impacted by CSO discharges.

Type of Sensitive Area	Number of CSOs	% of 250 Permits Reviewed
Waters with primary contact recreation (e.g., beaches)	178	71%
Other/unspecified	45	18%
Public drinking water intakes/designated protection areas	10	4%
Waters with threatened or endangered species/habitat	9	4%
Shellfish beds	7	3%
Outstanding National Resource Waters	1	<1%
National Marine Sanctuaries	0	0%

Table 6.5

MWRA Critical-Use Prioritization Program Results

Critical Use Area	CSO Control	1997 Baseline	2001	Projected 2008
N. Dorchester Bay	CSO Relocation	78 per year	21 per year (2)	0 per year
S. Dorchester Bay (1)	Separation	22 per year	19 per year	0 per year
Neponset River	Separation	17 per year	0 per year (3)	0 per year
Constitution Beach	Separation	16 per year	0 per year (3)	0 per year

1. Treatment (screening and disinfection) provided in 1997
2. Modified baseline following additional characterization
3. Sewer separation completed in 2000

MWRA developed its LTCP based on a water body use and sensitivity analysis. The program reduced CSO discharges to sensitive areas from 133 to 40 in three years and is expected to eliminate CSOs by 2008.

appear to have considered a range of control alternatives as expected by the CSO Control Policy.

Examples include:

❖ **Richmond, VA**

Richmond considered a full range of CSO control alternatives as part of its Long Term CSO Control Plan Re-Evaluation. The range of alternatives included:

- Sewer separation
- In-system storage
- Disinfection
- High-rate filtration
- Retention basins
- Swirl concentrators
- Sedimentation basins
- Screening
- Additional conveyance capacity
- BMPs and source control
- Expansion of the POTW

CSO controls were evaluated based on a thorough analysis of CSO volume and frequency, water quality, financial impacts, and public input. (Appendix C–Richmond case study)

Cost/Performance Considerations

Cost/performance considerations enable CSO communities to identify and select the most cost-effective level of CSO control, often referred to as the knee-of-the-curve. This is the point at which incremental pollution reduction or water quality improvement diminishes relative to increased cost. As stated in the CSO Control Policy,

> *The permittee should develop appropriate cost/performance curves to demonstrate the relationship among a comprehensive set of reasonable control alternatives that correspond to the different ranges specified...this should include an analysis to determine where the increment of pollution reduction achieved in the receiving water diminishes compared to increased costs.*

This type of analysis provides communities with information necessary to compare LTCP control alternatives in relation to

Before selecting CSO controls such as tunnel storage for wet weather flows, Richmond, VA evaluated many alternatives in view of CSO frequency and volume reductions, control effectiveness, financial impacts, and public input.

Photo: Richmond Department of Public Utilities performance, cost and environmental benefit in choosing the most appropriate solution.

Examples include:

- **Muncie, IN**
  The Muncie Sanitary District (MSD) is currently in the process of selecting cost-effective CSO abatement alternatives for the LTCP. At least eight alternatives are being evaluated using knee-of-the-curve analysis. Storage basins, increased pumping and wastewater treatment capacity, in-system storage, sewer separation, and various combinations of these controls are being considered. Complete sewer separation and "no action" are also included as MSD evaluates alternatives for its LTCP. Additionally, MSD is considering the impact of local sewage rate increases when evaluating alternatives and implementation schedule. (Appendix C–Muncie case study)

Operational Plan

The operational plan provides a framework for the coordinated operation of the CSS and all of its facilities in a manner that reduces overflows and provides maximum levels of treatment to wet weather flows. The CSO Control Policy states that:

> *After agreement between the permittee and the NPDES authority on the necessary CSO controls to be implemented under the long-term CSO control plan, the permittee should revise the operation and maintenance program developed as part of the nine minimum controls to include the agreed-upon long-term CSO controls.*

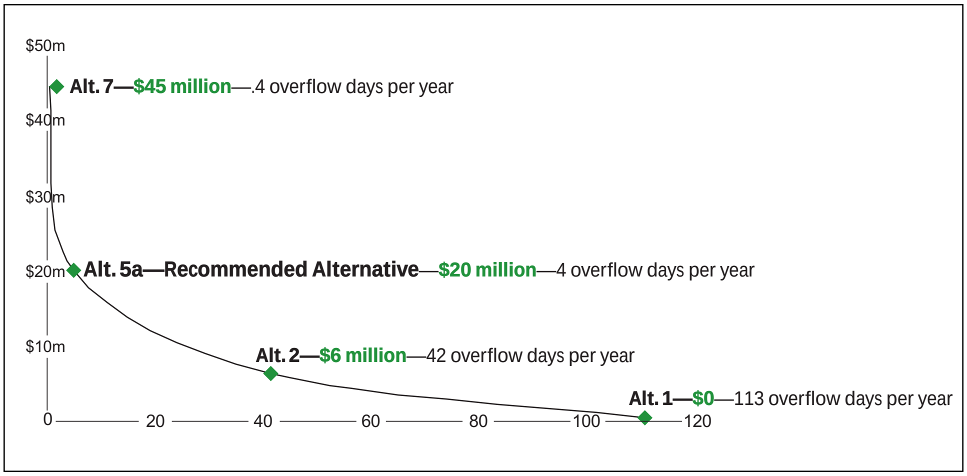
Maximization of Treatment at the Existing POTW

This LTCP element builds upon NMC 4, maximization of flow to the POTW for treatment. The CSO Control Policy expects that:

Figure 6.7

Cost-Benefit Analysis Using Knee-of-the-Curve

Knee-of-the-curve analysis can shed light on the cost-benefit relationships between alternatives. It is often the case that the most expensive alternative yields marginal benefits in comparison to a more affordable option.



In some communities, POTW treatment plants may have primary treatment capacity in excess of their secondary treatment capacity. One effective strategy to abate pollution resulting from CSOs is to maximize the delivery of flows during wet weather to the POTW treatment plant for treatment.

See example provided in Section 6.3.2 of this report.

Implementation Schedule

Development of an implementation schedule is typically based upon a combination of financial, environmental, and other site-specific factors. The CSO Control Policy expects that:

The permittee should include all pertinent information in the long-term control plan necessary to develop the construction and financing schedule for implementation of CSO controls.

The scheduling and phasing of construction activities can be based upon the following:

- Elimination of CSOs to sensitive areas
- Use impairment
- Financial capability
- Grant and loan availability
- User fees and rate structures
- Other variable funding mechanisms and sources of financing

In particular, the CSO Control Policy:

... recognizes that financial considerations are a major factor affecting the implementation of CSO controls...[and]...allows consideration of a permittee's financial capability in connection with a the long-term CSO control planning effort, WQS review, and negotiation of enforceable schedules.

It should be noted that many of the communities nearing full implementation of controls or realizing environmental benefits from CSO controls have worked on CSO abatement since the 1970s.

Post-construction Compliance Monitoring

The CSO Control Policy expects that:

The selected CSO controls should include a post-construction water quality monitoring program adequate to verify compliance with water quality standards and protection of designated uses as well as to ascertain the effectiveness of controls.

CSO communities are responsible for conducting a monitoring program during and after LTCP implementation to aid in determining the effectiveness of the overall LTCP controls in meeting CWA requirements and in attaining water quality standards. Pre- and post-construction monitoring data were not typically found in the data maintained in NPDES authority files.

Like most cities, Chicago maintains excess primary treatment capacity to accommodate wet weather flows. Shown is a primary clarifier at a Chicago-area POTW.

Photo: EPA

6.5 Financial Considerations

Successful implementation of an LTCP rests upon the ability of the CSO community to obtain funding for the selected controls in a sustained manner so that controls can be implemented and paid for over time. The financial capability of the community is a major factor in determining the implementation schedule for the LTCP. In fact, the CSO Control Policy expects:

> *NPDES permitting authorities should consider the financial capability of permittees when reviewing CSO control plans.*
>
> *The method of securing financing is also important. The CSO Control Policy states that each municipality....is ultimately responsible for aggressively pursuing financial arrangements...*

This section outlines the funding options available to CSO communities and describes the specific approaches taken by several CSO communities to secure funding to implement the LTCP.

6.5.1 Funding Options

A variety of capital funding options are available for CSO projects, including:

- Self financing. CSO control self-financing typically occurs through the issuance of bonds, establishment of special reserve funds, or the funding of CSO control projects with annual taxes, water and sewer fees, or other revenues.

- State Revolving Fund (SRF) loans. SRF programs can offer low or zero interest loans, guarantees of repayment, bond insurance, and refinancing of existing debt under certain conditions.

- Federal grants. The federal government has several programs that provide assistance for CSO projects. Most are offered only to small and economically disadvantaged communities.

- State grants. Twenty-eight states have grant programs that vary significantly in funding level and restrictions.

- Other capital funding options. Special assessment districts can be used to fund projects for a specific geographic area (require legal arrangement to charge those receiving the service for capital or operating costs of the project). In addition, proffers or exactions of contribution of land, services, or facilities from private sector development companies for rights to connect to a water/sewer system in the future.

These funding options are not available to every CSO community. For example, some CSO communities may have difficulty obtaining long-term bond financing due to limited experience in obtaining debt financing. In addition, separate grant or loan assistance programs for CSO communities are not available in all states. CSO communities generally identify their best funding options after reviewing all the funding sources, considering benefits and limitations, and determining applicability.

Specific examples of funding option combinations used by CSO communities to cover the costs of CSO control are presented below.

- **Burlington, IA**

  The City of Burlington used a mix of Federal Community Development Block Grants, federal grants, and bonds to finance CSO control. The city has been working on a sewer separation project in the Hawkeye drainage basin since 1988. The total cost of the project is projected to be $13.3 million. In 1998, the city was awarded a Federal Special Infrastructure grant for $7 million. The city is providing the local cost-share for this project through bond issuance and user fees.
  (Appendix C–Burlington case study)

  Western Port, MD

  The town of Western Port, with approximately 2,750 residents, developed a CSO control program that cost nearly $1.5 million to implement. Because of its proximity to and involvement with a local paper company, Western Port was eligible for grant funding from the Federal Bureau of Mines and the Soil Conservation Service. This grant covered one-third of project costs. The community also secured a low-interest SRF loan from the Maryland Department of Environment. The SRF loan covered another third of the project costs. A grant from the Federal Community Development Block Grant program covered one-fifth of the project costs, and a county grant covered 3 percent of the project. The net result was financing from a number of funding sources that enabled Western Port to keep user fees at an acceptable level of 1.2 percent of median household income (EPA, 1995d).

- **Randolph, VT**

  Preliminary engineering and design work for Randolph's CSO abatement program took place between 1991 and 1994. This work was funded through the State Planning Advance Program, with a total cost of approximately $250,000. Randolph spent an additional $2.66 million on LTCP development and CSO abatement by 1997. Funding for this additional cost was obtained through state grants (25 percent), SRF loans (50 percent), and from the town's annual operating budget (25 percent).
  (Appendix C–Randolph case study)

6.6 Obstacles and Challenges

The CSO Control Policy establishes a consistent national approach for controlling discharges from combined sewer systems to the nation's waters through the NPDES permit program. As described in the CSO Control Policy:

The purpose of the [CSO] Policy is to coordinate the planning, selection, design, and implementation of CSO management practices and controls to meet the requirements of the CWA and to involve the public fully during the decision making process.

CSO communities like Bayonne, NJ have invested heavily in CSO control and sewer rehabilitation, a necessity given the age of their sewer infrastructure. Many, however, express frustration over a perceived lack of well-defined environmental endpoints for CSO control.

Photos: NJ Department of Environmental Protection

CSO communities have made progress in developing and implementing CSO controls as required by permits and, in some cases, enforcement actions. But a number of challenges remain before the goals of the CSO Control Policy and the CWA are achieved. These challenges have been articulated by CSO communities and their consultants in a number of formal and informal settings, including: panels and outreach activities on the CSO and other wet weather programs; stakeholder meetings on wet weather issues convened under the Federal Advisory Committee Act; EPA-sponsored listening sessions on impediments to meeting the water quality-based provisions of the CSO Control Policy (EPA, 1999e), surveys by stakeholders including AMSA and the CSO Partnership (Appendix G), and a stakeholder briefing on this Report to Congress (Appendix I).

A common concern expressed by CSO communities is that the application of the CSO Control Policy has not resulted in well-defined endpoints for CSO control. In particular, the presumption approach does not ensure attainment of water quality standards. CSO communities are faced with the decision to move forward with major capital investments for CSO controls under the presumption approach that may not meet water quality-based objectives of the CWA, and with no assurance that additional CSO control will not be required.

EPA has identified the following key concerns expressed by CSO communities in the years since the CSO Control Policy was released:

- Need for additional financial and technical resources
- Complexity of water quality standards review process
- Uncertainty about the roles of EPA and state regulatory agencies
- Applicability of the watershed approach and competing priorities within water programs

This section presents additional information on the challenges faced by CSO communities in implementing a level of control that meets the expectations of the CSO Control Policy.

6.6.1 Resources

The *1996 Clean Water Needs Survey Report to Congress* (CWNS) estimates the investment necessary to address the nation's municipal water quality needs. CSO "needs" are the estimated costs to complete all CSO control projects eligible for SRF funding under the CWA. Needs include costs associated with facilities used in conveyance, storage, and treatment of CSOs. Annual operation and maintenance (O&M) costs, however, are not part of the CWNS. The CWNS estimates that needs associated with CSO controls, excluding O&M, total

$44.7 billion (in 1996 dollars). The CWNS estimate is based on the presumption approach to CSO control, which provides primary treatment for wet weather flows and assumes four to six untreated overflow events per year.

CSO communities raised concerns that the CWNS underestimates the actual level of control that will be needed to meet the requirements of the CWA. In particular, they noted the presumption approach may not provide a sufficient level of control to provide for the attainment of current water quality standards.

6.6.2 Water Quality Standards

The CSO Control Policy identifies attainment of water quality standards as one of its fundamental objectives:

> *A primary objective of the long-term CSO control plan is to meet water quality standards, including the designated uses, through reducing risks to human health and the environment by eliminating, relocating or controlling CSOs to the affected waters.*

Water quality standards consist of designated uses, narrative or numeric criteria to support these uses and an antidegradation policy and implementation procedures to protect the water quality improvements attained. There is considerable variability in the criteria that states use to protect recreational uses because not all states have adopted EPA's *Ambient Water Quality Criteria For Bacteria—1986* (see Table 6.6). The BEACH Act of 2000, discussed above, required Great Lakes and coastal states to adopt by April 2004, the 1986 water quality criteria for bacteria (*E.coli* and/or enterococci).

EPA recommends that states and tribes adopt these criteria for they are more protective of human health for gastrointestinal illness than fecal or total coliform. EPA recognizes the difficulties some states and tribes have had in adopting *E.coli* or enterococci as water quality criteria for bacteria and drafted implementation guidance to assist in the adoption process. EPA expects to publish final implementation guidance by the end of 2001.

The CSO Control Policy encourages CSO communities and states to coordinate the development and implementation of the LTCP with the review and, if appropriate, revision of water quality standards to ensure that the CSO controls will be sufficient to meet water quality standards. The CWA and the CSO Control Policy expect NPDES permits requirements to ensure that CSOs will not interfere with the attainment of water quality standards.

CSO communities, states, and environmental and CSO constituencies have voiced a number of different opinions on the timing of water quality standards reviews in relationship to the development and implementation of the LTCP. EPA recently published *Guidance: Coordinating Long-Term CSO Planning with Water Quality Standards Reviews* to lay a strong foundation for integrating CSO long-term control planning with water quality standards review. Many CSO communities and other stakeholders do not understand the water quality standards review process, the analyses required to revise the standards and the role the public plays in influencing any revision to a standard. The guidance outlines a process to facilitate agreement among CSO communities, states, and EPA on the data to be collected and the analyses to be conducted to support both the LTCP development and water quality standards reviews. Integrating the processes should provide greater assurance that CSO communities will implement affordable CSO control programs that meet appropriate water quality standards.

6.6.3 Uncertainty

CSO communities identified a number of areas in which they feel the CSO Control Policy is not explicit. Specific concerns related to:

- The attainment of water quality standards with implementation of LTCP.

Table 6.6

Bacteriological Indicators Used By States

States vary in their use of indicator bacteria to establish water quality standards. Several states use a combination of indicators, but many rely solely on fecal coliform.

Region	State	Freshwater Indicator Bacteria	Marine Indicator Bacteria
1	CT	Enterococci/Fecal Coliform/Total Coliform	Enterococci
	ME	*E. coli*	Enterococci
	MA	Fecal Coliform/Total Coliform	Fecal Coliform
	NH	*E. coli*	Enterococci
	RI	Fecal Coliform/Total Coliform	Fecal Coliform
	VT	*E. coli*	
2	NJ	Enterococci/Fecal Coliform	Enterococci/Fecal Coliform
	NY	Fecal Coliform/Total Coliform	Fecal Coliform/Total Coliform
3	DE	Enterococci	Enterococci
	MD	Fecal Coliform	Fecal Coliform
	PA	Fecal Coliform	
	VA	Fecal Coliform	Fecal Coliform
	WV	Fecal Coliform	
	DC	Fecal Coliform	
4	GA	Fecal Coliform	Fecal Coliform
	KY	Fecal Coliform	
	TN	Fecal Coliform	
5	IL	Fecal Coliform	
	IN	*E. coli*	
	MI	*E. coli*/Total Coliform	
	MN	Fecal Coliform	
	OH	*E. coli*/Fecal Coliform	
	WI	Fecal Coliform	
7	IA	Fecal Coliform	
	KS	Fecal Coliform	
	MO	Fecal Coliform	
	NE	Fecal Coliform	
8	SD	Fecal Coliform	
9	CA	*E. Coli*/Enterococci/ Fecal Coliform/Total Coliform	Enterococci/ Fecal Coliform/Total Coliform
10	AK	Fecal Coliform	Fecal Coliform
	OR	*E. coli*	Fecal Coliform
	WA	Fecal Coliform	Fecal Coliform

- The review and approval process for LTCP.
- The definition of "primary contact recreation waters" as related to sensitive areas.

Attainment of Water Quality Standards

The attainment of water quality standards in urban waters often cannot be achieved solely through CSO control. Other point source discharges, including storm water, and contributing nonpoint sources must also be controlled. Integration of LTCP development in a watershed context would alleviate some concerns about meeting water quality standards and equity. CSO communities are well positioned to participate in watershed efforts, but not well positioned to lead them.

Review and Approval of LTCPs

Of the 275 LTCPs submitted by CSO communities as of June 2001, 180 (65 percent) have received formal approval from the appropriate NPDES authority. The remaining (unapproved) LTCPs are generally being reviewed by the NPDES authority, or being revised based on comments or questions received during the review process. CSO communities are often unable or unwilling to commit to the substantial funding required to implement an LTCP without prior review and approval by the NPDES authority. Further, EPA has not issued guidance specific to the review and approval of LTCPs. The combined result has been delay in implementing some LTCPs. Delays can result in the need to revise an LTCP to reflect new data and cost information.

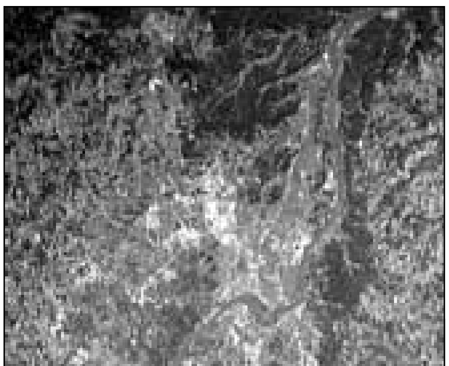
Sensitive Areas and Primary Contact Recreation Waters

The CSO Control Policy defines sensitive areas to include:
(1) Outstanding National Resource Waters, (2) National Marine Sanctuaries, (3) waters that provide habitat for threatened or endangered species, (4) waters with primary contact recreation, (5) waters used for public water supply, and (6) shellfish beds. NPDES permitting authorities, however, have substantial discretion in designating sensitive areas.

CSO stakeholders have voiced concern that most states use fishable/swimmable as their default designated use. Consequently, if waters with primary contact recreation is interpreted broadly, it could trigger sensitive area designations for a large percentage of receiving waters nationwide. These stakeholders assert that during the CSO Control Policy development negotiations, criterion 4 above was expressed in terms of swimming or bathing beaches or beaches with contact recreation. In the CSO Control Policy, however, the language reads, “waters with primary contact recreation.” Stakeholders reiterated that this is a critical distinction.

Marina on the Chicago River, Chicago. In urban areas, CSO control alone will not achieve attainment of water quality standards. Other pollution sources must also be evaluated and addressed, such as storm water, nonpoint source runoff, and commercial sources.

Photo: David Riecks



Louisville, KY changed its approach to water quality monitoring to support its watershed-based management program. Instead of monitoring to just to meet permit requirements, subwatersheds are monitored for water quality changes. The results are used to support sewer system modeling, planning, and management decision-making.

Photo: National Oceanic and Atmospheric Administration

6.6.4 The Watershed Approach

The CSO Control Policy provides that:

> *"Permitting authorities are to evaluate water pollution control needs on a watershed management basis and to coordinate CSO control efforts with other point and nonpoint source control activities."*

Despite this provision, CSO communities raised concerns over the way EPA and NPDES authorities compartmentalize the management of water programs. This compartmentalization impedes holistic management of wet weather water quality problems on a watershed basis. Many CSO communities have to implement controls and extensive planning, monitoring, and reporting efforts for a variety of wet weather and related programs that are not well coordinated at the NPDES authority level. These include:

- Phase I NPDES permit requirements for municipal separate storm sewer systems (MS4s) serving communities with over 100,000 population, and for storm water discharges associated with industrial activity, including construction activity disturbing at least five acres of land;
- Phase II NPDES permit requirements for MS4s serving smaller communities and construction sites (to be implemented by March 2003);
- Sanitary sewer overflow (SSO) management activities under permitting and enforcement requirements developed by states and EPA regions;
- Source Water Assessment and Protection Programs, under the 1996 Safe Drinking Water Act Amendments, to identify potential threats to areas serving as sources of drinking water and to implement protection efforts; and
- TMDL studies, wasteload allocations for point sources, and load allocations for nonpoint sources.

These programs often have separate implementation schedules and monitoring, outreach, and reporting requirements. Leadership in developing an LTCP to consider watershed issues is often absent.

An example of a CSO community taking the lead on watershed-wide issues:

✥ **Louisville & Jefferson County Metropolitan Sewer District, KY (LJCMSD)**
LJCMSD has worked to integrate five local programs covered by NPDES permits, including CSOs, using watershed-based monitoring and management strategies. LJCMSD identified a lack of coordinated monitoring and assessment data as the biggest obstacle to improving water quality. Each permit program had its own staff, priorities, operating procedures, sampling program databases, and lists of facilities. Little information-sharing took place between programs, and field personnel were spread thin, with

two- and three-person teams trying to cover enormous areas during the same wet weather event, often gathering different samples at the same locations. It was nearly impossible to establish long-term monitoring sites throughout LJCMSD for each of the five NPDES programs. LJCMSD developed a Combined Annual Report (a unified report format) that considers permit requirements and watershed issues as a whole. This effort has improved the effectiveness of LJCMSD's management activities and the ability of LJCMSD to track progress.
(Appendix C–Louisville & Jefferson County Metropolitan Sewer District case study)

6.7 Performance Measures and Environmental Benefits

As a matter of policy, EPA encourages communities to monitor and track environmental benefits associated with CSO control. The CSO Control Policy specifies:

> *...selected CSO controls should include a post-construction water quality monitoring program adequate to verify compliance with water quality standards and protection of designated uses as well as to ascertain the effectiveness of CSO controls.*

The overall goal of the prescribed post-construction monitoring is to determine compliance with the CWA and the overall effectiveness of the LTCP in achieving water quality standards. The CSO Control Policy did not establish or recommend any other programmatic measures of performance for CSO communities that could be used to quantify and document the results and effectiveness of CSO controls.

6.7.1 CSO Performance Measures for CSO Communities

In 1996, AMSA, in cooperation with EPA, published *Performance Measures for the National CSO Control Program* (AMSA,1996). The purpose of the report was to establish a recommended series of performance measures for use by communities to track improvements and results associated with CSO control. The report identified and described 24 performance measures grouped into four broad categories (Table 6.7).

These categories of performance measures paralleled those identified for permitting authorities' consideration in EPA's *Combined Sewer Overflow Guidance for Permit Writers* (see Section 5.8 for a discussion of these categories).

6.7.2 Loading Reduction and Environmental Benefits

Establishing CSO performance measures provides the foundation for assessing loading reductions and environmental benefits. The administrative and end-of-pipe categories provide a direct measure of CSO reduction and controls. The receiving water and ecological/human health/resource use categories provide a direct measure for assessment of environmental benefits achieved from CSO control.

These indicators are generally the result of analysis from extensive monitoring and tracking programs. Monitoring and tracking programs are complicated by several factors. Chief among them is that many measures, particularly water quality measures, require monitoring during wet weather conditions. Monitoring during wet weather conditions cannot be scheduled in a routine manner, but must instead be scheduled in response to CSO-producing rainfall events. Another complicating factor is that weather conditions and rainfall totals are highly variable from storm to storm and year to year, making comparisons difficult. Monitoring programs need to be targeted and implemented in a consistent manner from year to year to be able to establish pre-control baseline conditions and to identify meaningful trends over time as CSO controls are implemented.

In practice, it is often difficult, and in some instances impossible, to link environmental conditions or results to a single source of pollution, such as CSOs. In most instances, water quality is impacted by multiple sources, and trends over time reflect the change in loadings on a watershed scale from a variety of environmental programs.

6.7.3 Data, Findings and Examples

Although the methodology for this report did not emphasize the collection of data on loading reductions or environmental benefits, EPA did seek out existing, readily available data that could be used to measure of environmental benefits attributable to CSO control. Most relevant data and information were based upon local data submitted by CSO communities in annual or periodic reports, and from information collected and documented in the case studies (see Appendix C).

Table 6.7

CSO Control Performance Measures

A major part of CSO control is assessing the effectiveness of the controls and measuring improvements in receiving waters. Common sense, local conditions, and cost-effectiveness should drive the selection of performance measures.

1—Administrative

- Documented implementation status of NMC
- Documented implementation status of LTCP
- Waste reduction

2—End-of-Pipe

- Flow measurement
- Wet weather flow budget
- CSO frequency
- Frequency in sensitive areas
- CSO volume
- Volume in sensitive areas
- Dry weather overflow
- Pollutant load reduction
- BOD load
- TSS load
- Nutrient load
- Floatables

3—Receiving Water

- Dissolved oxygen trend
- Fecal coliform trend
- Floatables trend
- Sediment oxygen demand trend
- Trends of metals in bottom sediments

4—Ecological/Human Health Resource Use

- Shellfish bed closures
- Benthic organism index
- Biological diversity index
- Recreational activities
- Beach closures
- Commercial activities

EPA's observations on tracking CSO loading reductions and environmental benefits are as follows:

- Most of the available data necessary to assess environmental benefits originate from the CSO communities in databases or published reports.

- Data submitted by CSO communities on CSO control program effectiveness and loading reductions are not compiled at the state level in a way that can be easily assessed or distilled.

- The limited available information on environmental benefits comes mainly from CSO communities that initiated CSO controls prior to the CSO Control Policy and constructed facilities intended to protect water quality and designated uses. These communities are farther along than communities still in the LTCP development and early implementation stages.

- Environmental benefits associated with CSO control may also be attributable and non-distinguishable from other wet weather program controls that have been put in place.

While a national assessment of performance measures could not be undertaken, EPA's review of select CSO community materials clearly shows that major improvements in flow and load reduction and water quality have been documented in a few cases. Examples of performance measures and associated environmental results for CSO communities follow this discussion. The information provided on environmental results draws substantially on material from CSO communities that initiated CSO control programs before the CSO Control Policy. The benefits realized in these CSO communities are likely to be achieved by other communities as more and more CSO control solutions are implemented.

Examples of Loading Reductions

- **Chicago, IL**
  The frequency of CSO discharges in Chicago has decreased from 80 per year to 15 per year due to construction of the Metropolitan Water Reclamation District of Greater Chicago's Tunnel and Reservoir Plan (TARP) system. In addition, the volume of combined sewage captured and treated in TARP reached a cumulative total of 565 billion gallons in 2001. (Appendix C–MWRD Case Study)

- **Saginaw, MI**
  The majority of the City of Saginaw is served by combined sewers, which discharge during wet weather into the Saginaw River. In 1990, an estimated 2,928 million gallons per year of CSO was discharged. Development of a plan to construct seven retention treatment basins for CSO control was also initiated in 1990. Implementation of this plan reduced overflows to 760 million gallons of treated overflow per year, and eliminated the direct discharge of untreated combined sewage under virtually all circumstances. The range of

Table 6.8

Pollutant Removal Capability of Retention Treatment Basins on the Saginaw River

Wet weather retention treatment basins have helped reduce CSO discharges by 75% and yielded similar pollutant removal rates in Saginaw, MI.

CSO Variable	Percent Removal
Volume	22—59%
BOD	50—83%
TSS	50—82%
Phosphorus	35—78%
Ammonia	39—84%

pollutant removal accomplished in the retention treatment basins is presented in Table 6.8. (Appendix C– Saginaw Case Study)

❖ LJCMSD

LJCMSD operates a combined sewer system in a heavily urbanized area that covers 24,000 acres. Within the system, 115 CSOs discharge to the Ohio River and tributaries that cross through Louisville and neighboring communities. LJCMSD has submitted a draft LTCP that includes sewer separation and a variety of other CSO controls. Partial implementation of this plan has yielded the elimination of 5 CSOs, a 27-percent reduction in CSO frequency, and a 13-percent reduction in CSO volume. Substantial additional benefits are expected to accrue when the LTCP is fully implemented. (Appendix C–Louisville & Jefferson County Metropolitan Sewer District case study)

Examples of Environmental Benefits

New York City, NY

New York City has operated a monitoring program to assess pollution in the New York Harbor since 1909. As stated in the 1998 New York Harbor Water Quality Survey:

Through developments and upgrades to New York City's sewage treatment system, as well as operational improvements implemented over the past 10 years, and a suite of aggressive and innovative pollution control programs, the New York City Department of Environmental Protection has:

- *Virtually eliminated raw sewage discharges.*
- *Reduced illegal discharges by more than 90 percent.*
- *Increased wet weather floatables capture to almost 70 percent.*
- *Reduced toxic metals loadings to the waste stream from industrial sources by over 90 percent.*

As a result of these actions there is strong evidence of improvement to New York Harbor's water quality and surrounding environment. These range from the reestablishment of breeding populations of herons, egrets and other waterfowl in several areas of the Harbor, to improved benthic communities in the lower New York Bay and include:

- The opening of all New York City public beaches for the first time since 1922 and the lifting of wet-weather swimming advisories for all but three of the beaches.
- The upgrading of 68,000 acres of shellfish beds since 1985 and the removal of shell fishing restrictions for 30,000 acres in Raritan Bay.
- The reestablishment of Hudson River Shortness sturgeon.

- A 50-90 percent reduction from peak levels of priority pollutants in fine-grained sediment in the Hudson River. Further evidence of improvement in water quality is presented in Figure 6.8, showing long-term trends of improving dissolved oxygen (increasing) and fecal coliform (decreasing) conditions in New York Harbor. These trends are due to a combination of pollution control programs including CSO control, wastewater treatment improvement and expansion, and other point and nonpoint source controls (NYCDEP, 1999).

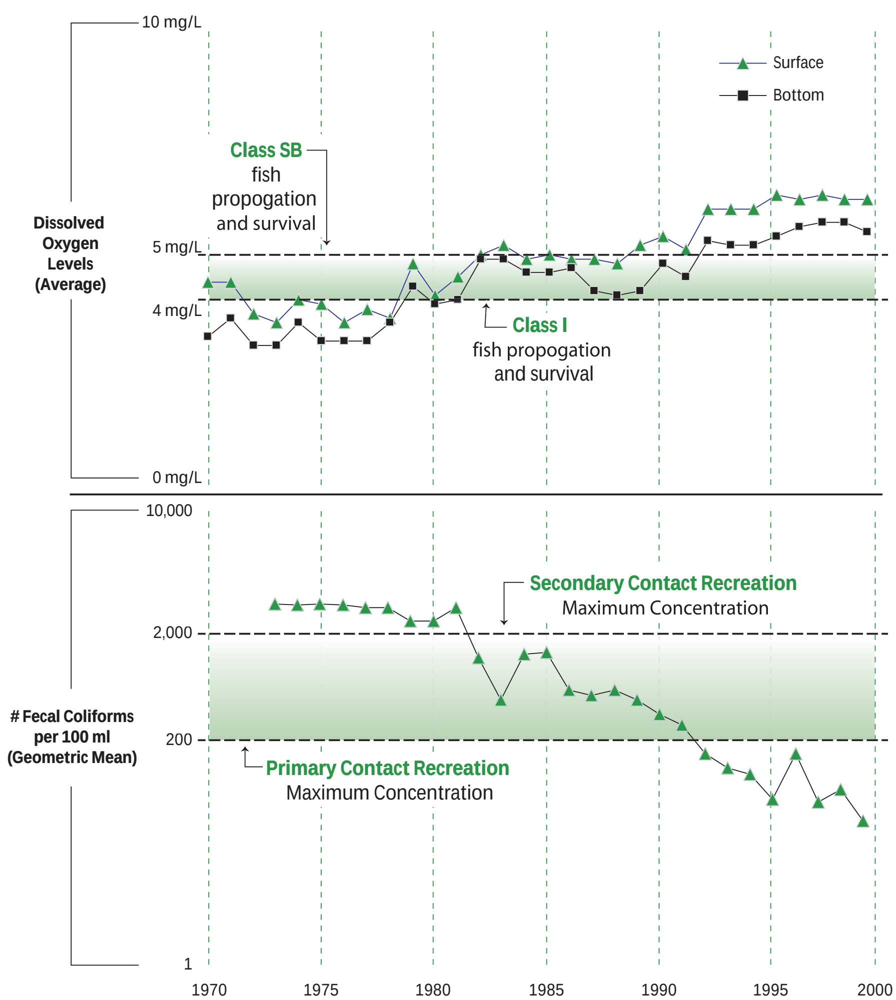


Figure 6.8

New York Inner Harbor Water Quality Improvements Due to Pollution Controls

Over a 20-year period, dissolved oxygen levels have increased and fecal coliform counts have decreased as a result of ongoing pollution control programs, including implementation of CSO controls.

Columbus, GA

Columbus fully implemented CSO control program includes POTW upgrades, sewer separation, new water resource treatment facilities, and a variety of pump station and collection system improvements. Monitoring on the Chattahoochee River shows that water quality and beneficial use improvements have been the direct result of CSO control. The Chattahoochee now meets water quality standards for fecal coliform and other parameters. The river in the downtown area is also free of trash, oil and grease, and other sewage debris. In addition, the City constructed a river walk and other riverside amenities that benefit residents and visitors in conjunction with CSO controls. As part of its LTCP, Columbus constructed two remote facilities to provide treatment for excess wet weather flows. The documented pollutant removal capability of the two treatment facilities is presented in Table 6.9. (Appendix C–Columbus case study)

Table 6.9

Pollutant Removal Capability of Two CSO Treatment Facilities in Columbus, GA

Remote wet weather treatment facilities, combined with improvements to the CSS, have reduced annual discharges of CSO contaminants by at least 52%.

Pollutant	Removal as % of Annual Load
BOD	55—61%
TSS	52—62%
Fecal coliform	95—99%
Copper	66—75%
Lead	62—83%
Zinc	62—82%

Rouge River Program, MI

The Rouge River National Wet Weather Demonstration Project covers 467 square miles of mostly urbanized areas in the greater Detroit area of southeastern Michigan. CSO controls have been implemented since the late 1990s, and the demonstration project's monitoring program is beginning to show environmental benefits associated with CSO control. Some of the key results and accomplishments are:

- About 30 miles of the Rouge River that was CSO-impacted in 1994 are now completely free of uncontrolled CSO discharges.

The first two years of performance monitoring data for the first six CSO basins shows the following:

- About 72 percent, or 933 million gallons, of combined sewage that previously went to the river was captured and treated at the Detroit POTW.
- Previously untreated overflows that occurred in excess of 50 times/year are now treated and occur from one to seven times per year.
- Results from continuously monitored stations show improvements in river dissolved oxygen conditions due to upstream CSO control projects and other watershed management measures/ changes.
(Appendix C–Rouge River Case Study)

Rochester , NY

Abatement of CSOs in Rochester dates back to planning that occurred in the 1960s and to initiation of CSO controls during the 1970s. The Monroe County Rochester Pure Waters District implemented numerous CSO projects over the past three decades. These include construction of a deep rock storage and conveyance tunnel system, construction of new treatment facilities, and improvement of existing facilities. Benefits associated with this mature CSO control effort are numerous and include increased recreational use of previously impacted waterways and land-based riverfront redevelopment. An example of the improved water quality condition in the Genesee River below the CSO area is presented in Figure 6.9 (AMSA, 1996).

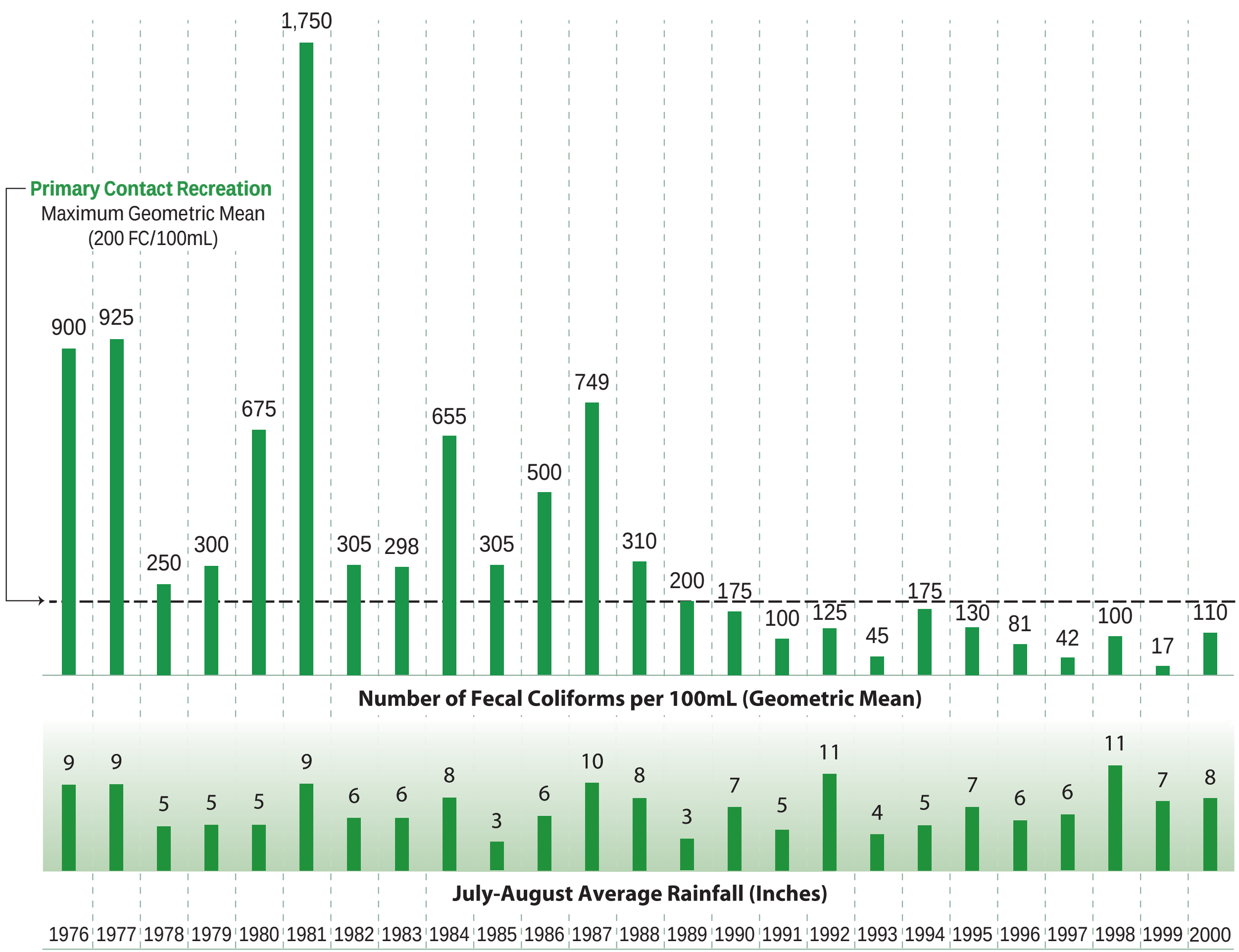
Minneapolis/St. Paul, MN

The twin cities of Minneapolis and St. Paul, Minnesota, completed separation of their combined sewer system in summer 1996. This marked the completion of a $332-million program to eliminate over 21,000 acres of combined sewers. The separation has reduced fecal

Figure 6.9

Genesee River Water Quality Improvements Due to CSO Controls

The City of Rochester has documented a 20-year reduction in fecal coliform below its CSO outfall due to additional storage and improved treatment capabilities.



coliform levels in the Mississippi River and has been credited with the marked increase in game fish population in the metropolitan area near the twin cities.

An indicator of improved water quality is the return of the may fly, which requires clean water to complete its life cycle (CSO Partnership website).

- **San Francisco, CA**
  San Francisco has been engaged in CSO planning and management since 1970, and its LTCP was fully implemented in the late 1990s. The city has an ongoing sampling program to evaluate the problems caused by overflows and to assess the environmental improvements gained from the program's implementation since 1972. CSO volume and frequency and CSO pollutant loads have been reduced substantially since CSO controls were implemented. Beach closings were reduced, directly benefitting the city's swimming, surfing, and sailboard enthusiasts. A summary of environmental benefits associated with CSO control in San Francisco is contained in Table 6.10. (Appendix C–San Francisco case study)

Table 6.10

Benefits of CSO Controls in San Francisco Harbor

Since implementing CSO controls, San Francisco has reduced the number of CSO events and pollutants of concern by an average 88%, and beach closings have been reduced by 94%.

Item	Before CSO Control	After CSO Control	% Reduction
Number of CSO events	58–80	1–10	75–98%
Annual CSO Volume (MG)	7,500	1,350	81%
Suspended Solids Discharge (tons/year)	3,550	450	87%
BOD5 Discharge (tons/year)	2,700	300	89%
Beach Postings (days/year)	200	12	94%

6.8 Findings

CSO Demographics

- There are 859 CSO permits issued to 772 CSO communities.
- 642 permits regulate POTWs serving combined sewer areas; 185 permits regulate SCSs.
- EPA estimates:
  - 30% serve areas with populations less than 10,000
  - 50% serve areas with populations less than 25,000
  - 70% serve areas with populations less than 75,000
- CSO outfalls are permitted to discharge to the following types of water bodies: rivers (43 percent), streams (38 percent), oceans/estuaries/bays (5 percent), ponds/lakes (2 percent), and others such as ditches, canals, unclassified, etc. (12 percent).

CSO Control Implementation

- Many municipalities have CSO requirements in NPDES permits or enforceable mechanism (e.g., order, decree) and are taking action to address CSO controls.

- 91 percent of communities have implemented some CSO controls as a result of permit or enforcement requirements, or on a voluntary basis.

- 77 percent documented implementation of at least one of the NMC as described in the CSO Control Policy; 32 percent documented implementation of all NMC

- The most commonly reported measures to implement the NMC were improving operation and maintenance, maximizing collection system storage, maximizing flow to the POTW, and elimination of dry weather overflows.

- 34 percent have submitted draft LTCPs; another 34 percent have documented implementation of CSO controls that were not developed as part of an LTCP.

- Communities with LTCPs are pursuing attainment of water quality standards in roughly equal measure under three approaches – demonstration, presumption, and a combination.

- Communities are relying on a wide range of technological approaches to address CSOs including storage (e.g. tunnels), expanded treatment capacity, sewer separation, and improved conveyance.

- Communities are using a combination of local funding sources, SRF loans, state grants and loans and——in special cases —line item congressional appropriations to fund CSO controls.

Obstacles and Challenges

- CSO LTCP controls typically involve major infrastructure investments that often compete with other infrastructure activities.

- Many reasons, including institutional barriers, exist for the lack of coordination between the LTCP development and water quality standards review processes. States cite public pressure to maintain their water quality standards, EPA requirements for UAAs, and the lack of water quality monitoring data that could be used to justify standards revisions. Municipalities consider the lack of a clear water quality-based endpoint to be a major impediment to development of LTCPs that will provide for CWA compliance, particularly when urban waters are affected by more than CSOs.

- Municipal data on efficacy of the NMC and LTCPs are highly variable and not easily accessible to EPA and the states. Municipal data on the environmental and public health impacts and improvements are very site-specific and not easily collected or distilled.

- CSO communities have to implement controls and extensive planning, monitoring, and reporting efforts for a variety of wet weather and related programs that are not well coordinated at the NPDES authority level. These programs often have separate implementation schedules and monitoring, outreach, and reporting requirements.

Loading Reductions and Environmental Benefits

- To the extent that environmental data necessary to assess the environmental impacts of CSO and the benefits achieved from CSO controls is collected at all, it is done at the community level. Most environmental benefits cited in this report are site-specific and generated from community-level reporting or through research for case studies.

- The limited data available indicate marked improvements in water quality for some communities implementing controls; however, it is difficult to attribute improvements to any one source of controls when other wet weather program controls are also being implemented (e.g., storm water, TMDLs, etc.).

Chapter 7

Evaluation of the CSO Control Policy

Activities undertaken by EPA, states, and CSO communities to implement and enforce the CSO Control Policy were discussed in Chapters 4, 5, and 6, respectively. This chapter synthesizes the findings from earlier chapters to evaluate the progress of the CSO Control Policy in controlling CSOs and protecting human health and the environment. In particular, this evaluation assesses the CSO Control Policy in the following areas:

- General implementation and enforcement.
- Adherence to the four key principles of the CSO Control Policy.
- Accomplishments attributable to implementation and enforcement of the CSO Control Policy.

This chapter concludes with a discussion of next steps to be taken by EPA based on report findings.

7.1 Implementation and Enforcement of the CSO Control Policy

There has been definite progress in implementing and enforcing CSO controls prior to, and as a result of, the CSO Control Policy. The strength of the CSO Control Policy is its recognition of the site-specific nature of CSOs and the flexibility given to states and CSO communities to develop cost-effective approaches to achieving CSO control. The CSO Control Policy provides a federal and state level of recognition of the importance of controlling CSOs, stimulating dialogue at the local CSO community level, and satisfying a need to get communities moving toward CSO control. Significant investments have been made by some CSO communities to reduce the frequency, volume, and duration of CSOs. Increased protection of human health and water quality has been documented in a number of these cases.

In this chapter:

Storm drain stencil project in a New Jersey CSO community. Most CSO permittees generally follow the concept of the NMC in their CSO control programs.

Photo: NJ Department of Environmental Protection

However, while progress has been made with respect to implementation and enforcement of CSO controls, challenges remain. Outside of judicial enforcement cases, there is limited implementation oversight by EPA, and there are still a number of CSO communities that have not made significant progress in controlling CSOs. Further, the issuance of a policy as opposed to a regulation impacted implementation and enforcement of CSO controls. The variability in program implementation and enforcement described in Section 7.2.2 is due in part to states' decision-making (how to implement within the NPDES process, what to require, what could be required, and timing of requirements). In some cases, states obtain funds and legal support based on new regulations which they must implement, not policy. Additional resources to implement and enforce the CSO Control Policy were not provided or prioritized by the states themselves because it is a policy. Some states must place NPDES-related requirements into state regulatory code and have been challenged by its legislatures as to the necessity for a regulation to implement a policy.

7.1.1 Implementation of the CSO Control Policy

According to data collected for this report, there are currently 772 CSO communities with 859 NPDES permits for CSSs in 32 states, which authorize discharges from 9,471 CSOs. Reductions in the number of CSS permits and CSOs have been observed since the issuance of the CSO Control Policy. This is due to increased efforts by states and CSO communities to control CSOs (e.g., sewer separation, more effective operation and maintenance, etc.) and to the fact that some systems had previously been inappropriately identified as CSSs by NPDES authorities.

Of the 859 NPDES permits that authorize CSOs, a significant number (740 or 86 percent) contain conditions that generally follow those delineated in the CSO Control Policy, and a smaller number (67 or 8 percent) contain other types of conditions to control CSOs. There are 52 CSO permits without enforceable requirements to address CSOs. Where the requirements to address CSOs were absent from the NPDES permit, a number of reasons were cited by NPDES authorities: (1) CSO permits are simply part of the permit backlog and have not yet been reissued, (2) CSOs may not be a top permitting priority in states where only a small number of CSOs exist, and (3) LTCP efforts are beyond the financial or technical capabilities of the owners/operators of some CSSs.

In examining CSO controls, the concept of the NMC has generally been followed by NPDES authorities and implemented by CSO communities. As described in Chapter 5, most NPDES authorities have established a set of controls for CSOs to meet the technology-based requirements of the CWA, the majority of which follow the NMC delineated in the CSO Control Policy. In some cases NPDES authorities took advantage of the flexibility provided in the CSO Control Policy. As a result, the technology-based controls required by some NPDES authorities exceeded the NMC as identified in the

CSO Control Policy. Only a limited number of NPDES authorities regulating a small number of CSO communities require less than the NMC.

Based upon EPA's review of 811 CSO permit files, 34 percent have submitted LTCPs, and 17 percent have documented some LTCP implementation. NPDES authorities have approved slightly more than half of the submitted LTCPs as sufficient to attain water quality standards. Several reasons may explain the current status of LTCP implementation:

- Delays in issuance of NPDES permits and enforceable mechanisms to require LTCP development and implementation.
- Delays in issuance of guidance related to LTCP development. Although the basic guidance for developing LTCPs was published by EPA in 1995, specific guidance related to financial capability assessment and monitoring and modeling guidance was not published until 1997 and 1999, respectively. In addition, EPA did not issue guidance on how development of LTCPs can be better integrated with reviews of water quality standards until August 2001.
- Delays in review and approval of submitted LTCPs, possibly due to the absence of explicit guidance, criteria, training, and benchmarks.
- Uncertainty on the part of CSO communities on their ability to attain water quality standards without control of other sources.
- Lack of oversight at all levels, and a lack of information with which to perform oversight (e.g., there are no standard reporting requirements).
- Inadequate resources and funding at the EPA, state, and local levels to facilitate development, review, approval, and implementation of LTCPs.

7.1.2 Compliance and Enforcement

As described in Chapters 4 and 5, some focused CSO compliance (e.g., inspections and monitoring) and enforcement activities have occurred. For example, several states have promulgated specific CSO enforcement policies, while other states and EPA regional offices have developed a Performance Partnership Agreement (PPA) from which state CSO enforcement policies developed. There also has been effective coordination within EPA in establishing compliance requirements. EPA has issued three memoranda, each intended to facilitate the implementation, compliance, and enforcement of the CSO Control Policy.

Based on compliance and enforcement data collected for this report:

- Judicial cases brought by EPA under the 1984 National Municipal Policy were an important factor in bringing about early CSO control programs in major municipalities.
- Thirty-two administrative actions and five judicial actions have been initiated by EPA in response to

CSO-relateded violations of NPDES permits or the CWA.

- State enforcement actions addressing CSO violations have resulted in 92 administrative actions, one civil judicial action, and 43 joint state-EPA or other state actions.

Even in light of these efforts, most EPA regions and states continue to approach compliance and enforcement as part of routine oversight of POTW operations (e.g., inspections of CSOs and CSO controls are performed in conjunction with inspections of POTW operations). In response to the concern over the threat to public health and the environment resulting from CSOs, EPA issued the *Compliance and Enforcement Strategy Addressing Combined Sewer Overflows and Sanitary Sewer Overflows* in 2000 (EPA, 2000b) to increase federal and state enforcement and compliance assistance.

CSO inspections are typically performed in conjunction with inspections of POTW operations.

Photo: Photodisc

EPA has also initiated a variety of compliance assistance activities to promote compliance with the CSO Control Policy requirements. This compliance assistance, initiated by EPA headquarters and regions, is provided through training and on-line systems, including the Local Government Environmental Assistance Network (LGEAN). Compliance assistance for CSOs is also being provided in a few states. More needs to be done in this area at both the federal and state levels.

While EPA has identified CSOs as a national priority, oversight of compliance and enforcement activities has been difficult. Overall challenges associated with compliance and enforcement of CSO controls include:

- Compliance and enforcement is somewhat limited by a lack of enforceable conditions in some cases (e.g., see discussion in Section 7.2.1 related to clear levels of control). NPDES authorities can evaluate compliance in terms of whether a CSO community is implementing the NMC, but it is difficult to determine the adequacy of implementation (e.g., is enough being done to maximize flow through the treatment plant or to control floatables?).

- The level of CSO compliance inspection and monitoring varies from region to region and state to state. As CSO occurrences are rainfall driven it is difficult to schedule sampling and compliance inspections during wet weather.

7.2 Observations Related to the Four Key Guiding Principles of the CSO Control Policy

This section discusses whether implementation and enforcement of the CSO Control Policy generally followed the four key principles to ensure that CSO controls are cost-effective and meet the objectives of the CWA. The four key principles are discussed in the following subsections.

While the four key principles are used as an analytical framework for assessment of the CSO Control Policy, it is acknowledged that some overlap occurs among the principles.

7.2.1 Provide Clear Levels of Control to Meet Appropriate Health and Environmental Objectives

As described in Chapter 2, provisions contained within the CSO Control Policy provide a number of options for controlling CSOs under the framework of the NMC and LTCPs. The CSO Control Policy also acknowledges that significant efforts have already been undertaken by many NPDES authorities and CSO communities to control CSOs. The CSO Control Policy provides for these existing efforts:

> *...portions of this Policy may already have been addressed by permittees' previous efforts to control CSOs. Therefore, portions of this Policy may not apply, as determined by the permitting authority on a case-by-case basis.*

The flexibility in the CSO Control Policy allowed for site-specific control solutions to be developed, previously implemented controls to be credited and considered, and for exceptions from policy requirements if existing controls demonstrated attainment of water quality standards. However, in light of this flexibility, data collected for this report indicates that clear levels of control from the standpoint of definitive compliance end-points have not yet been provided to a number of CSO communities by NPDES authorities.

NMC

As described in Chapters 5 and 6, the NMC have provided a minimum technology-based level of control for CSOs. The examples of NMC implementation provided in Chapter 6 and in the case studies presented in Appendix C demonstrate that the NMC contribute to reductions in CSO volume, frequency, and duration, as well as providing additional benefits. The NMC have fostered better use of existing CSS facilities to store and convey combined sewage, and they have given heightened priority to the elimination of dry weather overflows. They have also made CSO communities more attentive to pollution prevention and floatables control. In addition, they have informed the public about the presence and dangers of CSOs through posting and other measures. There are, however, a number of challenges remaining related to the NMC centered on documenting implementation and effectiveness.

The CSO Control Policy acknowledged the necessity to document the actions to be taken by CSO permittees to implement the NMC and to report on the effectiveness of the NMC in reducing or eliminating CSO impacts. It expected CSO communities to implement the NMC with appropriate documentation by January 1, 1997. Based on data collected for this report, initial documentation of NMC implementation was generally found in NPDES permit files. However, there was limited documentation related to on-going implementation of NMC activities. Documentation is needed to

The NMC have made CSO communities more attentive to pollution prevention and floatables control through activities such as street sweeping and catch basin cleaning.

Photo: EPA

CSO controls can be costly to implement. Construction of the 7.2 mgd storage tunnel in Richmond, VA cost more than $29 million. The tunnel is one component of a three-phased program.

Photo: Richmond Department of Public Works

confirm continued implementation of selected controls, particularly in instances where there are delays in LTCP development.

The CSO Control Policy also recommended documentation by CSO permittees to assess the effectiveness of the NMC in reducing and/or eliminating water quality impacts, and monitoring to characterize CSO impacts and efficacy of CSO controls. Generally, CSO permittees were found not to be reporting these data as part of documentation submitted to the NPDES authorities. In most cases, CSO permits only require one-time documentation of the NMC. Only a few NPDES authorities require annual reporting on implementation of the NMC. Further, as described in Section 5.8 of this report, although several NPDES authorities require regular reporting on the volume and frequency of CSO events, no data management protocols exist for tracking the results across time.

LTCP

As described in Chapter 6 and as demonstrated in the case studies presented in Appendix C, a number of CSO communities have developed successful LTCPs and are achieving environmental benefits through implementation. While many communities are just beginning to implement or have yet to implement LTCPs, there is reason to believe that the LTCP process is sound. Communities with advanced LTCP programs like New York City, Columbus, Georgia, and San Francisco are realizing the CWA objectives anticipated in the CSO Control Policy. Beach and shellfish bed openings and attainment of water quality standards have been observed and recorded. Priority has been given to the control of CSOs in sensitive areas. The CSO communities that are less advanced in LTCP implementation appear to be using similar planning processes and CSO controls, and can be expected to achieve similar results in the future.

Many CSO communities find that achieving water quality standards in urban waters is complicated by other sources of pollution including storm water and other nonpoint sources. In particular, some communities find that complete control of CSOs does not always lead to attainment of water quality standards. Further, without a TMDL it is difficult to identify an equitable level of CSO control. In fact, this dilemma of full control without attaining water quality standards causes some CSO communities to question the value of initiating any CSO controls. This uncertainty has resulted in delays on the part of CSO communities to commit to development and implementation of LTCPs.

The clear levels of control needed to meet water quality standards are often not defined. Some municipalities are uncertain as to how to approach the complexities related to controlling CSOs, particularly in trying to balance infrastructure investments and other competing regulatory requirements.

Evaluation of the LTCP concept (i.e., does it provide clear levels of control for CSOs and ensure compliance with CWA requirements) is difficult because many CSO communities are still in the process of developing

LTCPs. Although only about a third of CSO permittees have drafted LTCPs, data were collected and reviewed to assess the use of two approaches (presumption and demonstration) provided in the CSO Control Policy to meet the water quality-based provisions of the CWA.

Use of explicit performance criteria such as those included in the CSO Control Policy presumption approach has helped communities design LTCPs. Other CSO communities have not used the presumption approach due to the concern that any CSO will cause or at least contribute to non-attainment (see related discussion in Section 6.5.3). This is particularly the case when CSOs discharge to impaired waters (i.e., discharge to waters listed under CWA section 303(d) as not achieving applicable water quality standards).

A number of CSO permittees have decided to follow the demonstration approach for their LTCPs. In general, following a demonstration approach provides CSO communities with more assurance that when completed and implemented, LTCPs will result in attainment of applicable water quality standards.

Some CSO communities have proposed a combination of presumption and demonstration approaches, for different receiving waters.

Monitoring data to ascertain the effectiveness of the presumption, demonstration or combined approach for controlling CSOs to meet the water quality-based provisions of the CWA were not available for review for this report. Data for this analysis will become available as post-construction compliance monitoring programs are initiated.

Finally, as described in Section 6.3.2 of this report, a number of CSO controls were identified in the LTCPs reviewed for this report. Sewer separation (a form of collection system control) was the CSO control used most widely by CSO communities. EPA believes that sewer separation, if found to be feasible in light of site-specific constraints, was often selected because it alleviates concerns related to attainment of water quality standards for CSOs. It also reflects that certain states (e.g., Vermont) have encouraged sewer separation as the preferred control for CSOs. Many municipalities choose site-specific separation in service areas that are mostly served by separate sewers and where migrating the remaining connections from the CSS to the separate system is feasible.

7.2.2 Provide Sufficient Flexibility to Municipalities to Consider the Site-Specific Nature of CSOs

The CSO Control Policy expected that CSO permittees would:

> *...undertake a process to accurately characterize their sewer systems, to demonstrate implementation of the nine minimum controls, and to develop a long-term control plan...consider innovative and alternative approaches and technologies that achieve the objectives of this Policy and the CWA.*

Sewer separation tunnel installed by New Brunswick, NJ. Sewer separation is the most common long-term control used by CSO permittees.

Photo: NJ Department of Environmental Protection

The CSO Control Policy also advocated that selected approaches and technologies be designed to:

> *...allow cost effective expansion or cost effective retrofitting if additional controls are subsequently determined to be necessary to meet WQS, including existing and designated uses.*

This section discusses the impact the flexibility has had on implementation.

Flexibility Provided by Permitting Authorities in Implementing the CSO Control Policy

As described in Chapter 2, in response to the National CSO Control Strategy, states were requested to develop CSO permitting strategies to bring all wet weather CSOs into compliance with the requirements of the CWA. States submitted and received approval of state-wide permitting strategies. As described in Section 5.2, some states have adjusted the permitting strategies to accommodate the provisions contained in the CSO Control Policy. In other cases, states were found to continue to assert state priorities related to water quality protection programs, and some states were found to operate on a project-specific basis.

Overall, EPA noted variability in how the CSO Control Policy was implemented and enforced among the states that regulate CSOs. Some of the variability noted by EPA stems from the flexibility in the CSO Control Policy, which has led to differences in the approaches used by states to implement the NPDES permit and water quality standards programs. For example, permit conditions for CSOs, like any other point source discharger in California, are based on basin plans. New York uses an Environmental Benefits Priority System to identify those permits whose reissuance would provide the greatest environmental benefit. New Jersey issues permits, including those for CSOs, on a watershed basis. Some of the variability noted is also based on the relative importance placed on CSOs as compared to other discharges within a state. This was particularly noted by several states in light of the pressures to reduce NPDES permit backlogs. In those states that contain a small number of CSOs, EPA found that the CSO Control Policy provisions were primarily implemented on a CSO permittee-specific basis.

EPA also found that although most states require technology-based requirements similar to the NMC, certain states decided to require controls different than the NMC, or emphasized the use of one or more particular control. For example, New York requires CSO permittees to implement 15 specific BMPs to control CSOs which are essentially equivalent to the NMC. New Jersey initially emphasized the control of solids and floatables to aesthetically improve waters, and is now focusing on use of disinfection to minimize human health impacts.

Variability was also noticed among state requirements to develop and implement LTCPs. Some of this variability was based on the decision in several states to develop a preferred state-wide approach to specifically address CSOs. For example, Vermont has advocated the use of sewer separation as the means to control CSOs. Michigan requires all CSO permittees develop controls to meet a design storm based presumption approach. Massachusetts uses a watershed-based approach to prioritize CSO controls along with other critical environmental needs.

Generally, the more prescriptive a state was in terms of preferred approaches to CSO control, the more advanced program implementation was in controlling CSOs. In part, this may be due to the fact that state-wide approaches provide definitive targets for CSO permittees (e.g., the non-negotiable approach used by Michigan that requires either elimination of the CSO or adequate CSO treatment in accordance with specified design requirements). Alternatively, some CSO communities perceive the flexibility provided to NPDES authorities in the CSO Control Policy has not been extended to the communities, particularly in those states with very prescriptive state-wide approaches. Similarly, the flexibility in the process for reviewing and revising state water quality standards is perceived to be unevenly applied (see related discussion regarding water quality standards in Section 7.2.4 below).

Consideration of Cost-Effectiveness of CSO Control Options

The CSO Control Policy encourages municipalities, NPDES and water quality standards authorities, and the public to work together to develop cost-effective CSO controls that meet water quality standards. The CSO Control Policy states that cost/performance evaluations should:

> *...include an analysis to determine where the increment of pollution reduction achieved in the receiving water diminishes compared to the increased costs...(this analysis) should be among the considerations used to help guide selection of controls.*

As described in the *EPA Guidance for Long Term Control Plan* (EPA,1995f), these analyses typically involve estimating costs for a range of control levels, then comparing performance versus cost and identifying the point of diminishing returns, referred to as the "knee-of-the-curve." The EPA guidance also recommends that CSO permittees consider non-monetary factors (e.g., environmental issues and impacts, technical issues, and implementation issues) that can influence the selection of CSO control alternatives.

According to the *1996 EPA Clean Water Needs Survey* (EPA, 1997b), costs for all CSO control projects were estimated to be $44.7 billion (in 1996 dollars). As discussed in Section 6.4.4 of this report, incremental increases in levels of CSO controls considered may result in significant increases in total project costs. While it appears knee-of-the-curve analysis is being conducted and considered in developing LTCP control recommendations, it is only one element considered in selectingCSO control options.

Other Issues Related to Flexibility in Implementation of the CSO Control Policy

Although the CSO Control Policy provides and promotes flexibility in controlling CSOs, the flexibility is limited to CSO control. Many CSO permittees are municipalities that are also responsible for compliance with other NPDES permit program requirements such as effluent limitations for discharges from the POTW (including secondary treatment standards and applicable water quality-based effluent limitations), management of biosolids, implementation of a pretreatment program, and control of discharges from municipal separate storm sewer systems. In addition, there are a number of other programs, such as the TMDL program for impaired receiving waters, that may impact the stringency of controls that must be implemented for point source discharges from municipal operations. EPA is also considering proposing revisions to the NPDES permit regulations to improve the operation of municipal sanitary sewer collection systems and reduce the frequency and occurrence of sanitary sewer overflows.

Other than encouraging the evaluation of proposed CSO control needs on a watershed basis, the CSO Control Policy does not discuss flexibility as it relates to interaction and overlap in related NPDES regulatory programs and requirements (i.e., there is no flexibility afforded to CSO communities to balance other NPDES program requirements with those based on the CSO Control Policy).

However, there are some examples of CSO communities that have successfully worked with the NPDES authority to balance NPDES program requirements. For example, the Louisville & Jefferson County Metropolitan Sewer District has taken the initiative to work with the State of Kentucky to combine NPDES program requirements so that monitoring can be coordinated and implemented on a watershed basis. Coordination of programmatic requirements has not only resulted in more effective monitoring to assess receiving water impacts (e.g., monitoring CSO, storm water, and POTW discharges to the same receiving water body at the same time), but has assisted in prioritizing and focusing future municipal expenditures.

7.2.3 Allowing a Phased Approach to Implementation of CSO Controls

The CSO Control Policy described a phased approach in permitting to implement the CSO Control Policy. Phase I permits were to be designed to at least require immediate implementation and subsequent documentation of the NMC, and development and submittal of an LTCP generally within two years after the effective date of the permit (unless a longer schedule is determined to be needed). Phase II permits were to require continued implementation of the NMC, implementation of the LTCP including the selected controls necessary to meet CWA requirements, and implementation of the approved post-construction compliance monitoring program.

In general, the phasing concept of the CSO Control Policy has been followed. Most CSO communities were initially required through a NPDES permit or other type of enforceable mechanism to implement the NMC and then develop an LTCP.

Use of Enforceable Mechanisms to Implement CSO Control Requirements

Development and implementation of LTCPs by CSO communities was required through an enforcement action in some instances (e.g., administrative order). Enforcement actions are used in some cases to accommodate the fact that NPDES permits are limited in the way compliance schedules may be incorporated. If an LTCP for a CSO community includes significant structural controls (e.g., expanding POTW capacity) that will take longer to complete than allowed by the state standards (e.g., water quality standards do not allow for the issuance of a compliance schedule as part of an NPDES permit), then an enforcement order is necessary to establish a schedule for implementation. If the schedule is for more than five years, then a judicial enforcement order is necessary. In these cases, a judicial enforcement order is the only means to establish a legally binding schedule for implementation. Finally, an enforcement action may be taken as a result of non-compliance on the part of a CSO permittee.

Role of Financial Capability and Effect of CSO Financing on Phased Implementation

Financial capability is one of six factors listed in the CSO Control Policy for consideration when developing a schedule for implementation of CSO controls. Financial capability may justify a longer-term phased approach to implementation of LTCPs and implementation schedules.

According to the *EPA Guidance on Financial Capability Assessment and Schedule Development* (EPA, 1997e), the financial capability determinations and characterization of a municipality's financial capability to implement CSO controls can be based on a number of measures. General scheduling boundaries provided in the financial capability guidance are presented in Table 7.1 below.

EPA found that CSO communities do perform a financial capability assessment and factor the results of the assessment into the implementation schedule included as part of the LTCP. In some cases, the length of the proposed schedule for completion of selected CSO controls may be related to the effect of the length of time provided for amortization of CSO-related capital investments.

EPA also found that NPDES authorities do follow the EPA guidance and negotiate implementation schedules. However, there is little in the way of documentation to describe how financial capability has been used in development and approval of CSO controls or LTCPs.

As discussed in Chapter 6 and based on the fact that many CSO communities have yet to develop an LTCP, it is expected that significant municipal expenditures to control CSOs will be required, and that issues related to the financial capability of municipalities to finance CSO controls are likely to become more important. The impact of future CSO control expenditures and financial capability will intensify financial impacts on municipalities as they continue to deal with degrading infrastructure and other needs. It is expected that municipal residents with lower incomes may be faced with sharp increases in sewer rates. Sizeable populations within CSO communities often already bear significant cost-burdens.

The *1996 Clean Water Needs Survey* estimated capital costs for all CSO control projects to be $44.7 billion. Based in part on the potentially significant resources required to develop and implement CSO controls, a variety of federal and state funding programs have been made available to assist CSO communities. As described in Chapters 4 and 5, states mainly use the SRF to fund CSO control projects ($2.08 billion during the period 1989-2000). SRF loans for CSO projects in 2000 were the highest ever, accounting for $411 million (12 percent of total SRF assistance). State-specific loan and grant programs also exist, but offer limited funding (generally available for use in covering planning and program development versus implementation costs).

7.2.4 Review and Revise, as Appropriate, Water Quality Standards When Developing CSO Control Plans

As described in Chapter 2, the CSO Control Policy encouraged a comprehensive and coordinated planning effort to control CSOs and achieve applicable water quality standards. The purpose of this coordination was to ensure that any CSO controls identified in the LTCP would be coordinated with the review and revision, as appropriate, of applicable water quality standards. Coordination would assist in ensuring that proper data are provided to allow for review and revision, as appropriate, of the applicability of water quality standards. This section discusses how coordination with state water quality standards has occurred as a result of the CSO Control Policy.

Table 7.1

Implementation Schedule Based on Financial Capability

EPA has issued guidance for NPDES authorities on how to relate community financial capability to proposed implementation schedules. EPA found that authorities follow the guidance, but do not document their activities well.

Financial Capability Category	Implementation Period
Low burden	Normal engineering/construction schedule
Medium burden	Up to 10 years
High burden	Up to 15 years

Review and revision as necessary of water quality standards within the context of the CSO Control Policy were rarely documented. There may be a number of reasons that impede the review process:

- The water quality standards regulations at 40 CFR Part 131 acknowledge there may be instances where modifications to or variances from applicable water quality standards may be justified to acknowledge site-specific conditions of the discharge and receiving water. However, revisions to water quality standards are generally not encouraged. This is particularly true as it relates to downgrading designated uses, which requires a UAA that can be resource intensive. Some types of revisions are completely prohibited; for example, the removal of an "existing" use, defined as a use that was being attained in 1975. In addition, there are a few states that, as a matter of practice, will not accept requests for modifications of water quality standards.

- The data and information to support changes to designated uses and associated water quality standards can be collected most cost-effectively as part of the development of an LTCP, which can be an expensive process.

- There is uncertainty on the part of communities about the process for the review and revision, as appropriate, of state water quality standards. There has been a need for guidance identifying explicit data requirements to support water quality standards review for CSO receiving waters. EPA published guidance concerning the coordination of CSO controls and water quality standards in August 2001.

As described in Section 5.6.1, a few states have developed specific procedures for considering the applicability of water quality standards for CSO receiving waters. However, most states have not specifically accommodated water quality standards reviews for CSOs (i.e., they do not provide a specific method to address changes to designated uses, variances, or adjustment to water quality criteria for CSO-impacted water bodies as part of the LTCP process). Rather, most states address the review of water quality standards for CSOs during a state-wide or watershed based triennial review. States have limited resources and competing priorities for water quality standards reviews, particularly for waters with court-ordered TMDLs. Therefore, the state may be unable to accommodate a specific review request.

EPA believes that greater levels of coordination are needed among all entities to support the development of CSO control to meet appropriate water quality standards and the review and revision of these standards as appropriate. This requires a more intensive effort where permitting and water quality standard activities are in different organizational units.

Although three states have procedures for considering the applicability of water quality standards for CSO receiving waters, only MWRA, the sanitary authority serving Boston, has received CSO-related standards revision.

Photo: Photodisc

Water quality standards reviews must include sufficient data to support designated use changes, site-specific criteria development, and/or variance requests. Often the data are not available to properly evaluate modification requests. In these cases, the state, the CSO permittee, or both, would bear the responsibility to generate an appropriate data set to allow for a determination. If coordination is not occurring with all interested stakeholders, then additional resources may be needed to address issues raised by these other stakeholders.

EPA now recommends the use of *E.coli* or enterococci for freshwaters and enterococci for marine waters because epidemiological studies show that *E.coli* and enterococci are better indicators of gastrointestinal illness than fecal coliform. EPA recommends the geometric mean of the samples taken to not exceed the criterion and the single sample maximum to be met for a water body to fully support its primary contact recreation use. Future state decisions to adopt new indicator bacteria will have implications for CSO LTCPs designed based on existing water quality standards.

7.3 Accomplishments Attributable to Implementation and Enforcement of the CSO Control Policy

EPA believes that implementation of the CSO Control Policy by EPA regions, states, and CSO communities since 1994 has reduced loadings and benefitted the environment.

7.3.1 National Estimates of CSO Volume and Pollutant Loading Reductions

As described in Chapter 4, EPA has initiated efforts to track and report on GPRA performance measures, and has developed a national model to estimate pollutant and flow reductions attributable to implementation of CSO controls by communities. For purposes of this report, the GPRACSO model was used to provide some preliminary estimates of the nationwide CSO reductions based on various CSO management scenarios. A brief summary of the GPRACSO model and how the model was used to derive estimates for this report is presented in Appendix S. Overall, the GPRACSO model attempts to evaluate how CSS management has evolved over a 10-year period. EPA applied the GPRACSO model to obtain a basic understanding of CSS management, simplifying as necessary to obtain system-wide estimates of overflow for each CSS.

For purposes of this report, the GPRACSO model was applied to evaluate CSO volume and BOD pollutant loadings associated with four scenarios:

- Baseline scenario—representing CSO volumes and pollutant loadings prior to issuance of the CSO Control Policy.
- Low-end current implementation scenario—representing estimates of CSO volumes and pollutant loadings after implementation of the CSO Control Policy. This scenario represents conservative, low-end estimates of management measures that are currently in-place.
- High-end current implementation scenario—representing less-conservative, higher-end estimates of implementation of management measures to reduce CSO volumes and pollutant loadings.
- Future expected implementation scenario—representing a best-case future scenario of CSO volume and pollutant load reductions assuming full implementation of CSO controls.

As shown in Table 7.2, the GPRACSO model predicts that approximately 1.46 trillion gallons per year of CSOs occurred prior to issuance of the CSO Control Policy, and over 1 billion pounds per year of BOD were discharged from CSOs. Currently, EPA estimates untreated CSO volumes range from 1.26 to 1.29 trillion gallons per year, and BOD loadings range from 915 to 930 million pounds per year. The GPRACSO model predicts that there has been between a 12 percent and 14 percent reduction nationwide of untreated CSO volume and BOD loadings, respectively, since issuance of the CSO Control Policy in 1994.

Assuming full implementation of the CSO Control Policy, approximately 1.3 trillion gallons per year of CSOs would be treated nationally, and approximately 600 million pounds per year of BOD would be removed from discharges from CSOs. As shown in Table 7.2, this will require communities with CSSs to provide advanced primary treatment to an estimated additional one trillion gallons, or 35 percent more volume, than is currently receiving this minimum level of treatment.

It should be noted that EPA has attempted to be conservative when estimating reductions in overflows and pollutant loadings. As described above, only structural CSO controls, such as improved POTW operations, were considered (i.e., non-structural controls such as enhanced pretreatment requirements and downspout disconnect programs are not recognized). It should also be noted that GPRACSO model results

Table 7.2

Pollutant Reduction Estimates Based on Implementation of CSO Control Policy

EPA's GPRACSO model was used to evaluate the potential reduction to CSO volume based both on current implementation and future expected implementation.

Scenario	Annual Untreated CSO Volume (Trillion Gallons/Year)	Dry/Wet Weather Volume Treated (Trillion Gallons/Year)	Annual BOD Discharged (Million Pounds/Year)
Baseline	1.46	2.80	1,070
Low-End Current Implementation	1.29	2.97	930
High-End Current Implementation	1.26	3.00	915
Future Expected Implementation	0.20	4.06	480

sometimes indicated CSO volumes and loadings actually increased over the baseline condition. This occurs wherever the service population or acreage has increased, while POTW treatment capacity has remained constant (i.e., the dry weather sanitary flows have increased, leaving less capacity to treat wet weather flows).

7.3.2 Accomplishments Attributable to Implementation and Enforcement of the CSO Control Policy

The focus of the second Report to Congress in 2003 will be the extent of human health and environmental impacts caused by CSOs and SSOs. Although not the focus of this report, this section describes some of the accomplishments related to the control of CSOs brought about by the CSO Control Policy.

As described in Chapter 4, EPA does not yet possess a data management system that tracks reductions in CSO frequency, duration or volume, or improvements in water quality. However, based on data collected for this report, EPA observed a number of accomplishments attributable to implementation of the CSO Control Policy. Many of these achievements have directly contributed to reductions in CSOs and protection of receiving water quality. Accomplishments include:

- Stimulating implementation of effective CSO controls—As described throughout Chapter 6, implementation and enforcement of the CSO Control Policy has stimulated many CSO communities to take actions to control CSOs. Some of these activities, such as floatables controls, have directly resulted in improving the aesthetics and recreation of receiving waters. Other activities, such as increasing capacity at POTWs to treat greater volumes wet weather flows, have resulted in flow and load reductions, and in a few cases, notable improvements to water quality and protection of human health have been documented.

- Reducing dry weather overflows—As described in Section 6.2.1, particular importance (both from a permitting and compliance and enforcement basis) was placed on CSO permittees to eliminate dry weather overflows. This focus is important from a human health and environmental protection standpoint, as dry weather overflows occur at times when receiving waters are less able to accommodate pollutant loadings (as compared to when higher flow conditions occur as a result of wet weather). Data indicate that most CSO communities have eliminated chronic dry weather overflows, and have inspections programs designed to detect and eliminate other occasional dry weather overflows when they occur.

- Protecting sensitive areas - As described in Chapter 2, the CSO Control Policy expects that CSO permittees give highest priority to controlling CSOs to sensitive areas. Section 6.3.3 indicates that more than 30 percent of the CSO files reviewed noted CSO discharges to sensitive areas. As a result, a number of CSO permittees have prioritized and implemented specific programs and initiatives to address discharges to sensitive areas.

- Raising public awareness - A major component of the CSO Control Policy was to ensure that all stakeholders were aware of the potential human health and environmental problems associated with CSOs, as well as the types of controls available to reduce the volume, frequency and duration of CSOs. Raising the awareness of all stakeholders assists in ensuring that CSO control options will be protective of human health and the environment, as well as securing resource commitments for developing and implementing CSO controls.

7.4 Next Steps

As described throughout this report, significant efforts have been made at all levels to implement and enforce the CSO Control Policy. However, more work remains to ensure that human health and the environment are adequately protected from CSOs. Slower progress than expected in the development and implementation of LTCPs continues for several reasons. Chief among them are delays in the issuance of permits requiring CSO controls, delays in the issuance of guidance, and delays in LTCP approval. In addition, there is a reluctance on the part of CSO communities to commit resources due to actual or perceived uncertainties related to definitive compliance endpoints for CSO control.

EPA expects NPDES authorities, state water quality standards authorities, and CSO communities to actively participate in the implementation and enforcement of the CSO Control Policy. EPA realizes the importance of its role to lead future activities that will ensure continued progress is made in controlling CSOs. Based on the findings from this report, there are a number of activities EPA will pursue in the future:

Ensure that All CSOs Are Appropriately Controlled

- Implement the "shall conform" statutory mandate.
  - Begin efforts to implement new CWA Section 402(q)(1), which requires that future permits or other enforceable mechanisms for CSOs conform to the CSO Control Policy. These efforts will include evaluating the need for regulatory amendments, policy statements or other appropriate actions to ensure implementation of CSO programs consistent with the CSO Control Policy.

Ensure All CSOs Are Appropriately Regulated

- Follow up with NPDES authorities to ensure that CSO permits or other enforceable mechanisms are issued as soon as possible for those CSO communities that have not yet been required to control CSOs. EPA will also work with the states to ensure that permits and enforcement actions (e.g. orders, decrees) are consistent with the CSO Control Policy, as required by new CWA Section 402(q)(1). EPA will issue guidance on this topic.

Improve Implementation of the CSO Control Policy

- Advocate CSO control on a watershed basis.
  - Continue efforts to focus protection of water quality on a watershed approach and support development of CSO LTCPs on a watershed basis. EPA will also continue efforts to encourage integration of wet weather programs, including support in facilitating the wet weather pilot projects grant program as described in an amendment to Title I of the CWA.
- Work with states to speed the water quality standards review and revision process.
  - Continue to work with states, communities, and constituency groups on coordinating the review and revision of water quality standards with development of LTCPs. EPA will establish a tracking system for water quality standards reviews on CSO-receiving waters. EPA will also assess the need for additional guidance and tools to facilitate the water quality standards review process for all sources, including CSO.
- Strengthen CSO information management.
  - Work to coordinate information management activities and strengthen performance measurement such that data generated by CSO communities can be collected and managed to demonstrate the environmental outcomes of CSO control.
- Improve compliance assistance and enforcement.
  - CSOs will continue to be a national compliance and enforcement priority in fiscal years 2002 and 2003. EPA will work closely with NPDES authorities and states to target enforcement actions, where appropriate, to ensure compliance with the CSO requirements in NPDES permits or other enforceable mechanisms. In addition, EPA will develop and promote compliance assistance tools.
- Improve EPA and state oversight.
  - Review and strengthen existing practices and procedures used by EPA and states to ensure CSO controls are being implemented. This review will include evaluation of reporting requirements to demonstrate ongoing implementation of the NMC, as well as examination of procedures used to ensure proper communication and coordination during review

and revision of water quality standards and implementation procedures.

Initiate Efforts for the Second Report to Congress in 2003.

- Initiate efforts to define the scope and methodology for the second Report to Congress due in December 2003. In the second report EPA is required to summarize the extent of human health and environmental impacts caused by CSOs and SSOs, report on the resources spent by CSO communities to address these impacts, and evaluate the technologies used, including whether sewer separation is environmentally preferred for all situations. EPA will build on CSO data collected for this report and develop a methodology for addressing the challenges of collecting and analyzing SSO data.