

Appendix F

Analysis of CSO Receiving Waters
Using the National Hydrography
Dataset (NHD)

F.1 Background

EPA compiled a national inventory of NPDES permits for CSO facilities during the development of the *Report to Congress—Implementation and Enforcement of the Combined Sewer Overflow Control Policy* (EPA 2001). Data collection, management, and analysis are documented in Appendix F of the 2001 report. The national CSO inventory was developed from a review of permit files and information provided by NPDES authorities. The resulting inventory included a summary of total CSO outfalls per permit and, where available, a narrative descriptions of CSO outfall location (e.g., “near intersection of Water and Main Streets”) and/or by spatial coordinates (i.e., latitude and longitude). This inventory was reviewed by states and EPA regions to determine if the total number CSO outfalls was correct, but the information on outfall location was not verified as part of the 2001 report effort.

F.2 Objectives

As specified in the Consolidated Appropriations Act for Fiscal Year 2001 (P.L. 106-554):

*..the Environmental Protection Agency shall transmit to Congress a report summarizing—
(1) the extent of the human health and environmental impacts caused by municipal combined sewer overflows and sanitary sewer overflows, including the location of discharges causing such impacts, the volume of pollutants discharged, and the constituents discharged; ...*

Given this requirement, and with the CSO permit inventory in-place from the 2001 report, EPA established a goal of updating the CSO data to include geographical locations for CSO outfalls included in CSO permits. EPA’s overriding objective for this effort was to provide a framework for identifying areas at and downstream of CSO outfalls to examine potential environmental and human health impacts.

F.3 Development of a National CSO Outfalls GIS Database

EPA began the process of geographically locating CSO outfalls by building on data originally collected for the 2001 report. The CSO permit inventory was updated through a review by states and EPA regions. Based on the latest data updates, EPA obtained latitude and longitude for outfalls included in more than two-thirds of active CSO permits. Most of the other permits had narrative descriptions locating CSO outfalls. These narrative descriptions varied, but generally mentioned the nearest cross-street or public landmark and often included the name or description of the receiving waterbody.

EPA extracted CSO outfalls with narrative location descriptions. EPA utilized ESRI ArcGIS for the geo-spatial processing and analysis of these outfalls. EPA developed a GIS base map of land areas, transportation networks, and local waterbodies for each CSO permit to help locate outfalls based on narrative data. The analysis utilized the Census 2000 Topologically Integrated Geographic Encoding and Referencing (TIGER®) database of the U.S. Census Bureau for reference mapping. The geographic data for the TIGER® database is freely available from ESRI in ArcGIS format. The TIGER® database includes geographic data for roads, railroads, hydrography, utility lines, and government entities (e.g., places and counties).

EPA extracted TIGER® base map data for over 200 areas to match the more than 2,000 narrative outfall locations to a spatial location. A combination of ArcGIS address mapping (where street data were available) and visual identification were employed to match the narrative location to a geographic point. Once located, additional descriptive information was used to verify the position. This included comparing the ArcGIS mapped position relative to receiving waters or distance from landmarks recorded in the CSO inventory. Narrative locations

not identifiable within the ArcGIS analysis were excluded, and points that could not be confirmed with other narrative descriptive locators were flagged for follow-up with the NPDES authority and were updated as necessary. Upon completion of identification and updates, the spatially-referenced CSO outfall latitude and longitude coordinates were computed and exported.

With this procedure, over 90 percent of CSO outfalls were geographically mapped. These outfalls were then tested for data quality and consistency. The CSO outfalls were intersected with available GIS data (states, watersheds, and waterbodies). CSO permits were linked to PCS to supplement data for descriptive outfall locations within the CSO inventory. Spatially-referenced CSO outfalls with state, watershed 8-digit HUC, or waterbody information from PCS inconsistent with that obtained from the ArcGIS base data were flagged for review by the NPDES authority. Upon completion of review and incorporation of available updates, the CSO outfalls associated with nearly 95 percent of active CSO permits were geographically referenced, as shown in Figure F.1. The spatially-referenced CSO outfalls served as a data source for evaluating and assessing potential environmental and human health impacts from CSO discharges.

F.4 Available EPA Data Sources

EPA conducted literature reviews and developed an inventory of possible data sources at the federal, state, and local levels that could be used to assess potential impacts from CSOs. The listing below reflects national scale data sources used to assess potential impacts from CSOs. These descriptions include website citations where the data source is described in more detail, including references to data dictionaries and/or other metadata, analyses conducted, and findings. The application of these data sources for this Report to Congress is presented in the next section.

Figure F.1 Location of CSO Outfalls



Permit Compliance System (PCS) - <http://www.epa.gov/enviro/html/pcs/>

Discharge of pollutants into waters of the United States is regulated under the NPDES program, a mandated provision of the Clean Water Act. To assist with the regulation process, state and federal regulators use an information management system known as PCS. PCS stores data about NPDES facilities, permits, compliance status, and enforcement activities for up to six years. PCS includes data on CSO permits but lacks data on location of outfalls for most permits. EPA is currently working with the regions and states to develop an approach for including and maintaining CSO outfall locations within the existing PCS framework. While PCS is a tool for EPA and state use only, public data are made available through EPA's Envirofacts website <http://www.epa.gov/enviro/>, which provides a single point for accessing EPA's facility dataset.

National Assessment Database (NADB) - <http://www.epa.gov/305b/2000report/>

The National Assessment Database contains information on the attainment of water quality standards. Assessed waters are classified as "fully supporting," "threatened," or "not supporting," their designated uses. This information is reported in the NWQI Report to Congress under Section 305(b) of the Clean Water Act. Analyses presented in this report use EPA's 2000 NWQI Report to Congress and the NHD-referenced data as means of assessing areas downstream of CSO outfalls.

Water Quality Standards Database (WQSDB) - <http://www.epa.gov/wqsdatabase/>

The WQSDB contains information on the designated uses for waterbodies. Designated uses set a regulatory goal for the waterbody, define the level of protection assigned to it, and establish scientific criteria to support that use. While not directly used for this report, the WQSDB provides supporting reference and data for EPA's 305(b) NWQI.

303(d) Total Maximum Daily Load (TMDL) Tracking System - <http://www.epa.gov/tmdl/>

The TMDL Tracking System contains information on waters that are not supporting their designated uses. These waters are listed by the state as impaired under Section 303(d) of the Clean Water Act. The status of TMDLs is also tracked. This report uses the April 1, 2002 NHD-referenced data to consider 303(d) listed waters downstream of CSO outfalls and to examine TMDLs in place for those areas.

Safe Drinking Water Information System (SDWIS)

The Safe Drinking Water Act requires that states report information to EPA about public water systems, including violations of EPA's drinking water regulations. The Safe Drinking Waters Act regulations and their enabling statutes establish maximum contaminant levels, compliance guidelines, and monitoring and reporting requirements to ensure that water provided to customers is safe for human consumption. This information is stored in SDWIS. Data as of June 25, 2003, was provided by EPA's Office of Ground Water and Drinking Water in an NHD-referenced format to facilitate comparison with known CSO outfall locations.

National Shellfish Register of Classified Growing Waters

The classification of shellfish-growing waters is based on the National Shellfish Sanitation Program (NSSP), a cooperative effort involving states, the shellfish industry, and the FDA. Since 1983, it has been administered through the Interstate Shellfish Sanitation Conference (ISSC). The ISSC was formed to promote shellfish sanitation, adopt uniform procedures, and develop comprehensive guidelines to regulate the harvesting, processing, and shipment of shellfish. In 1995, the NSSP and coastal states listed over 33,000 square miles of marine and estuarine waters as classified shellfish-growth areas and published the coverage for distribution in ArcGIS geographically referenced areas. The areas are very site-specific and not a part of a hydrography network. Nonetheless, the data were easily linked to nearby CSO outfalls via standard ArcGIS geoanalysis detailed later in this appendix.

F.5 Technical Approach

The technical approach taken to link a digital CSO outfall dataset to other EPA data and program assessments is summarized below. The key activities undertaken for this effort include converting CSO outfall data to a spatially referenced digital format, relating the outfall locations to the NHD, and using the NHD stream network to look at areas at and downstream of the CSO outfalls through comparative analysis of other EPA data referenced to the NHD. EPA maintains program data including 303(d) lists, 305(b) assessments, and drinking water intake data linked to the NHD in its Reach Address Database (RAD). RAD provides the linkage from EPA datasets to the NHD referenced water reaches. EPA's Watershed Assessment, Tracking, & Environmental Results (WATERS) initiative serves as a common platform for linking data from all of EPA's surface water programs. These relationships are discussed in more detail below.

National Hydrography Database (NHD) - <http://nhd.usgs.gov/>

NHD is a nationally consistent hydrography dataset for the United States. A culmination of recent cooperative efforts between EPA and USGS, it combines elements of USGS digital line graph hydrography files and the EPA Reach File (RF3). NHD is designed to serve three simultaneous functions for surface waters:

1. Provide a standard unique identifier (reach code) for each part of the surface water network. Reach codes act like street addresses in a road network, providing a unique identifier for streams and other waterbodies.
2. Contain a tabular routing (navigation) network of these features.
3. Include a digital map representation of these features.

The analyses conducted for this report use the three functions of NHD. With NHD, CSO outfall locations are described by reach, the network is used to examine downstream conditions, and a visual representation of the locations and downstream pathway is given.

NHD is currently available in 1:100,000 (1:100K) scale format from USGS for the continental United States. Although some states are moving to higher resolution representations of their waters (e.g., the 1:24,000 (1:24K) scale), the 1:100,000 scale NHD was used for the analyses presented in this report.

Reach Address Database (RAD) - <http://www.epa.gov/waters/about/rad.html>

EPA's RAD stores program data linked to NHD reaches, including information on the spatial extent of various program data. Datasets in RAD include, but are not limited to, the 303(d) and 305(b) programs. RAD stores only locational information for stream addresses (i.e., position of the listing within the NHD reach network). The details of that reach, such as designated use, monitoring results, assessment scores, or impairment type, remain in the program database. This report uses RAD as the gateway for linking CSO outfalls referenced to NHD with other EPA program data.

Reach Index and Reach Navigation of the Digital CSO Outfalls

A Reach Indexing Tool (RIT) was used to designate CSO outfall locations to the nearest point of an NHD reach, creating a CSO outfall stream address. These data were transferred to the RAD to provide instant linkage to other RAD program data. In order to access the other data, the CSO outfall addresses were then 'reach walked' to other RAD data. The reach walk is a service available within the WATERS system that allows upstream or downstream navigation of the NHD network, and thus a traverse of any data in the RAD/WATERS system. The reach walk was conducted to provide information on the distance between the CSO outfall stream address and other EPA

program data within RAD.

Downstream Analysis, Impacts, and Pollutants of Concern

For analysis of the reach walked NHD data, a downstream distance of one mile was considered to be a point where CSO impacts would be most discernable. Where pollutant or stressor information was available, the primary pollutants found in CSOs (pathogens, solids (TSS), and oxygen-demanding organic materials measured as BOD₅) were included in the analysis.

F.6 Analysis and Results

305(b) Analysis and 303(d) Analysis

Electronic data were available via WATERS within the RAD framework for 305(b) (assessment) and 303(d) (listing) information, as part of the Clean Water Act requirements. While 303(d) listed waters were available electronically for all states except Alaska, electronic 305(b) assessments were available for 13 of the 32 CSO states (as shown in Figure F.2). Data comparisons were made only for states where data were available.

State assessed waters within one mile downstream of CSO outfalls were evaluated. Waters in that distance with a cited impairment (pathogens, sediment/siltation, and organic enrichment causing low dissolved oxygen) were further examined. For example, existing TMDLs were reviewed to explore the relationship between impairment and source load allocation, including CSOs, as part of the existing TMDL. The tables on the next page summarize the findings.

Figure F.2 CSO States with Electronic NHD-Indexed 305(b) Assessed Waters

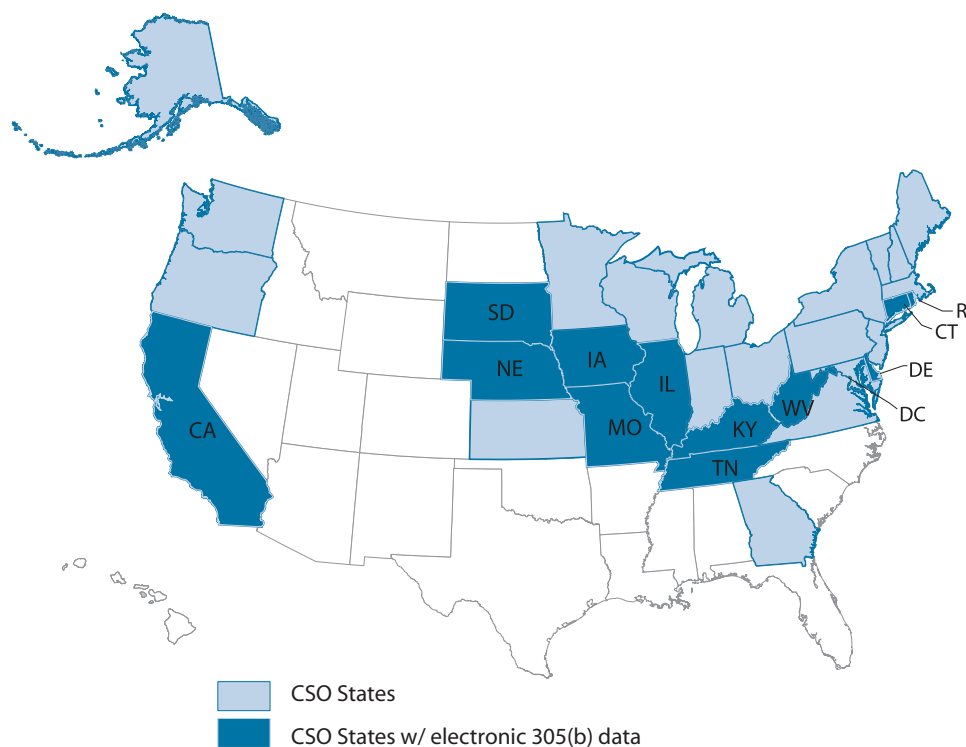


Table F.2 Waters Considered in this Analysis

	# of NHD Reaches
In CSO States	1,495,853
within 1 mile downstream of a CSO Outfall	1,560

Table F.3 2000 NWQI Assessment within 1 mile of CSO Outfall

Assessed Waters	Total Assessed	Assessed as Good	Assessed as Impaired	Percent Impaired
Assessed 305(b) segments in CSO states with electronic 305(b) data	59,335	44,457	14,878	25%
Assessed segments within one mile downstream of a CSO outfall	733	181	552	75%

Table F.4 303(d) Listed Waters by Cause Categories aligning with impacts from CSOs

Listed Waters	Reason or Cause of Listing		
	Pathogens	Enrichment Leading to Low Dissolved Oxygen	Sediment and Siltation
Total number of listed waters in CSO states	3,446	1,892	3,136
Number of listed waters within one mile of a CSO outfall	191	163	149

Drinking Water Analysis

The SDWIS database and the CSO database were geospatially cross-referenced using the NHD. The location of drinking water intakes downstream of a CSO was determined and their proximity was assessed.

The database was queried selecting the drinking water intakes within one mile of a CSO outfall. Phone interviews were conducted with both the NPDES and drinking water authorities for cities with CSOs located within one mile upstream of a drinking water intake to confirm the location of the CSO outfall, whether the CSOs are active, and the location of the drinking water intake. Two facilities were eliminated from the analysis because their drinking water intake or their CSO outfalls were not located within the one-mile analysis radius. The results of this analysis are summarized in Table F.5.

Table F.5 Association of CSO Outfalls with Drinking Water Intakes

EPA Region	State	CSO Outfalls within 1 Mile Upstream of a Drinking Water Intake
1	ME	7
2	NY	7
3	PA	19
3	WV	9
4	KY	7
5	IN	3
5	OH	7
Total:		59

Note: EPA was unable to confirm data for an additional 14 outfalls in two states (PA and WV); these outfalls are not included in this table.

Classified Shellfish-Growing Areas Analysis

Classified shellfish-growing areas are not georeferenced to the NHD. The geographic coverage available from NOAA provides spatial locations of the shellfish-growing areas and associated attribute data. The attribute data include information such as the shellfish classification and suspected sources of pollution including wastewater treatment plants and CSOs.

Given the geospatial location of the CSOs and shellfish-growing areas, it is possible to analyze the distance between the two datasets using a buffer. A buffer creates an area around a geospatial dataset for a specified distance. It is then possible to intersect the buffer with another dataset to determine if they coincide spatially. This buffer process was used to determine how many CSOs are located within five miles of a shellfish-growing area. The results of this analysis are summarized in Table F.6 below.

Table F.6 Classified Shellfish-Growing Areas Within Five Miles of a CSO Outfall

Shellfish Harvest Classification	Number of Classified Shellfish Growing Areas within 5 Miles of a CSO outfall
Prohibited	411
Restricted	80
Approved	154
Unclassified	14
Total	659