

Characterization of CSOs and SSOs

Stakeholder Meeting

June 24 – 25, 2003



Congressional directive

- **The Administrator of the Environmental Protection Agency shall transmit to Congress a report summarizing:**
 - ... the location of [CSO and SSO] discharges*
 - ... the volume of pollutants discharged*
 - ... the constituents discharged*

Definition of a CSO

- A combined sewer overflow or CSO is a mixture of untreated sewage and storm water discharged from a combined sewer system (CSS) at a point prior to the headworks of a POTW.
- CSOs occur during periods of wet weather when the CSS becomes overloaded.

Frequency of CSO events

- A “CSO event” is defined as a discharge from one or more CSO outfalls in response to a single wet weather event.
 - ▶ CSOs occur between 1 and 80 times per year.
- Currently, there are very few dry weather CSOs.

Definition of a SSO

- A sanitary sewer overflow or SSO is a discharge of untreated wastewater from a sanitary sewer system (SSS) at any point in the collection system, prior to the headworks of a POTW.
- This definition does not include basement backups.

Overview of key data sources

- State databases for tracking CSO and SSO events
- NPDES permit files
- Interviews with state and municipal officials
- LTCPs and other capital improvement documentation
- Extensive literature review
- Existing EPA documentation
 - ▶ Technical reports
 - ▶ Products of cooperative agreements

Methodological approach

● Data analysis:

- ▶ Describe the current universe of combined sewer systems and sanitary sewer systems
 - NPDES permit files
 - State databases for tracking CSO and SSO events
 - Interviews with state and municipal officials
- ▶ Summarize information on common pollutants contained in CSOs and SSOs
 - Interviews with state and municipal officials
 - LTCPs
 - Literature review

Methodological approach

● Data analysis:

- ▶ Tabulate existing information on the volume, frequency, and location of CSOs and SSOs
 - NPDES permit files
 - State databases for tracking CSO and SSO events
 - Interviews with state and municipal officials
- ▶ Develop national estimates of the volume and frequency of CSOs and SSOs
 - Statistical extrapolation
 - GPRACSO model

Methodological approach

● Outreach

- ▶ Interviews with state and municipal officials
 - CSO: 41 municipalities in 15 states
 - SSO: 42 municipalities in 18 states
- ▶ Stakeholder meetings

Methodological approach

● Data considerations

- ▶ Inconsistency in definitions of “CSO event” and “SSO event”
 - Volume threshold
 - Events lasting longer than 24 hours
- ▶ Under-reporting of SSO events
- ▶ Basement backups typically not tracked or reported to NPDES authorities

Key research questions

- How many NPDES permits exist for combined sewer systems and sanitary sewer systems?
- What are the common pollutants found in CSOs and SSOs?
- What are the volume, frequency, and location of CSOs and SSOs?

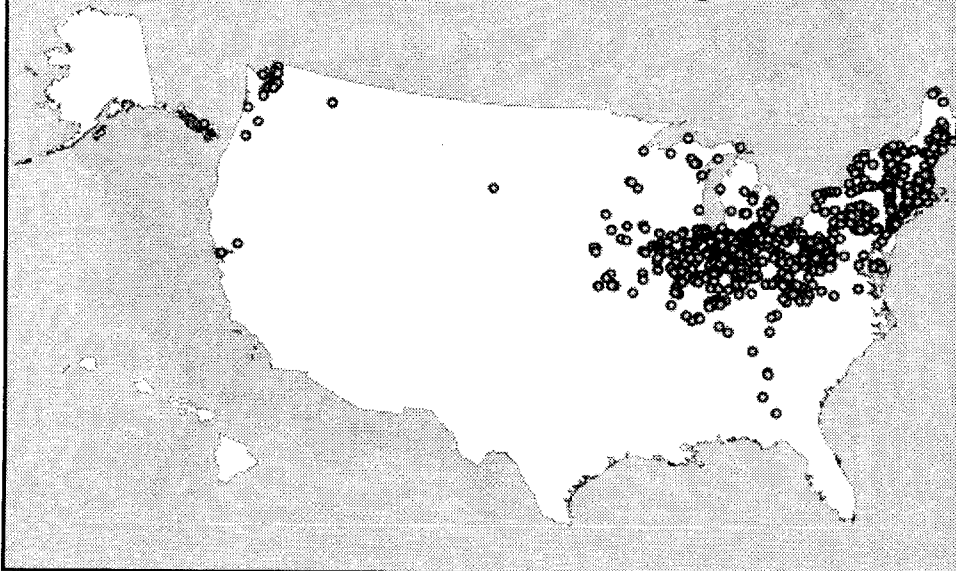
What does the CSO universe look like?

- As of November 2002:
 - ▶ 9,259 permitted CSO outfalls
 - ▶ 842 active CSO permits
 - ▶ 748 permits (89%) require implementation of the NMC
 - ▶ 594 permits (71%) require development and implementation of an LTCP

What does the CSO universe look like?

- According to the 2000 Clean Water Needs Survey:
 - ▶ Approximately 46 million people served by CSSs
 - ▶ 140,000 miles of combined sewer
- Most CSO communities are small
 - ▶ 50% of CSO permits are associated with POTW design capacities less than 2.5 mgd
 - ▶ Only 30% have design capacities greater than 7.5 mgd

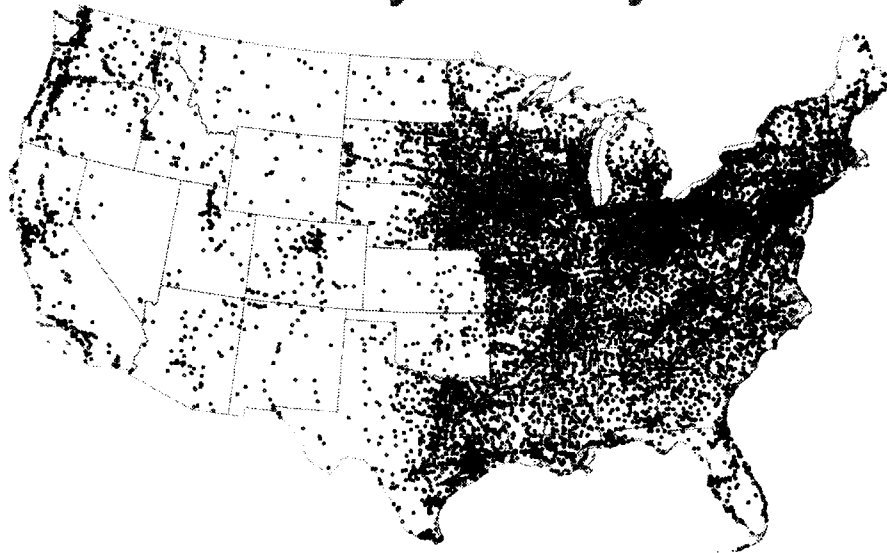
Location of NPDES permittees with combined sewer systems



What does the SSO universe look like?

- Every sanitary sewer system has the potential to have an SSO.
- According to the 2000 Clean Water Needs Survey:
 - ▶ Approximately 144 million people served by sanitary sewer systems
 - 14,688 operational wastewater treatment facilities treating flows from sanitary sewer systems
 - 4,607 satellite sanitary sewer systems
 - ▶ 584,000 miles of sanitary sewer

Location of NPDES permittees with sanitary sewer systems



What are the common pollutants found in CSOs and SSOs?

- Bacteria and other pathogens, solids (TSS) and oxygen-demanding substances (BOD)
- Other pollutants include: nutrients, toxic substances, floatables, and personal care products and other emerging pollutants.

Bacteria and other pathogens

Source	Fecal coliform (#/100 mL)	<i>E. Coli</i> (#/100 mL)
Treated Wastewater – Secondary	< 200	< 200
Untreated Domestic Sewage/SSO	$10^3 - 10^8$	$10^4 - 10^7$
CSO	$10^5 - 10^7$	$10^4 - 10^7$
Urban runoff	$10^3 - 10^7$	$10^3 - 10^7$

Oxygen-demanding substances

Source	BOD ₅ (mg/L)	COD (mg/L)
Treated Wastewater – Secondary	<5 – 30	80
Untreated Domestic Sewage/SSO	110 – 350	250 – 1,000
CSO	25 – 100	200 – 1,000
Urban runoff	10 – 250	200 – 275

Solids

Source	Solids Concentration (TSS, mg/L)
Treated Wastewater – Secondary	<5 - 30
Untreated Domestic Sewage/SSO	120 - 400
CSO	150 - 400
Urban runoff	67 - 101

Nutrients

Source	Total N (mg/L)	Total P (mg/L)
Treated Wastewater – Secondary	15 - 25	<1 - 5
Untreated Domestic Sewage/SSO	20 - 70	4 - 12
CSO	3 - 24	1 - 10
Urban runoff	0.4 – 1.0	0.7 – 1.7

Toxic substances

- **Metals and other inorganics**
 - ▶ Most commonly observed metals in municipal wastewater are copper and zinc.
- **Synthetic organic pollutants**
 - ▶ The pretreatment program has provided significant reductions in concentrations of synthetic organics discharged to municipal collection systems.

What are the volume, frequency, and location of CSOs?

- 32 states, including the District of Columbia, with permitted CSO outfalls
- CSO reporting requirements vary from state to state.
 - ▶ Two states compile annual information on CSO events and discharges (Maryland & Michigan).
- EPA's GPRACSO model estimates the volume and frequency of CSOs in the absence of comprehensive state information.

Volume of CSOs

Scenario	Annual Volume Treated (trillion gallons)	Untreated CSO Discharged Annually (trillion gallons)
Baseline, prior to CSO Policy	2.80	1.46
Current level of CSO control	2.97	1.29
Full CSO Policy implementation	4.06	0.20

Source: GPRACSO model, as presented in EPA's 2001 *Report to Congress on Implementation and Enforcement of the Combined Sewer Overflow Control Policy*

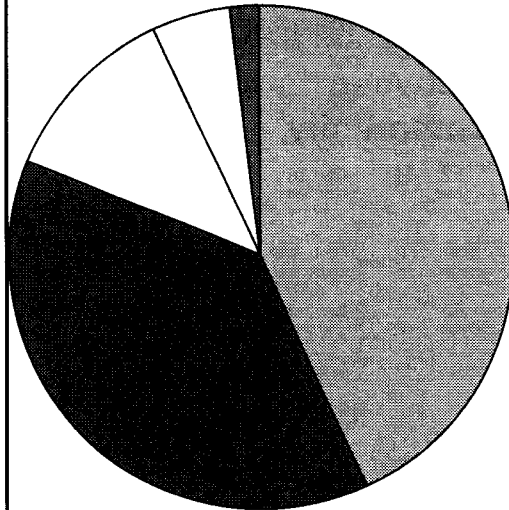
Frequency of CSOs

- CSO events occur between 1 and 80 times per year, per CSO community.

Location of CSOs

- EPA has established locational information (latitude/longitude) for nearly 90% of all CSO outfalls.
- Allows CSOs to be indexed to the National Hydrography Dataset (NHD)
 - ▶ CSOs will be integrated into EPA's WATERS database.

Types of waters receiving CSO discharges



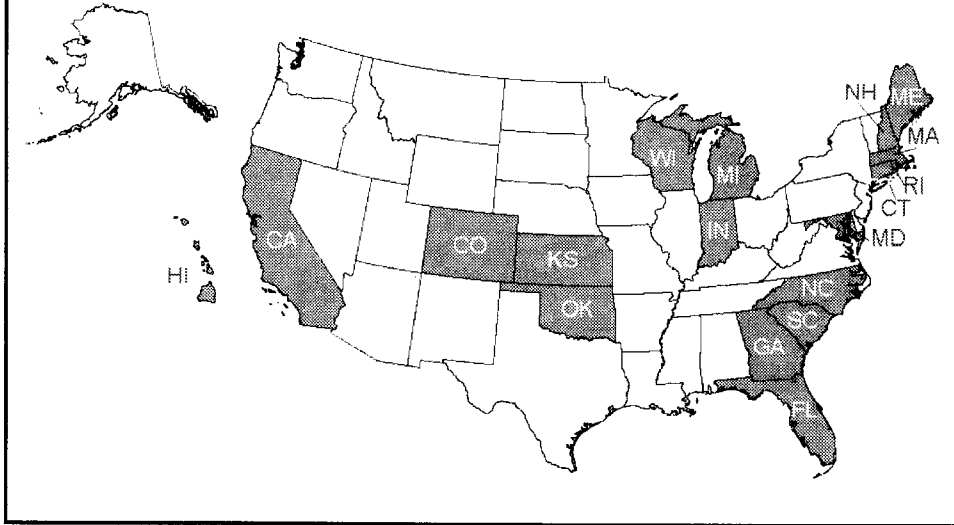
■	Rivers	43%
■	Streams	38%
□	Other	12%
□	Oceans/Bays/Estuaries	5%
■	Ponds/Lakes	2%

Source: EPA's 2001 *Report to Congress on Implementation and Enforcement of the Combined Sewer Overflow Control Policy*

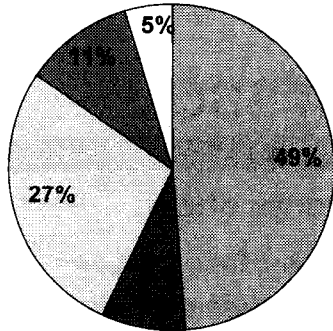
What are the volume, frequency, and location of SSOs?

- 18 states compile SSO event records electronically.
- 27,361 events reported (2000 – 2003)
 - ▶ Cause information is available for about 75% of all events.
 - ▶ Volume estimates available for about 88% of all events.
 - ▶ 4.7 BG reported spilled (2000 – 2003)
- National estimates forthcoming

States compiling SSO event records electronically

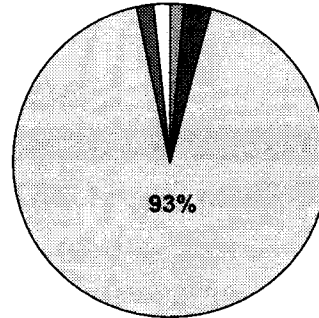


Distribution of SSOs with Known Cause



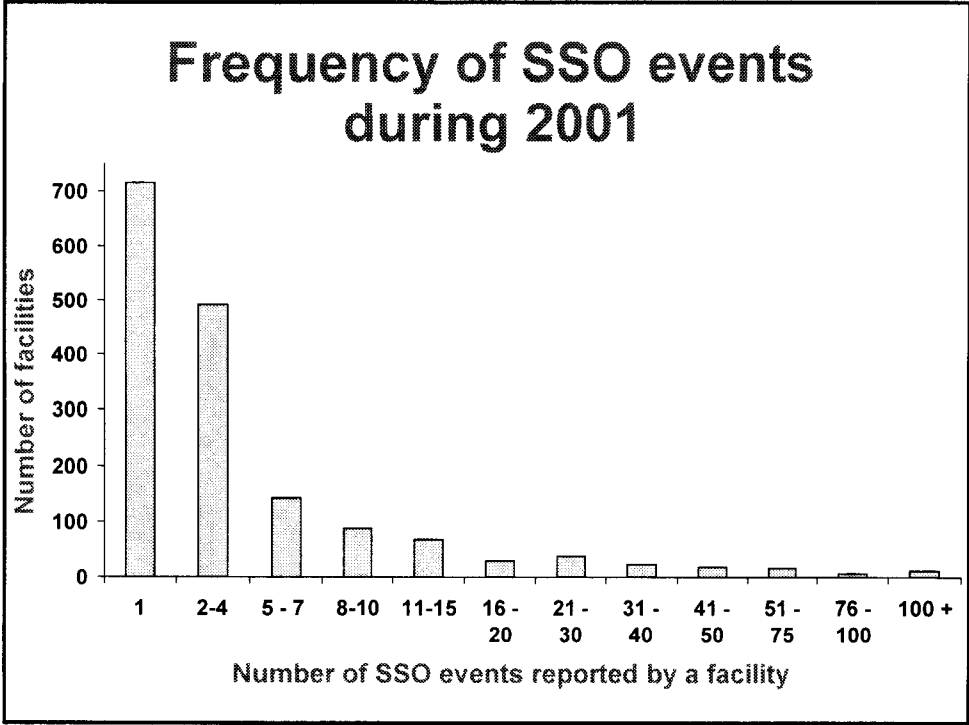
n = 20,874 events

Distribution of Total SSO Volume, by Cause



Total SSO Volume Reported: 4.7 BG

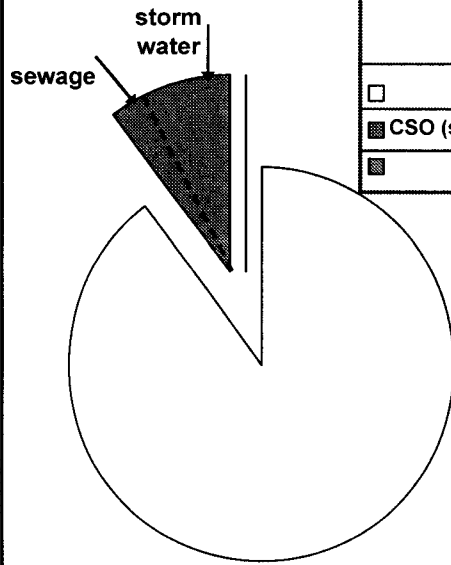
	Cause	# of Events	Avg. Volume (gal)
■	Blockage	10,120	6,990
■	Pipe Break	1,772	80,514
■	Wet Weather & I/I	5,726	916,496
■	Mechanical/Power Failure	2,244	55,248
■	Misc.	1,012	70,172



Location of SSOs

- **Data for 11,357 SSO events show:**
 - ▶ **72% of SSO events reach surface waters.**
 - ▶ **95% of the SSO volume reaches surface waters.**
 - **Most SSO event reports do not estimate the percentage of the individual event that reach surface waters.**

Annual discharges from municipal wastewater sources

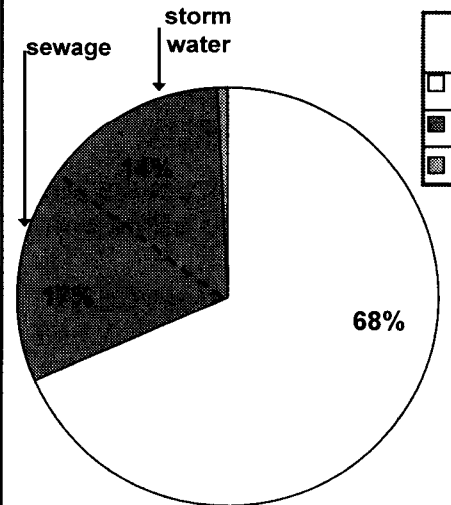


	Annual Vol. (BG)	%
□ Treated wastewater	11,425	90
▒ CSO (storm water + sewage)	1,290	10
▓ SSO	15	>1

NOTE - CSO annual volume:

- 315 BG sewage
- 975 BG storm water

Annual BOD loads from municipal wastewater sources

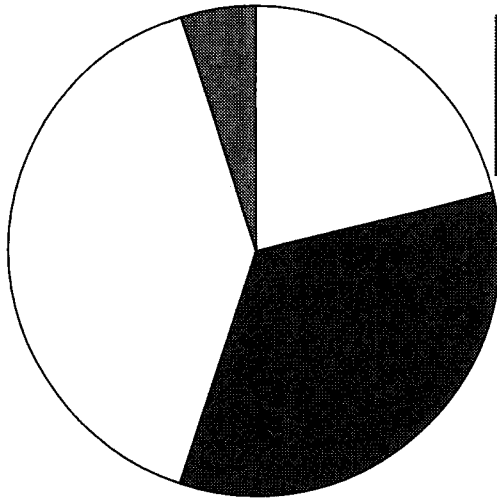


	Load (tons)	%
□ Treated wastewater	715,000	68
▒ CSO (storm water + sewage)	460,000	31
▓ SSO	10,000	1

Assumes BOD concentrations of:

- 20mg/L for treated wastewater
- 85 mg/L for CSO
 - 50 mg/L storm water
 - 200 mg/L sewage
- 160 mg/L for SSO

Comparison of point and nonpoint sources of BOD



□	Municipal POTWs	21%
■	Industrial point sources	34%
□	Rural non-point sources	40%
■	Urban storm water and CSOs	5%

Source: National Water Pollution Control Assessment Model (NWPCAM), as presented in *Progress in Water Quality - An Evaluation of the National Investment in Municipal Wastewater Treatment*

Conclusions

- **Pollutant loads from CSOs and SSOs**
 - ▶ On a national scale, pollutant loads from CSOs and SSOs are small in comparison to other point and non-point sources.
 - ▶ On a national scale, pollutant loads from CSOs are significant in comparison to other municipal wastewater sources.
 - ▶ On a local scale, pollutant loads from CSOs and SSOs can be significant.