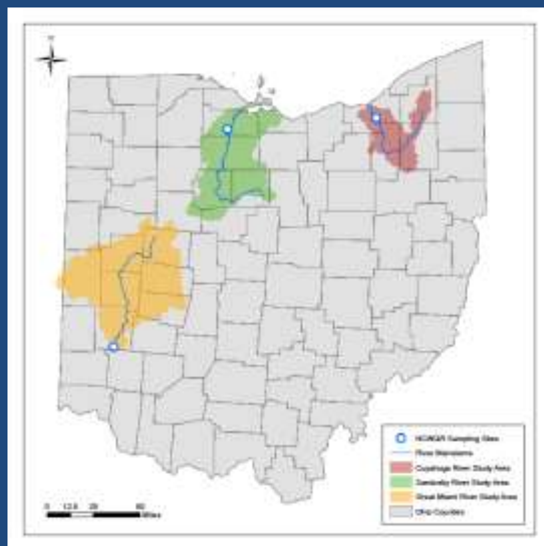
Urban Point Sources
Nutrient Loads: Relationship of Point Source to Total Downstream

Dale White, Ohio EPA – Division of Surface Water – Modeling and Assessment
Ohio Nutrient Forum - November 14, 2012

Approach

- 3 watersheds (Cuyahoga, Great Miami, Sandusky)
  - CSO exists
  - Long-term, in-stream chemical monitoring exists
  - Compare high urban to high non-urban
- Watershed-scale estimates
- Worst-case Scenario – will over-predict PS loads
  - In-stream processing *ignored*
  - CSO concentrations on *high* end of range

Location of Study Areas



Land Use (% of total) Upstream Gage

Station (Drainage Basin)	Agriculture	Grass/Hay/Pasture	Urban	Forest, Water, Wetland, Other
Cuyahoga	9	12	40	39
Great Miami	65	8	17	10
Sandusky	78	4	8	10
				(source: NCWQR)

Distribution of WWTP

Drainage Basin	Area (mi^2)	# Majors (Design Flow > 1 MGD)	# Significant minors (Design Flow > 0.5 MGD)	Largest Sources (MGD)
Cuyahoga	707	13	3	Cleveland-Southerly (175) Akron (90)
Great Miami	2710	25	4	Dayton (72) Middletown (36) Springfield (25)
Sandusky	1251	4	2	Fremont (7.6)

Approach

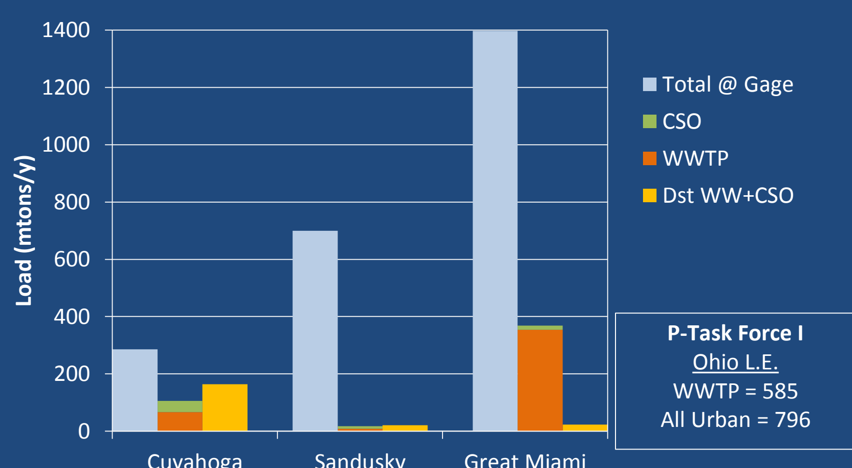
- Annual Total Load
  - Mass of pollutant discharged into water-body in one year
  - Measured from long-term data obtained from gage data at downstream station
- Point Source Load
  - Calculated from WWTPs effluent data
  - CSO load from typical discharge and estimated concentration (high-end of range)

Nature of the Point Source

- Point Sources defined…
  - discharges from WWTPs and municipal sewer overflows
  - WWTPs: wastewater treatment plant discharge
    - 24/7, 365 days/y
    - In this study…primarily municipal but some industrial
  - CSO: municipal sewer overflows
    - Episodic, storm-related discharges

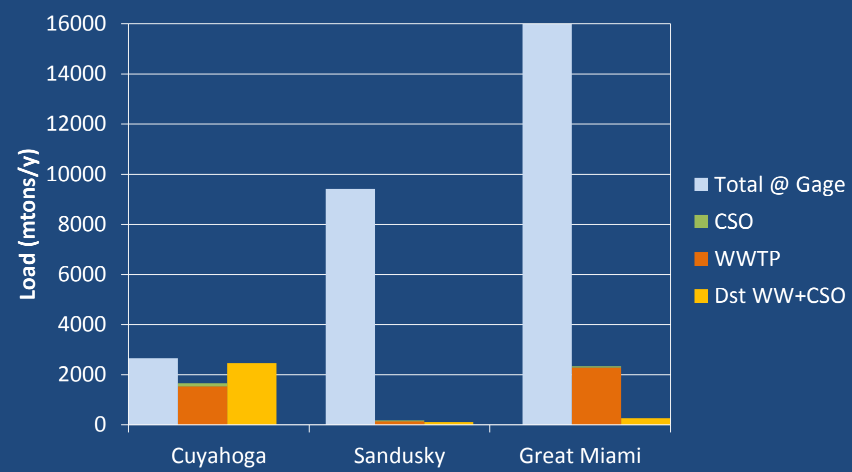
Comparison Among Basins – **TP**

2006-2011 period



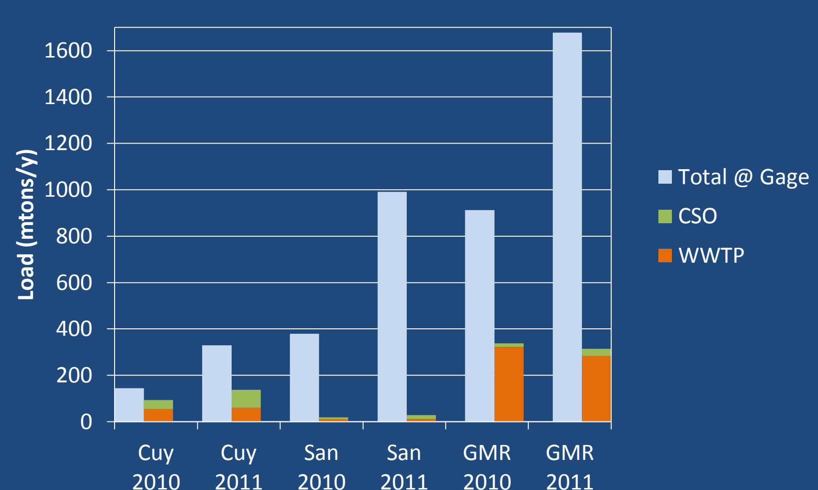
Comparison Among Basins – **TN**

2006-2011 period



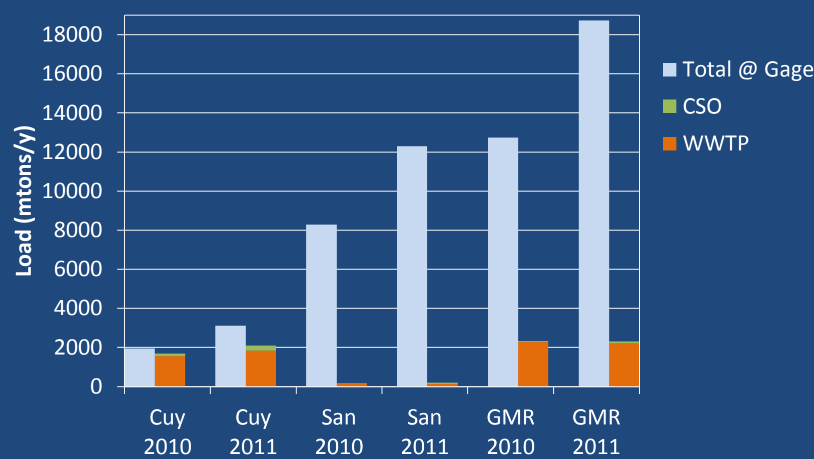
Comparison Among Dry/Wet Year – **TP**

2010 vs. 2011



Comparison Among Dry/Wet Year – **TN**

2010 vs. 2011



Percent of Total Load by Urban PS

2011 water year (wet)			
Basin	**TN**	**NO23**	**TP**
Cuyahoga	67	100	42
Great Miami	12	14	19
Sandusky	2	1	3

2010 water year (dry)			
Basin	**TN**	**NO23**	**TP**
Cuyahoga	87	100	64
Great Miami	18	21	37
Sandusky	2	2	5

Point Source Improvements

- Cities Spending Billions of Dollars to Eliminate CSOs and Upgrade WWTPs
  – NEORSD: $2.5 Billion
  – Akron: $900 million
  – Toledo: $316 million
- Toledo, Akron and Cleveland CSO Control Projects Ongoing
  – Most Projects Fully Implemented by 2030

Use this in Chart…

– By 2017 Over Half of All CSO Communities Will Have Fully Implemented Their Required CSO Control Projects and Most CSO Communities Will Have Fully Implemented CSO Control Projects by 2030

Current Program: LTCP Implementation

- When will LTCP Construction be Complete?

Year of Completion	Number of Communities
Already Complete	20
2012	3 (23)
2013	7 (30)
2014	2 (32)
2015	2 (34)
2016	2 (36)
2017	7 (43)

Year of Completion	Number of Communities
2018	3 (46)
2019	4 (50)
2020	3 (53)
2021	1 (54)
2025	4 (58)
2030	10 (68)

Thanks to…

- Ohio EPA CSO program staff and lead
- National Center for Water Quality Research (esp. Dave Baker)
- Regulated community…for self-monitoring

Contact

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Extra Slides – For Discussion

Questions to consider…

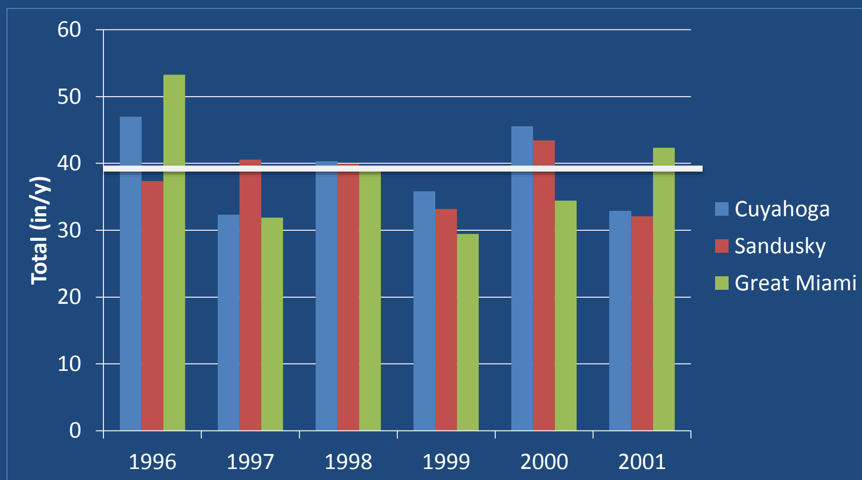
1) What is the relative contribution of CSO and WWTP of TP and TN to large endpoints (Lake Erie, Ohio River)?
2) What projections exist for reduction and elimination of CSO load?

Sandusky River Basin - Detail

WWTP Specifics

- Design Flow ≥ 0.5 MGD: all majors, significant minors
- Examined these parameters:
  - TSS, ammonia, Kjeldahl nitrogen (TKN), nitrate+nitrite, and TP
  - Organic N: from TKN or 20% TSS
  - Self-monitor data
- Median daily load: due to monitoring frequency, skewness, outliers
  - TP: range from 2x/wk to 1x every 2 wk

Annual Precipitation (1996-2001)



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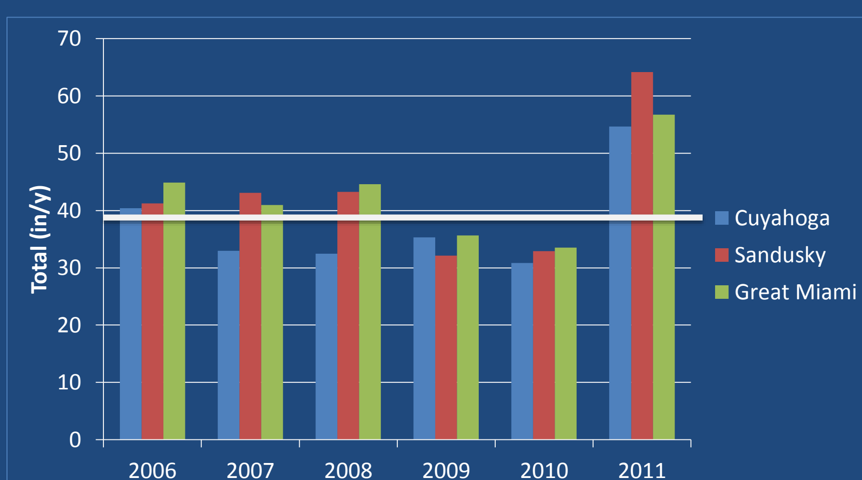


CSO Specifics (1)

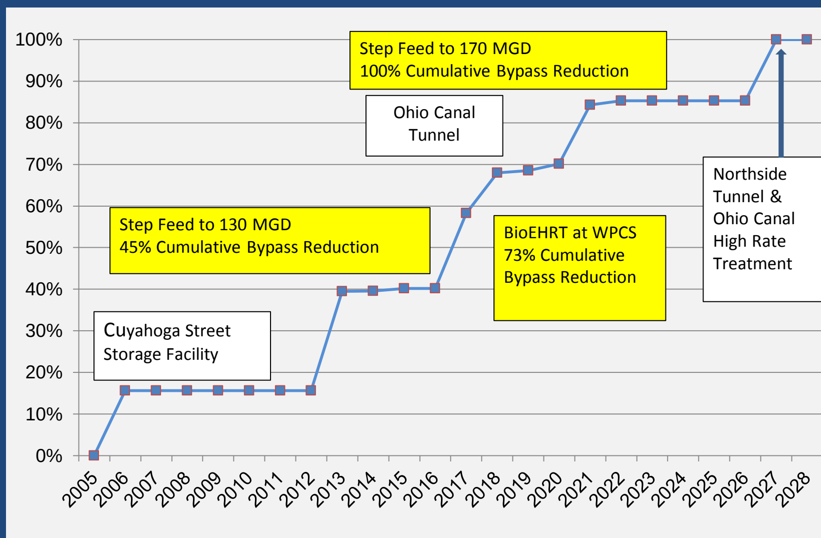
- 3 major CSOs – all below NCWQR gage
  - NEORSD (some DD), Fremont, Middletown
- Typical Year (of Q)
  - Difficult to measure Q: hazardous, planning, timing
  - Long period of record (e.g., NEORSD 45 years)
  - Considers rainfall depth and intensity, #storms per year

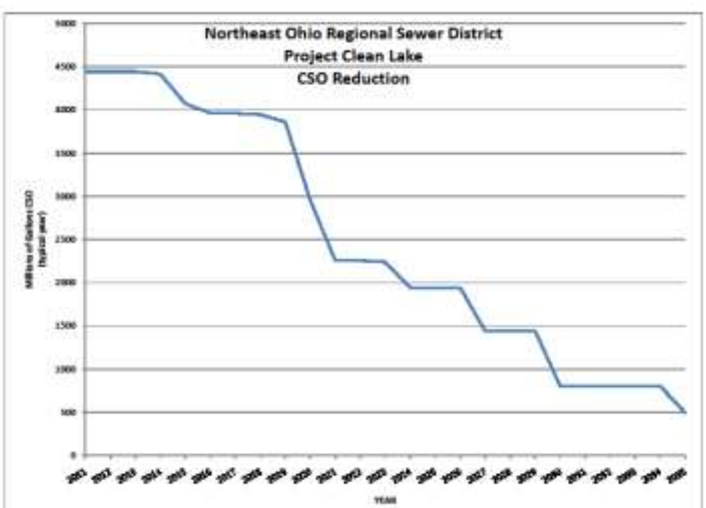
CSO Specifics (2)

- Chemical monitoring
  - Concentrations reflect combination of storm-water and untreated sewage
  - Variable due to First Flush:
    - Accumulated surface contaminants
    - Re-suspend collection system sediment from low-flow periods
  - Obtained from national studies
    - Hence, CSO loads are fixed magnitudes by facility

Akron CSO Program

Reduction by Year: Overflow Volume & 2nd By-pass





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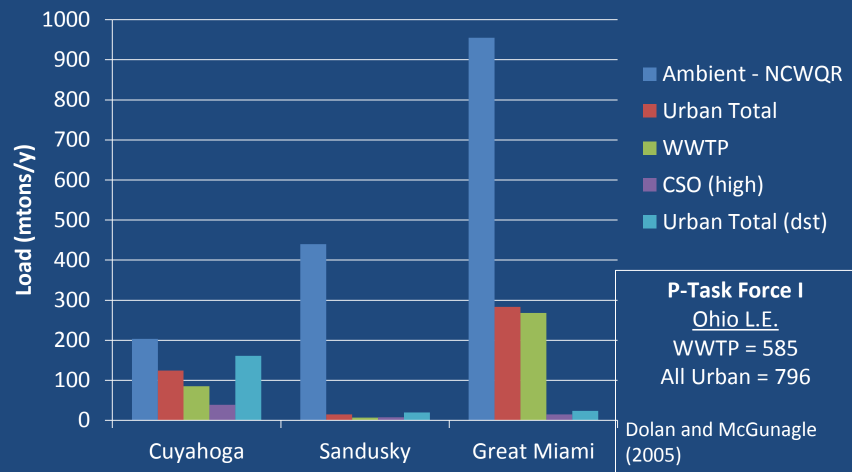
Comparison Among Basins – **TP**

1996-2001 averaging period



Comparison Among Basins – **TN**

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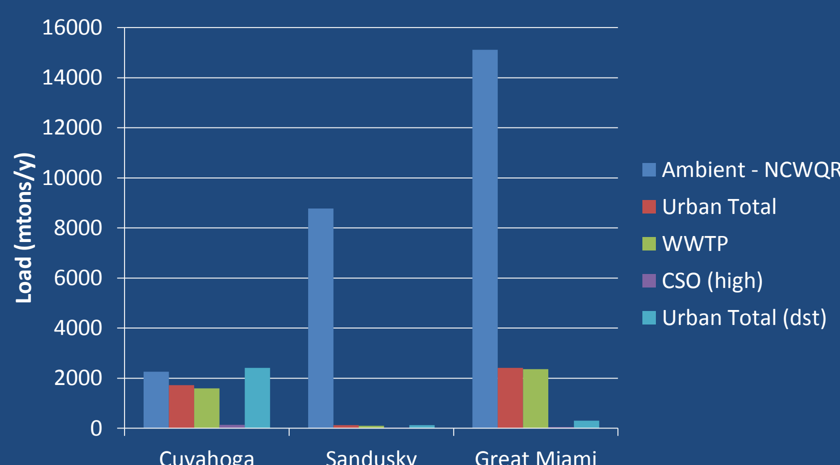

Approach (2)

- Timeframe
  - Older vs. newer (6-yr averages)
    - 1996-2001 vs. 2006-2011
  - Dry vs. wet year (annual precipitation)
    - 2010 vs. 2011
- Parameters of interest:
  - TP, TN, nitrate+nitrite
  - Ortho-phosphate (reactive P): estimate not consistent

WWTP Specifics

- Design Flow ≥ 0.5 MGD: all majors, significant minors
- Examined these parameters:
  - TSS, ammonia, Kjeldahl nitrogen (TKN), nitrate+nitrite, and TP
  - Organic N: from TKN or 20% TSS
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CSO Contaminant Concentrations

Source	TP	TN	TKN
NEORSD	2.19	–	–
USEPA (2004)	0.1 to 28, median = 0.7	–	0 to 82.1
USEPA (2001)	1 to 10	3 to 24	–
Metcalf and Eddy (2003)	1.2 to 2.8	–	4 to 17
Applied here			
Typical	2.19	10	
High	5	17	
Notes: All concentrations in mg/L			

Percent of Total Load

Urban PS (CSO high)

2006 to 2011 averaging period			
Basin	**TN**	**NO23**	**TP**
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Great Miami	14	17	26
Sandusky	2	2	2

1996 to 2001 averaging period			
Basin	**TN**	**NO23**	**TP**
Cuyahoga	76	94	61
Great Miami	16	16	30
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Urban PS (CSO high, 2011 2x)

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CSO Facility Accomplishments

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