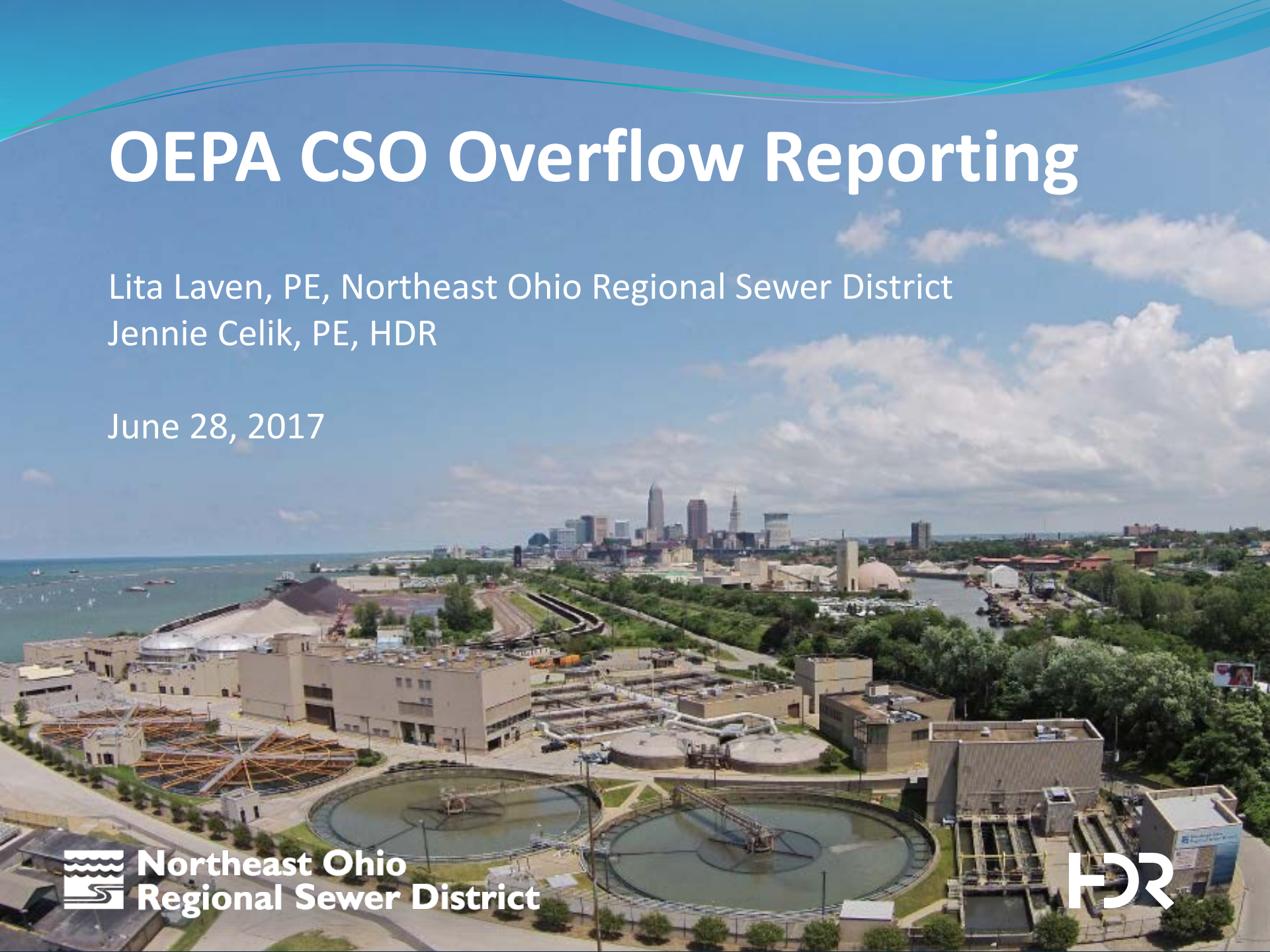
OEPA CSO Overflow Reporting

Lita Laven, PE, Northeast Ohio Regional Sewer District
Jennie Celik, PE, HDR

June 28, 2017



Agenda

1) NEORSD Background
2) Project Overview & Objectives
3) Field Investigations
4) Data Review
5) CSO Overflow Volume Calculations
6) Hydraulic Model Comparison
7) Next Steps

Northeast Ohio
Regional Sewer District

NEORSD Background

Northeast Ohio
Regional Sewer District

Governance

- Created in 1972 by Court Order
- Political subdivision of Ohio
- Governed by seven Trustees
- Servicing all or part of 62 member communities, >1 million customers
- Average daily flow treated ~230 million gallons

Northeast Ohio Regional Sewer District

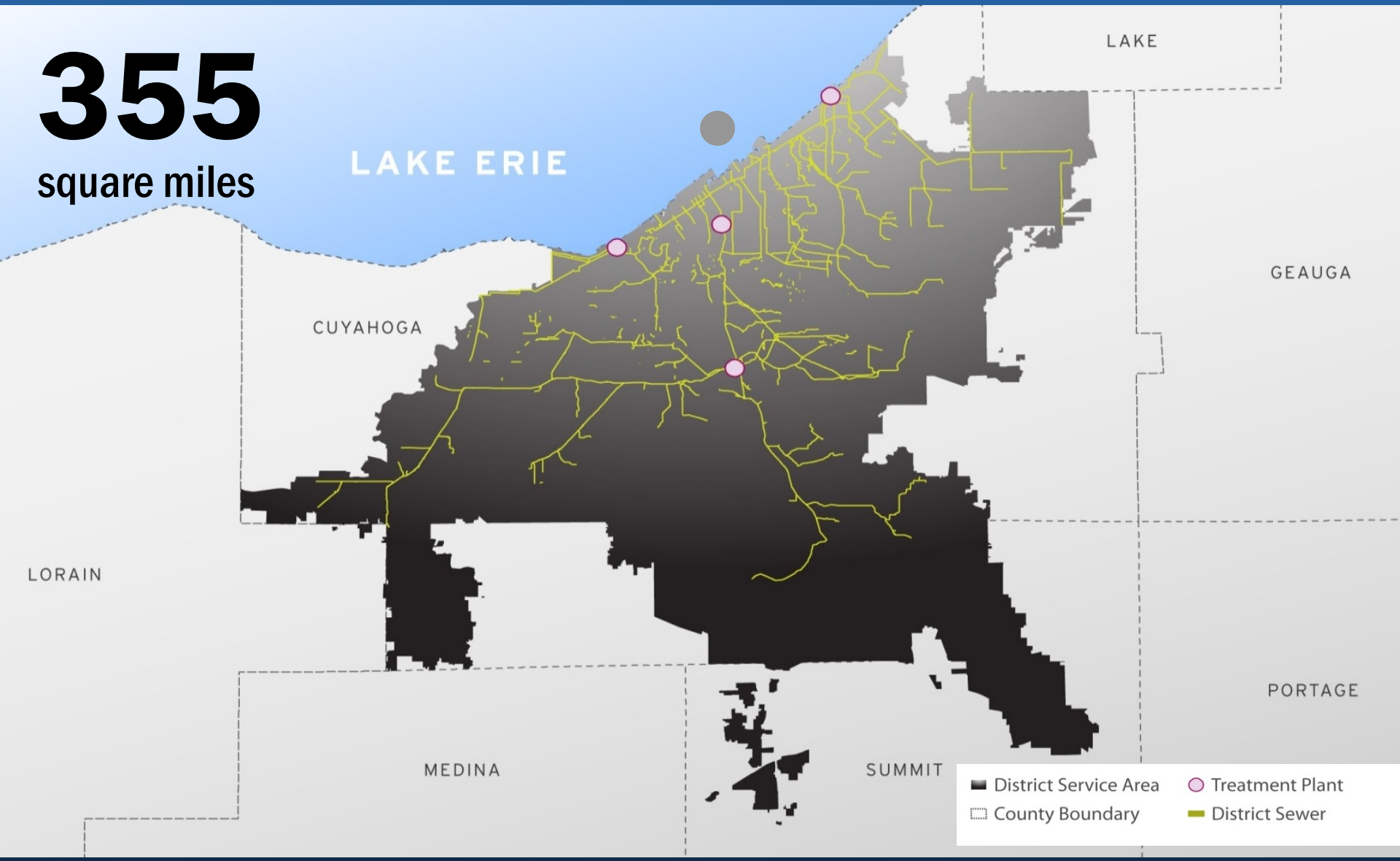
NEORSD Responsibility

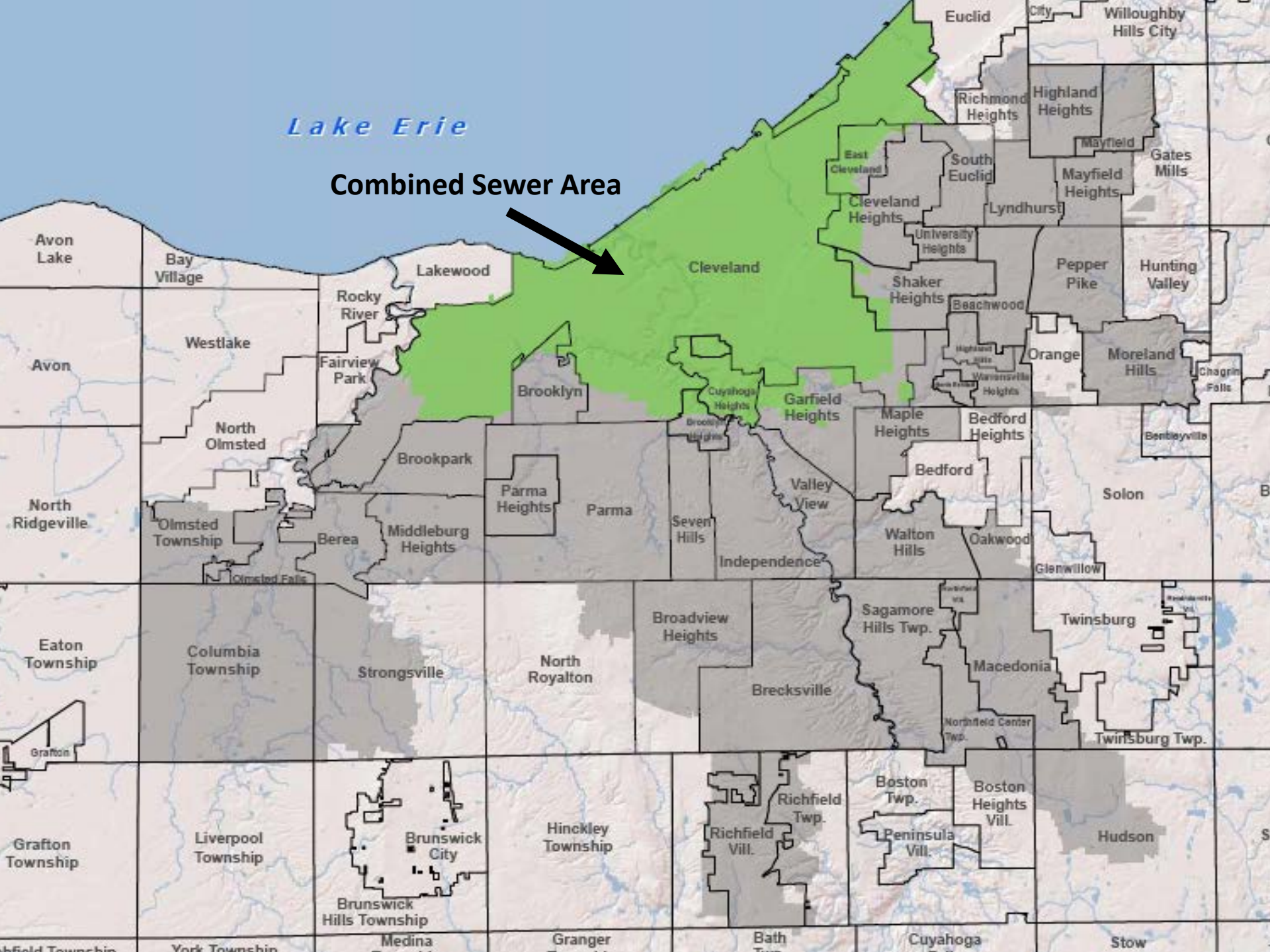
- Wastewater Treatment Plants
- Interceptor sewers
- Combined Sewer Overflow (CSO) Control
- Regional Stormwater Management

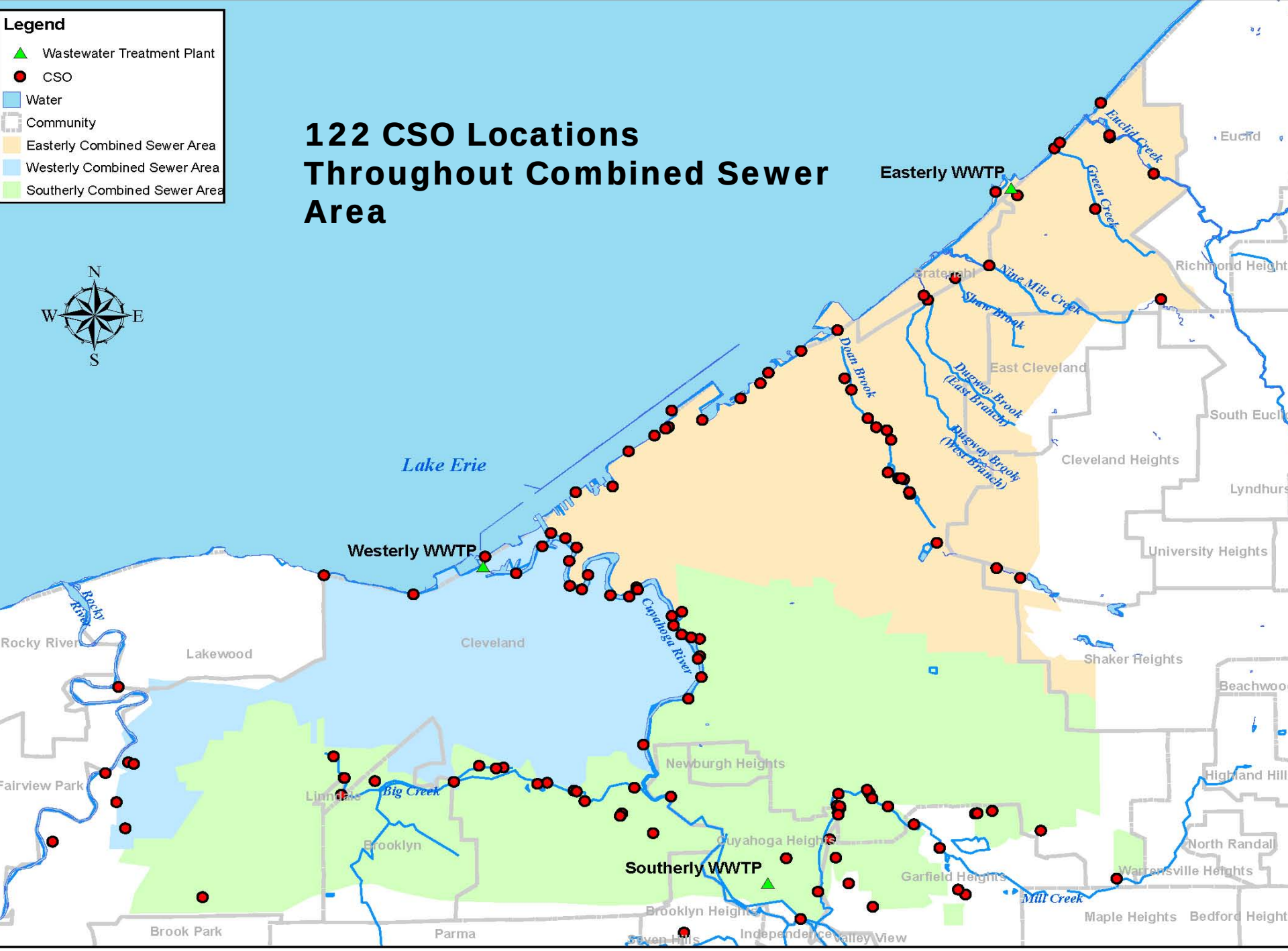
Northeast Ohio
Regional Sewer District

NEORSD Service Area

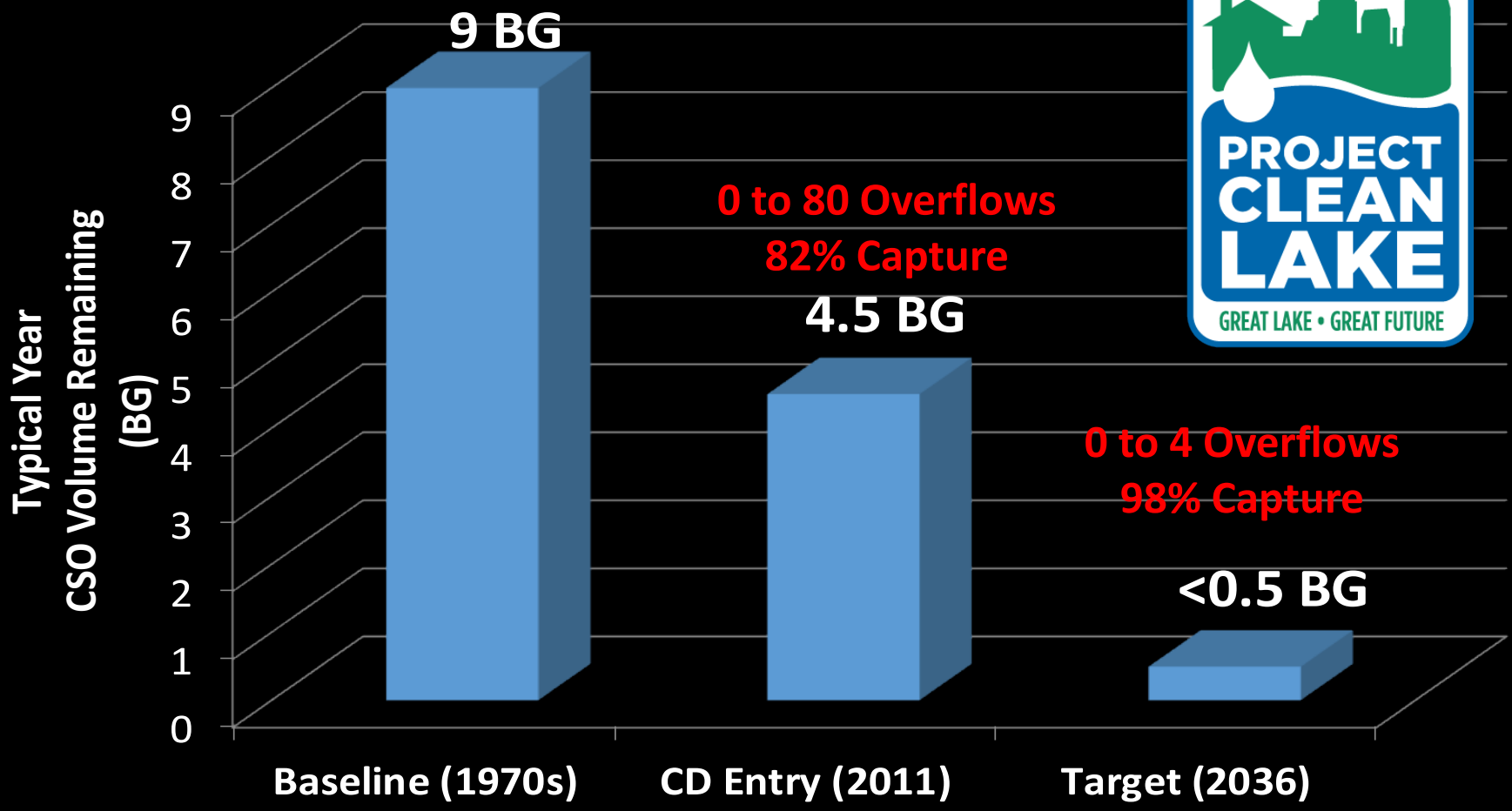
355
square miles




Lake Erie
Combined Sewer Area
Euclid
City
Willoughby Hills City
Richmond Heights
Highland Heights
Mayfield
Gates Mills
East Cleveland
South Euclid
Mayfield Heights
Cleveland Heights
Lyndhurst
University Heights
Avon Lake
Bay Village
Lakewood
Cleveland
Shaker Heights
Beachwood
Pepper Pike
Hunting Valley
Rocky River
Westlake
Avon
Fairview Park
Brooklyn
Cuyahoga Heights
Garfield Heights
Orange
Moreland Hills
Chagrin Falls
Maple Heights
Bedford Heights
Bentleyville
North Olmsted
Brookpark
Bedford
Parma Heights
Parma
Valley View
Solon
North Ridgeville
Olmsted Township
Berea
Middleburg Heights
Seven Hills
Walton Hills
Oakwood
Independence
Glenwillow
Olmsted Falls
Eaton Township
Columbia Township
Strongsville
North Royalton
Broadview Heights
Sagamore Hills Twp.
Twinsburg
Macedonia
Brecksville
Northfield Center Twp.
Twinsburg Twp.
Grafton
Grafton Township
Liverpool Township
Brunswick City
Brunswick Hills Township
Hinckley Township
Richfield Vill.
Richfield Twp.
Boston Twp.
Boston Heights Vill.
Peninsula Vill.
Hudson
Medina
Granger
Bath
Cuyahoga
Stow


Legend
Wastewater Treatment Plant
CSO
Water
Community
Easterly Combined Sewer Area
Westerly Combined Sewer Area
Southerly Combined Sewer Area
122 CSO Locations Throughout Combined Sewer Area
N
W
E
S
Easterly WWTP
Westerly WWTP
Southerly WWTP
Lake Erie
Euclid Creek
Green Creek
Nine Mile Creek
Shaw Brook
Dam Brook
Dugway Brook (East Branch)
Dugway Brook (West Branch)
Cuyahoga River
Rocky River
Big Creek
Mill Creek
Euclid
Richmond Height
East Cleveland
South Euclid
Cleveland Heights
Lyndhurst
University Heights
Shaker Heights
Beachwood
Highland Hill
North Randall
Warrensville Heights
Maple Heights
Bedford Height
Garfield Heights
Newburgh Heights
Cuyahoga Heights
Brooklyn Heights
Independence
Valley View
Seven Hills
Parma
Brook Park
Brooklyn
Linndale
Cleveland
Lakewood
Rocky River
Fairview Park

CSO Long-term Control Plan



PROJECT CLEAN LAKE
GREAT LAKE • GREAT FUTURE

Northeast Ohio Regional Sewer District

Historical NEORSD CSO Permit Monitoring

1988–1997 – Initial CSO Monitoring Program

- 3PA00002*DD
- Monitored five CSOs at a time each month
- Data collected:
  - BOD
  - total suspended solids
  - flow rate
  - duration of overflow
  - number of occurrences

1997-2014 - No Defined CSO Permit Monitoring

- CSO Facilities Planning
- CWA 308(a) Requests
- CSO Operational Plan Notification
- Water Quality Monitoring
  - Streams and Lake
- Beach Monitoring
- Consent Decree Monitoring

Northeast Ohio Regional Sewer District

Project Background & Objectives

Northeast Ohio
Regional Sewer District

NPDES Permit 3PA00002*GD

- Effective October 1, 2014
- CSO Monitoring Requirement
  - Monthly CSO overflow occurrence and volume
    - 21 CSO stations
  - CSO occurrence sampling and analysis
    - 7 of the 21 CSO stations
    - 2 days during the calendar year

Northeast Ohio Regional Sewer District

Project Background

- Permit Requirement
  - Develop CSO Monitoring & Sampling Plan
    - NEORSD reviewed existing monitoring and overflow estimation program
      - New monitoring needs
      - Need for refined equations for existing monitors

Northeast Ohio Regional Sewer District

Project Objectives

- General Engineering Services Task Order
- Develop new CSO calculations to support monthly eDMR reporting
  - Defensible
  - Easy to use by District staff

Northeast Ohio Regional Sewer District

Approach

Northeast Ohio
Regional Sewer District

Approach

- Background Review of Reporting
- Desktop Review of Regulators
- Field Investigation
- CSO Overflow Volume Calculation
- Data Review

Northeast Ohio Regional Sewer District

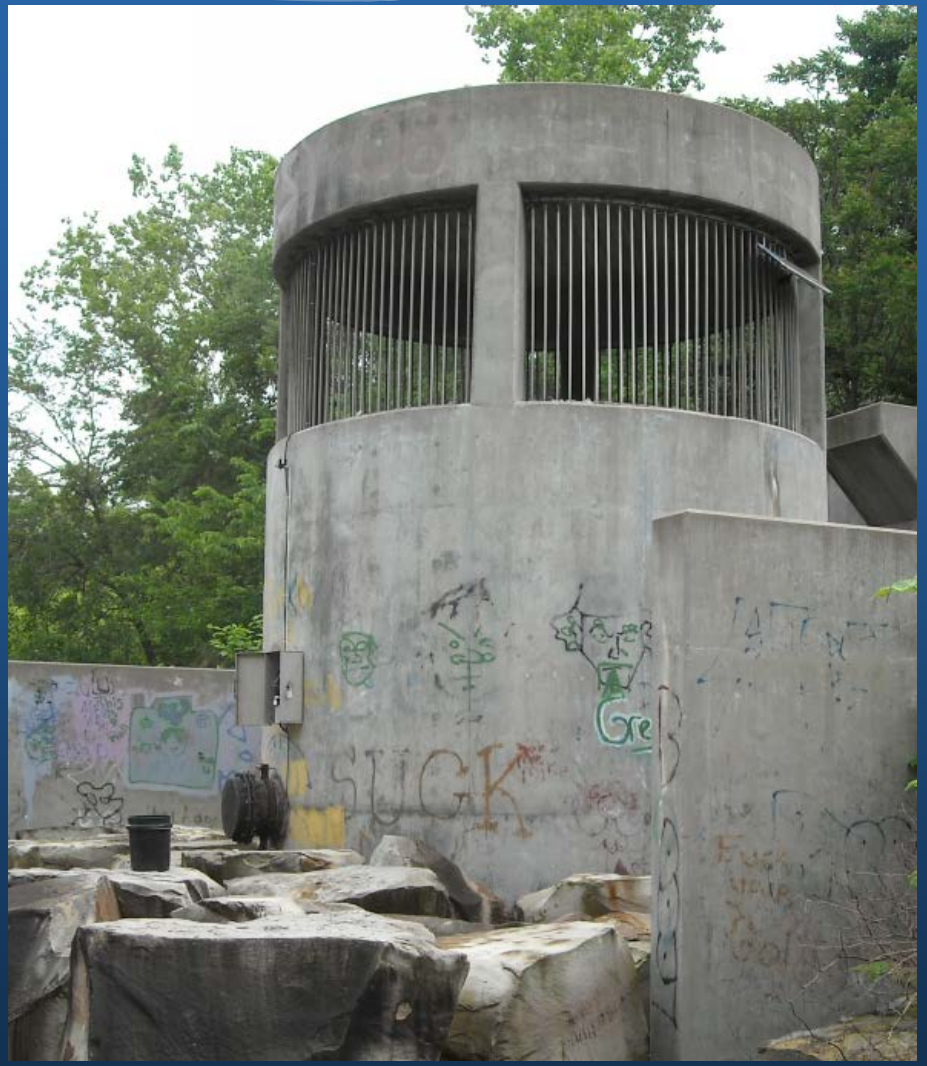
Desktop Review

- Weir Configurations
  - Weir, Broad-crested
  - Weir, Sharp-crested
  - Bascule Gate
  - Slide Gates
- Instrumentation
  - Level instrument (pressure transducer, bubbler)
  - Flow Meter

Northeast Ohio Regional Sewer District

CSO-258: Desktop Review

- Vertical silo
- Overflow from 120” Mill Creek Tunnel
- Curved weir with vertical bars



Northeast Ohio Regional Sewer District

CSO-258: Desktop Review

- Pressure transducer installed invert of an 18” pipe

Northeast Ohio Regional Sewer District

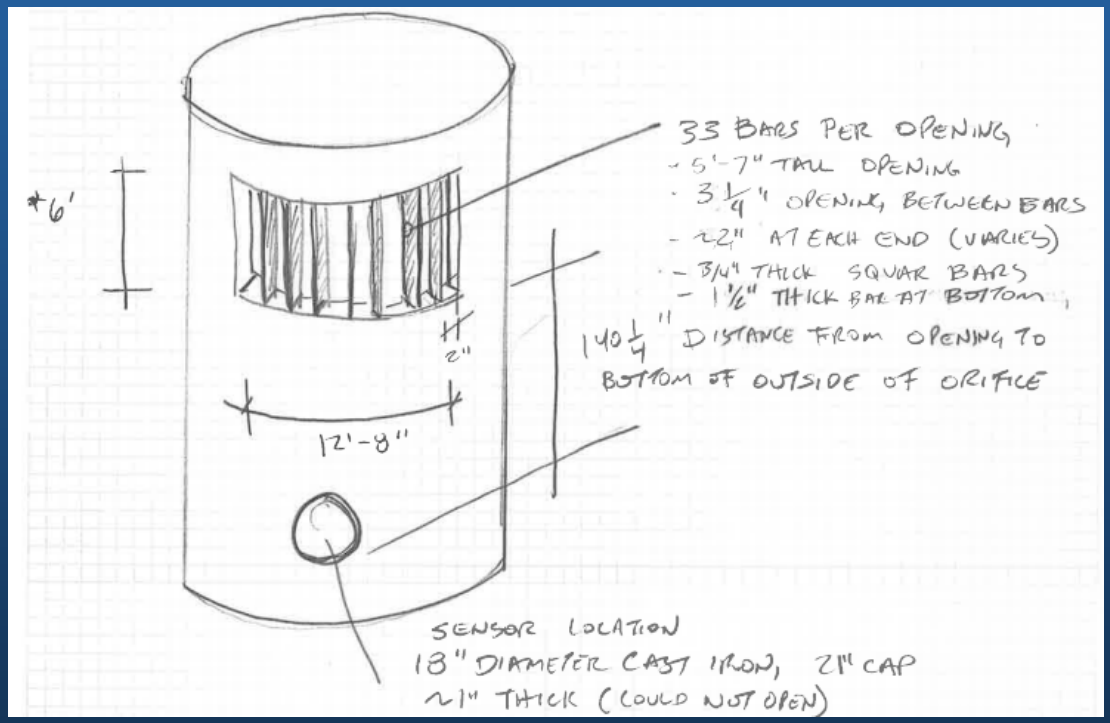
CSO-258: Desktop Review

- Pressure transducer installed invert of an 18” pipe

Northeast Ohio Regional Sewer District

CSO-258: Desktop Review

CSO-258:
Field Investigation Photo Log



Northeast Ohio Regional Sewer District

CSO-258: Overflow Volume Calculation

- Curved Weir
- Contracted sides
- Sharp-crested Weir
- Non-submerged
- Effective weir length
- Instrument Reading when water level is at weir crest

- Contracted, nonsubmerged weir equation

$$Q = \left(\frac{2}{3}\right) C b_{eff} H^{3/2} \sqrt{2g}$$

$$H = H_{US} - H_{WEIR}$$

Northeast Ohio Regional Sewer District

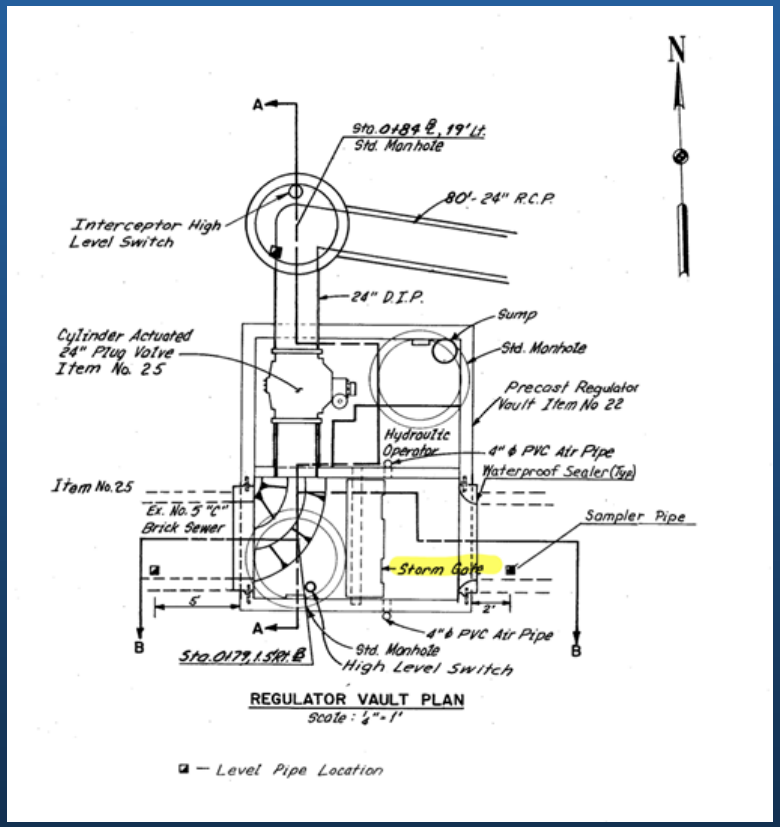
CSO-044: Desktop Review

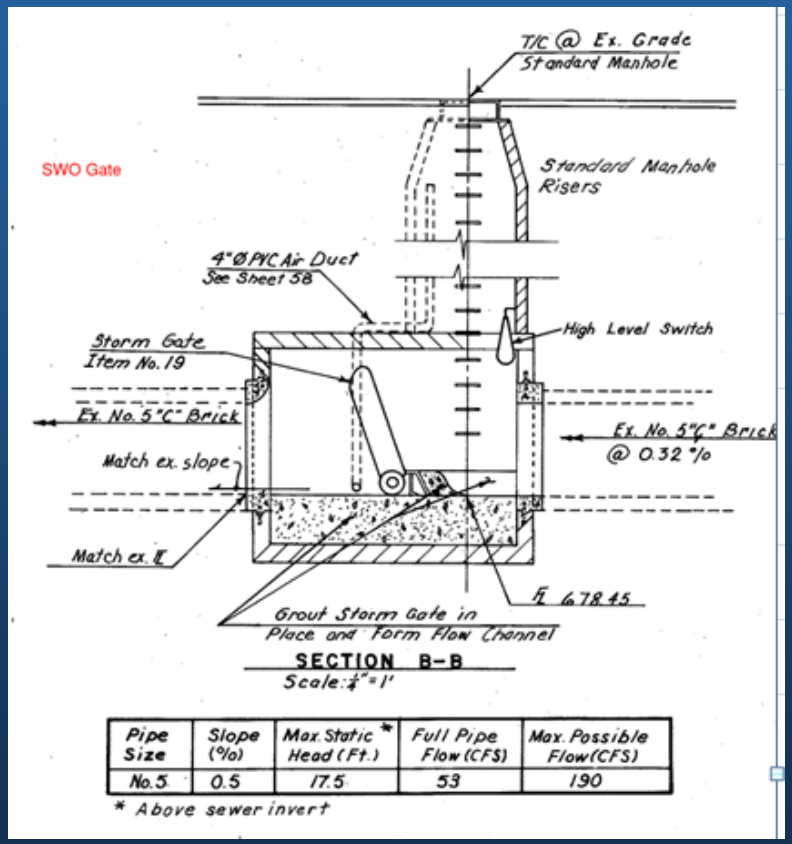
- Bascule Gate Auto-Regulator

  (1-100% Open)
- Storm gate opens by hydraulic operator when set points are met.

Northeast Ohio Regional Sewer District

CSO-044: Desktop Review



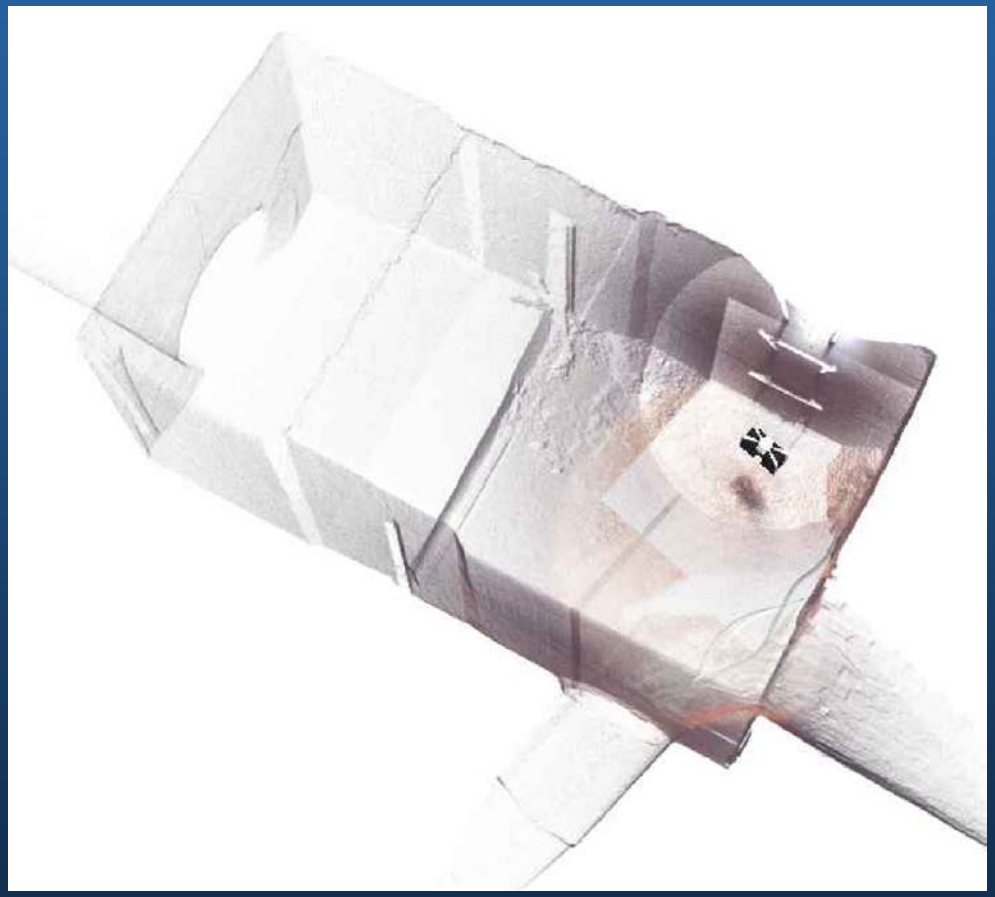


Pipe Size	Slope (%)	Max. Static Head (Ft.) *	Full Pipe Flow (CFS)	Max. Possible Flow (CFS)
No. 5	0.5	17.5	53	190

* Above sewer invert

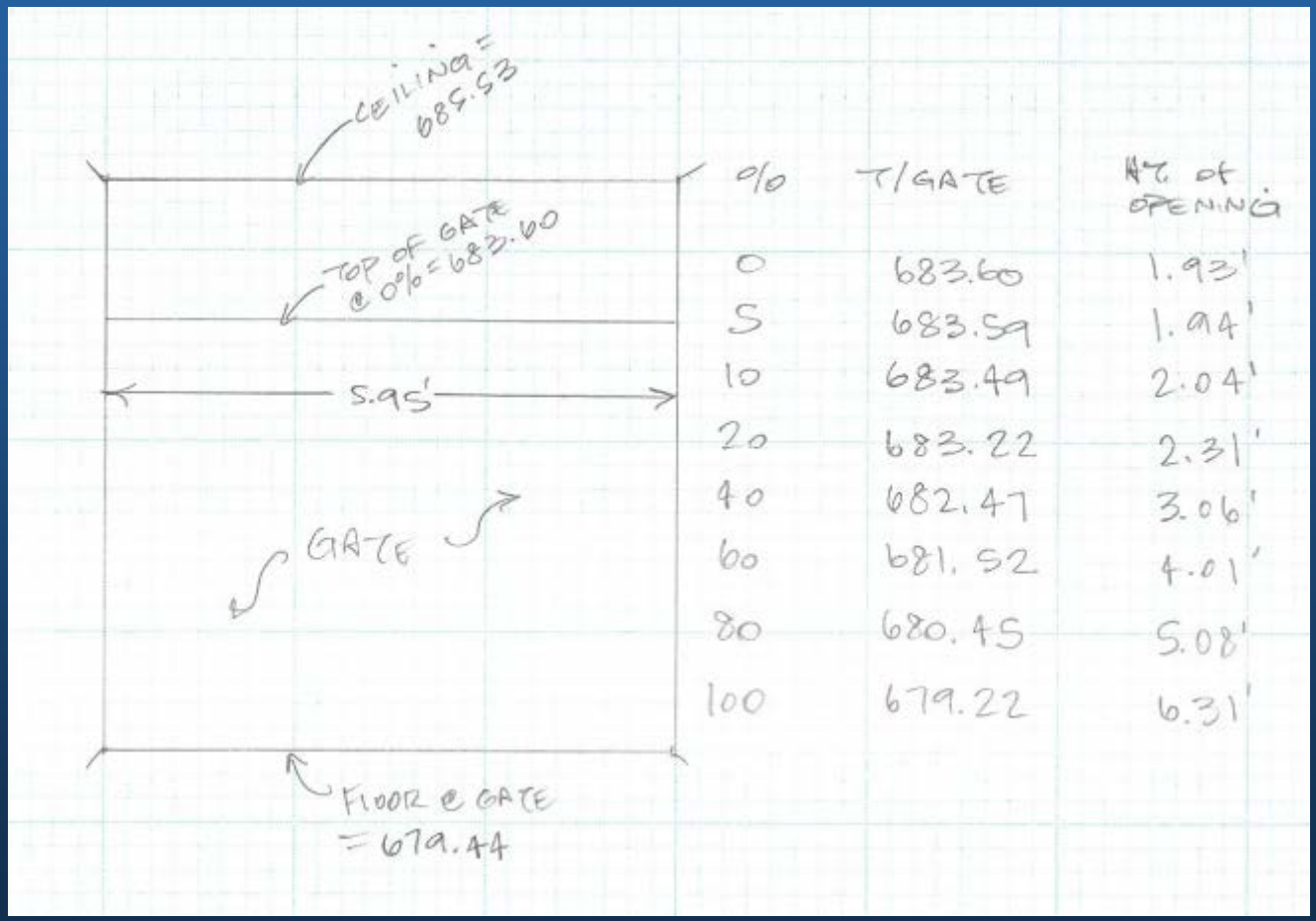
Northeast Ohio Regional Sewer District

CSO-044: Desktop Review



Northeast Ohio
Regional Sewer District

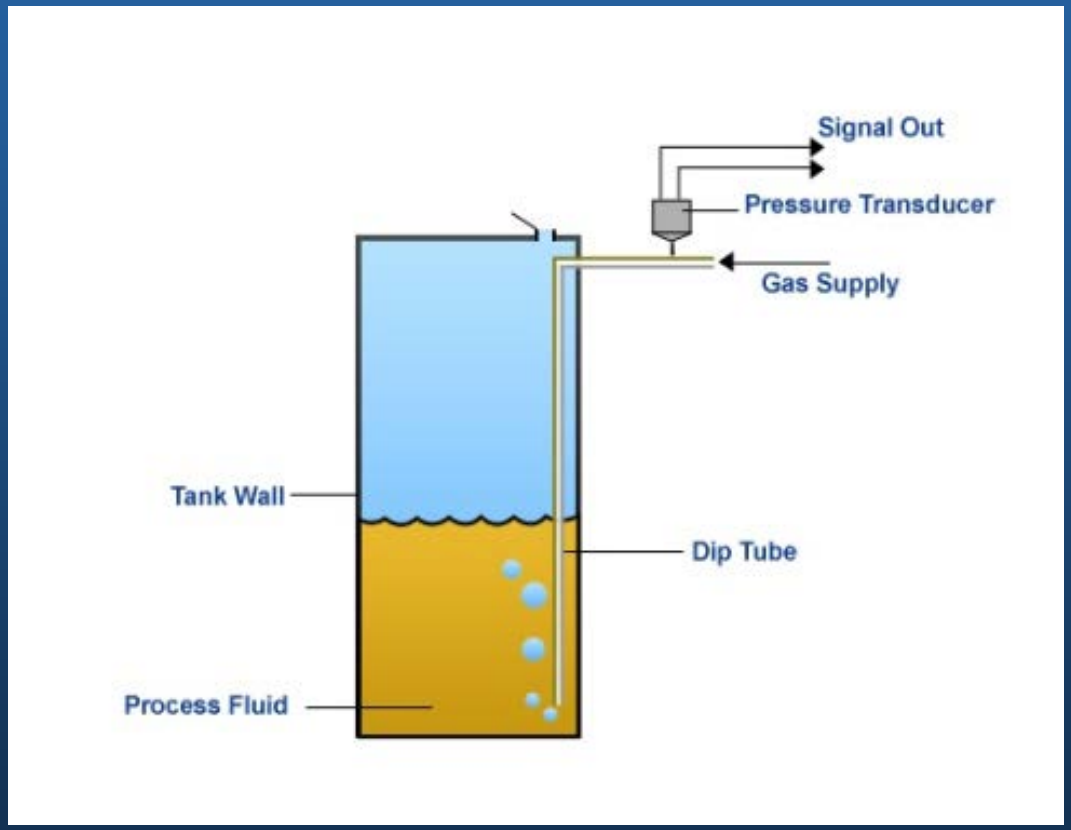
CSO-044: Field Investigation Field Measurements



%	T/GATE	Ht. of OPENING
0	683.60	1.93'
5	683.59	1.94'
10	683.49	2.04'
20	683.22	2.31'
40	682.47	3.06'
60	681.52	4.01'
80	680.45	5.08'
100	679.22	6.31'

Northeast Ohio Regional Sewer District

Level Determination



Source:
www.globalspec.com

Northeast Ohio
Regional Sewer District

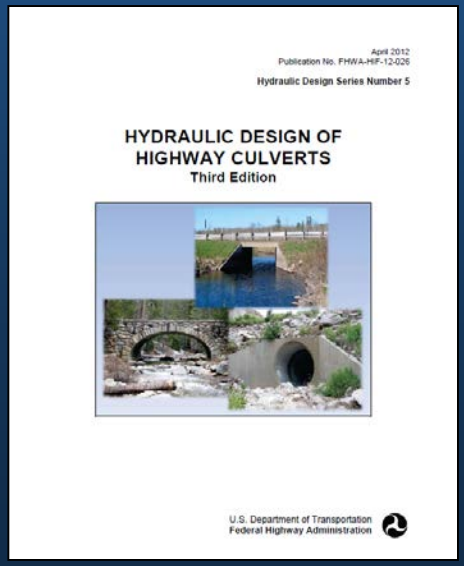
CSO-044: Overflow Volume Calculation

- Initially, flow is restricted by partially open gate position
  - Weir Control
- Then, flow is restricted by the outlet
  - Inlet Control
- Used If / Then logic to determine

- Contracted, nonsubmerged weir equation

  (shown earlier)
- Inlet Control Equations

Source:



Northeast Ohio Regional Sewer District

Other Sites:

CSO-056

Influent

DWO Gate

SWO Gate

CSO-025

Typ Weir Opening

Northeast Ohio Regional Sewer District

Other Sites:

CSO-025

Chamber

Typ Weir Opening

Level Sensor

Northeast Ohio Regional Sewer District

OEPA Reporting

Time	CSO 45 FLOW	CSO45 LEVEL (Level in Trunk in feet)	CSO 045 (SWO gate position in %) Gate Opening, G (0-100)
	MGD	FT	%
8/24/2016 23:25		3.03	1.47
8/24/2016 23:30		3.03	1.47
8/24/2016 23:35		3.03	1.46
8/24/2016 23:40		3.03	1.46
8/24/2016 23:45		3.03	1.47
8/24/2016 23:50		3.03	1.47
8/24/2016 23:55		3.03	1.46
8/25/2016 0:00		3.03	1.47
8/25/2016 0:05		3.03	1.47
8/25/2016 0:10		3.03	1.46
8/25/2016 0:15		3.03	1.47
8/25/2016 0:20		3.03	1.47
8/25/2016 0:25		3.03	1.46
8/25/2016 0:30		3.03	1.47
8/25/2016 0:35		3.03	1.47
8/25/2016 0:40		3.03	1.47
8/25/2016 0:45		3.03	1.46
8/25/2016 0:50		3.04	1.47
8/25/2016 0:55		3.04	1.47
8/25/2016 1:00		3.04	1.47
8/25/2016 1:05		4.51	1.48
8/25/2016 1:10		8.32	1.49
8/25/2016 1:15		8.62	1.49
8/25/2016 1:20		8.43	1.51
8/25/2016 1:25		8.17	1.50
8/25/2016 1:30		7.98	1.50
8/25/2016 1:35		7.91	1.51
8/25/2016 1:40		7.89	1.53
8/25/2016 1:45		7.81	1.52
8/25/2016 1:50		7.72	1.49
8/25/2016 1:55		7.63	1.53
8/25/2016 2:00		7.55	1.53
8/25/2016 2:05		7.48	1.53
8/25/2016 2:10		7.42	1.53
8/25/2016 2:15		7.37	1.53
8/25/2016 2:20		7.33	1.53
8/25/2016 2:25		7.29	1.53
8/25/2016 2:30		7.24	1.55
8/25/2016 2:35		7.18	1.53
8/25/2016 2:40		7.11	1.52
8/25/2016 2:45		7.03	1.56
8/25/2016 2:50		6.95	1.53
8/25/2016 2:55		6.85	1.52
8/25/2016 3:00		6.74	1.56

Ohio EPA - Form 4500 - Data Entry Spreadsheet

Facility: Northeast Ohio Regional SD
Permit: 3PA00002*GD
Monitoring Period: Aug-16
Station Code: 045

	74062 Overflow Occurrence No./Month When Disch. Total		74063 Overflow Volume Million Gallons When Disch. 24hr Total		
Date	Measurement	Comment	Measurement	Comment	RAIN DAY YES OR NO? Based On Total
8/24/2016	0				N
8/25/2016	1		*0.0725*		N
8/26/2016	0				N
8/27/2016	0				N
8/28/2016	0				N
8/29/2016	0				N
8/30/2016	0				N
8/31/2016	0				N
9/1/2016	0				N
9/2/2016	0				N
9/3/2016	0				N
9/4/2016	0				N
9/5/2016	0				N
9/6/2016	0				N
9/7/2016	0				N
9/8/2016	1		*0.0041*		N
9/9/2016	0				N
9/10/2016	0				N
9/11/2016	0				N
9/12/2016	0				N
9/13/2016	0				N
9/14/2016	0				N
9/15/2016	0				N
9/16/2016	0				N
9/17/2016	1		*0.1564*		N
9/18/2016	0				N
9/19/2016	0				N
9/20/2016	0				N
9/21/2016	0				N
9/22/2016	0				N
9/23/2016	0				N

Northeast Ohio Regional Sewer District

Hydraulic Model Comparison

Northeast Ohio
Regional Sewer District

Hydraulic Model Comparison

CSO Site	NPDES Calculations		Hydraulic Model	
	Asset ID	Configuration	Version	Model ID
025	MC-64	Weir, Broad	MCCS	CSO 025
035	S-75	Weir, Broad	SOBL	S75.2
038	S-82	Inlet	SOBL	CSO 038
040	SO-08-AKC	Weir, Sharp	SOBL	SO8.1
044	BC-03-AIS	Bascule Gate	BCBL	CSO 044
045	BC-05-AJB	Slide Gate	BCBL	CSO 045
056	BC-10A-ABK	Weir, Sharp	BCBL	CSO 056
058	BC-08-APU	Bascule Gate	BCBL	BC8.2
059	BC-02-ASJ	Bascule Gate	BCBL	BC2.1
069	NW-03-AEG	Slide Gate	WEBL	CSO 069
072- SOBL	SO-01-AHA	Bascule Gate	SOBL	CSO 072
080	WR-27	Weir, Broad	WEBL	CSO 080
088[2]	-	-	WEBL	CSO 088
200	FCT	Flow Meter	ESBL	CSO 200
202	FSM	Flow Meter	ESBL	CSO 202
206	FEO	Flow Meter	ESBL	CSO 206
211	H-19	Weir, Broad	ESBL	H19.2
218	DV-25	Flow Meter	ESBL	CSO 218
239	L-39	Weir, Broad	ESBL	CSO 239
242	L-23	Weir, Sharp or Broad	ESBL	CSO 242
258	SILO-CMC	Weir, Sharp	MCCS	CSO 258

[1] Per NEORSD's CSO Monitoring and Sampling Plan, version Addendum #1, dated June 2015.

[2] CSO Site added after development of original regulator equations.

Hydraulic Model Comparison

CSO Site/ Regulator	Dates of Available Data		Number of Months Compared
	eDMR	Model	
025	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
035, S-75	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
035	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
038	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
040, SO-08	4/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	9
040	4/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	9
044	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
045	10/1/2015 – 2/29/2016	1/1/2015 – 2/29/2016	5
056	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
058, BC-08	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
058	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
059, BC-02	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
059	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
069	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
072	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
080	4/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	9
088[1]	2/1/2016 – 2/29/2016	N/A	0
200	4/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	9
202	4/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	9
206	4/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	9
211, H-19[2]	1/1/2016 – 2/29/2016	1/1/2015 – 12/31/2015	0
211[2]	1/1/2016 – 2/29/2016	1/1/2015 – 12/31/2015	0
218	4/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	9
239	4/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	9
242	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3
258	10/1/2015 – 2/29/2016	1/1/2015 – 12/31/2015	3

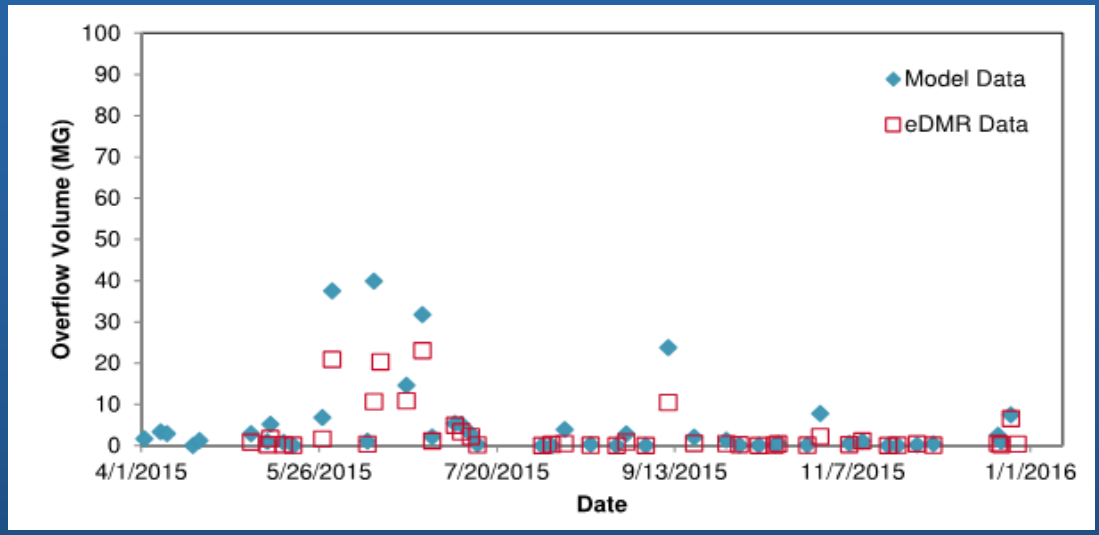
[1] CSO 088 site was added after development of original regulator equations. The flow meter at that site was installed on 2/1/2016.

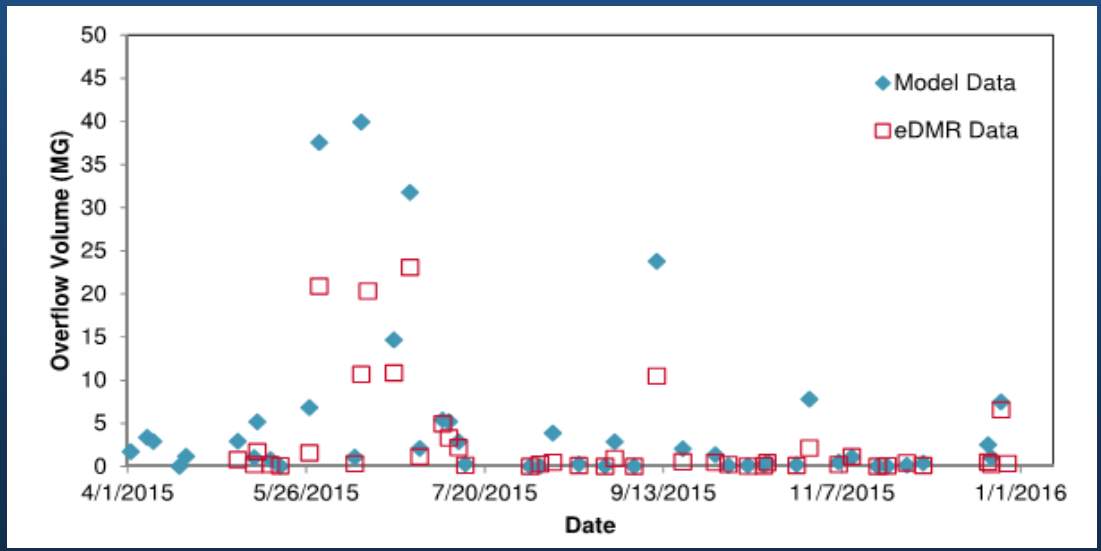
[2] CSO 211 site does not have eDMR data available. The flow meter at that site was installed on 1/1/2016.

Northeast Ohio Regional Sewer District

Hydraulic Model Comparison

CSO 040

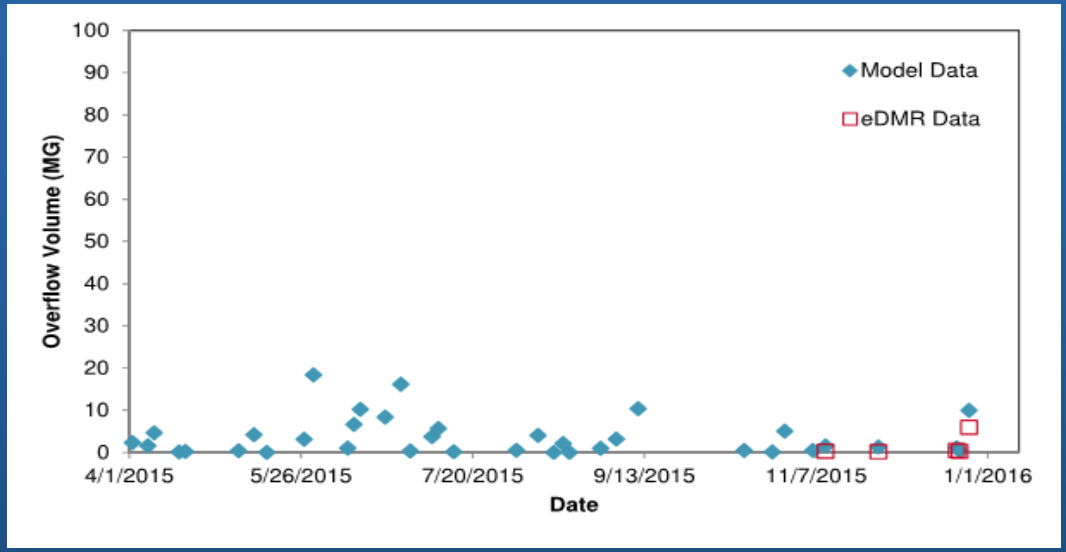


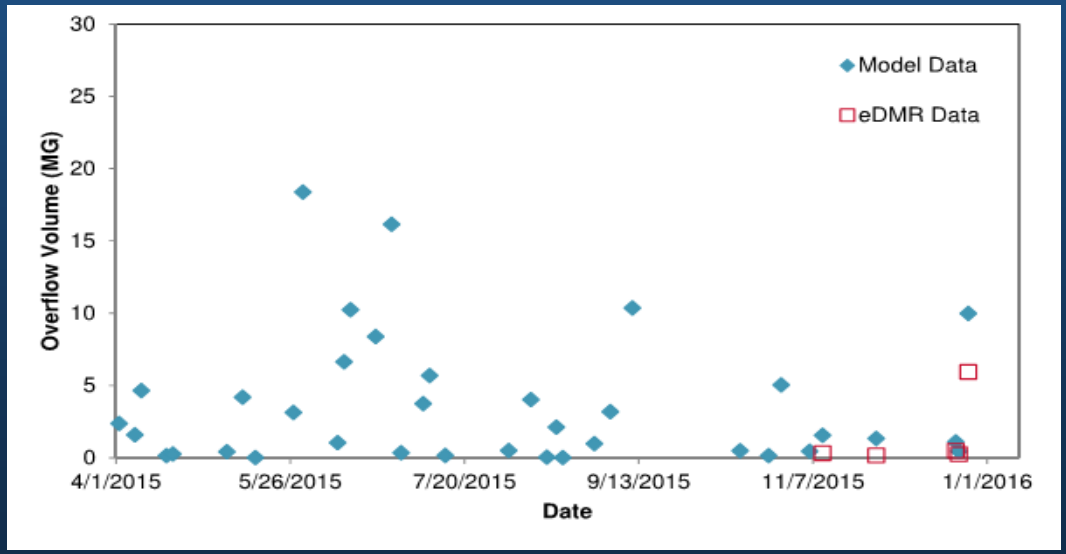


Northeast Ohio Regional Sewer District

Hydraulic Model Comparison

CSO 056

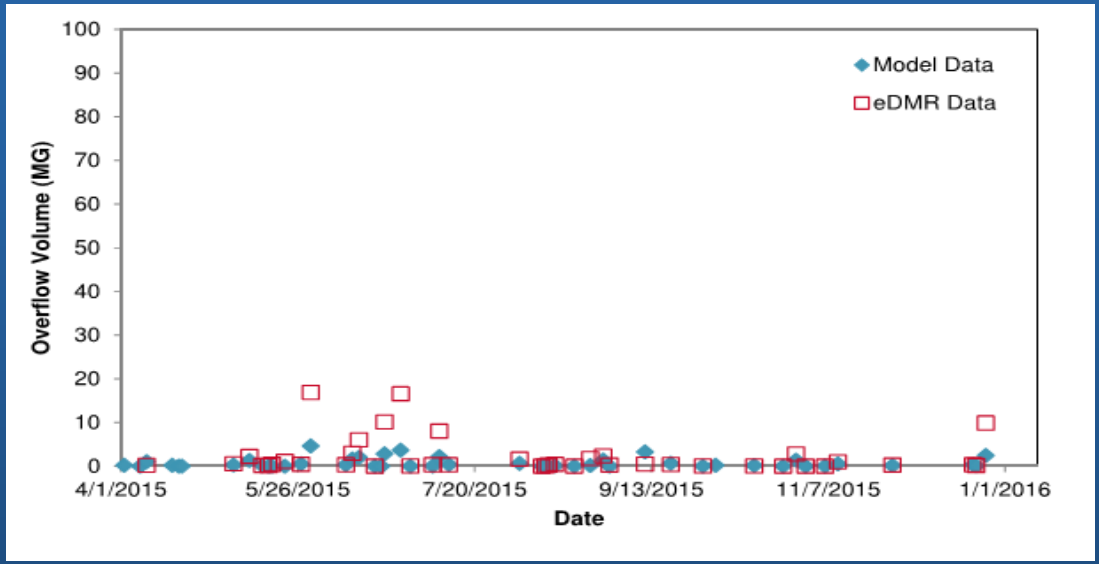


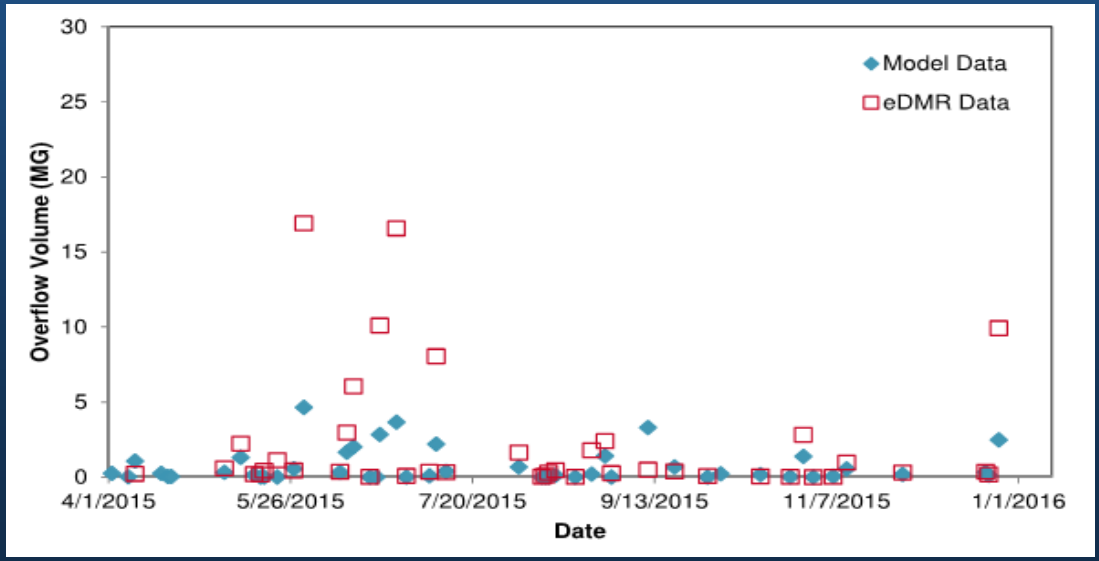


Northeast Ohio Regional Sewer District

Hydraulic Model Comparison

CSO 239





Northeast Ohio Regional Sewer District

Conclusions

- The comparison between the two methods were not conclusive.
- Hydraulic model predicted more overflows & greater volume, in general.
- The District has defensible backup for overflow reporting

Things to Consider

- Model calibration & instrument calibration
- Flow meter vs level instrument
- Regulator configuration in the model vs field-verified information.
- Debris in structures impacted level reading.
- Level sensors downstream of gates, to detect backflow / river levels
- Weir plates for more improved hydraulics

Northeast Ohio Regional Sewer District

Next Steps

Northeast Ohio
Regional Sewer District

Next Steps

- Refine 1 CSO calculation based on additional monitoring data
  - River intrusion
- Seek integrating calculation with automation project to streamline process

Northeast Ohio Regional Sewer District

Lessons Learned

Northeast Ohio
Regional Sewer District

Lessons Learned

- Perform thorough desktop review before field visits.
- Understand the data you need to collect to avoid several site visits.
- Civil & instrumentation discipline coordination required.
- Calculation programming in Excel more complicated than expected.

Northeast Ohio Regional Sewer District

Thank you!

- Acknowledgements:
  - AECOM (formerly URS), Cleveland, Ohio
  - KS Associates, Elyria, Ohio
  - NEORSD Staff (Systems Integration, Sewer System Maintenance & Operations (SSMO))
- Contact Info:
  - Lita Laven: Lita.Laven@neorsd.org
  - Jennie Celik: Jennie.Celik@hdrinc.com

Northeast Ohio Regional Sewer District

HDR