NASHVILLE'S REHAB PROGRAM*

A Strategic Plan Removes 3.6 Billion Gallons of I/I

PRESENTED BY

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** A significant portion of this work was conducted CTE-AECOM as part of the Nashville Overflow Abatement Program 1991-2005*

IS SEWER REHABILITATION EFFECTIVE ?

MEASURES OF EFFECTIVENESS

- Reduction of I/I
- Reduction of Overflows
  - (and concurrent water quality improvement)

NATIONAL TRENDS

WERF* - study of trends of I/I reduction in 44 utilities:

"Unfortunately, none of the information between projects was comparable..."

** Water Environment Research Foundation*

LACK OF INFORMATION

- Holds our industry back
- Discourages investment in infrastructure renewal
- Hinders environmental improvements

Successful Trenchless Rehabilitation

- Based on **actual field results** in Nashville, TN
- **Largest published database** for measured I/I reduction in the US
- Analyzed **94 miles of rehabilitation** (250 miles total - ~ 10% system)
- **I/I cut in half**
- **123 overflows eliminated**
- EPA commends **stream improvements**

Strategy for Application of Products is as Important as Product Quality

- Product Effectiveness is Equal (no leaks ***where applied***)
- Therefore: Concentrate Effort to Defeat Migration
- Dry Defects on Video May be Wet Weather Leaks
- Some Defects May Not be Visible on Video
- Pipe Segments: “Connect-the-Dots”

System Approach

Ten steps:

1. Identify Goals
2. Select Target Area
3. Quantify Problem
4. Locate Defects
5. Select Pipe Segments
6. Estimate Cost-Benefit
7. Design & Install
8. Verify Performance
9. Follow-up Flow Monitoring
10. Calculate O & M Savings

Nashville Design Criteria -- Total System Approach

Goal:

"Containment" for flows from 5-year, 24-hour rainfall

Policy:

- All service laterals connected to the rehabilitated pipes will be renewed to the easement line or the property line.
- All manholes connected to rehabilitated pipes will be renewed.

THREE TYPES OF I/I MEASUREMENTS USED FOR NASHVILLE PROGRAM

- Annual I/I
  - (normalized for a year with average rainfall)
- I/I Rates Projected For a Standard Storm Event
  - 24 Hour I/I from 24 Hour Rainfall event
  - Peak Hour I/I rate from 24 Hour Rainfall Event

Evaluation of Work In Nashville

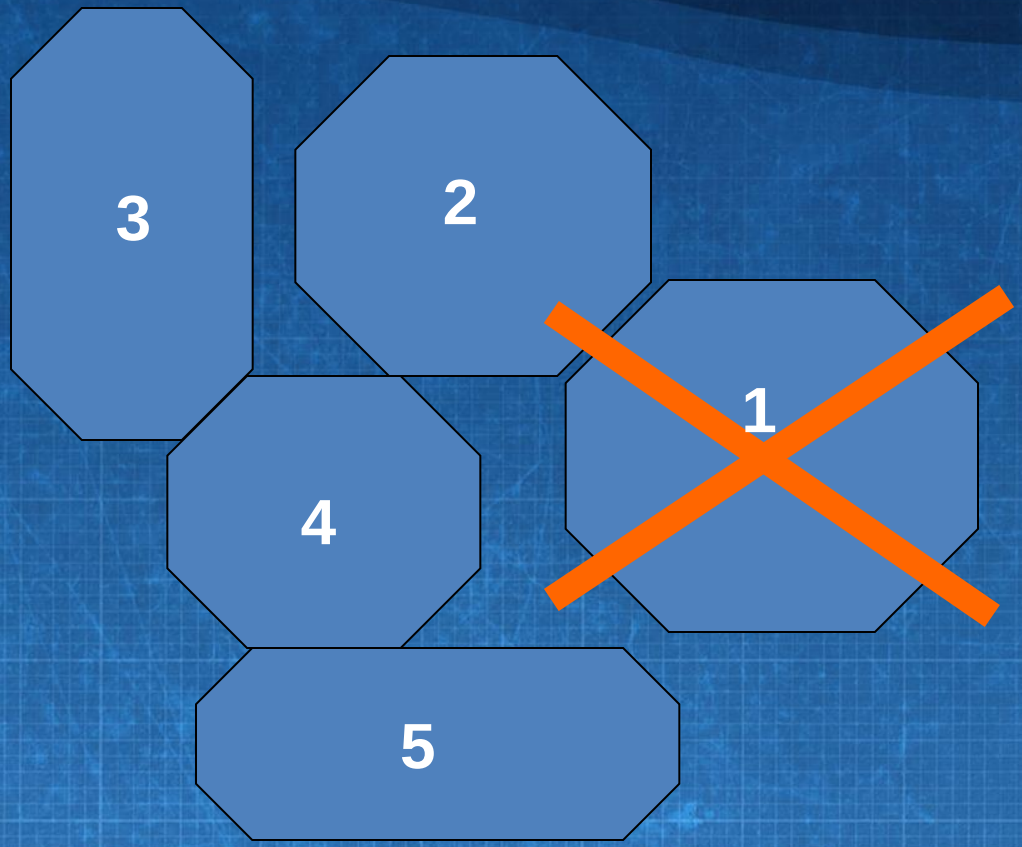
- 27 areas analyzed
- 94 miles rehab'd
- (1/3+ of total work in Nashville)
- + 50% I/I reduction (in the project areas)

Project	Length	Annual I/I Reduction		5-Year, 24-Hour I/I Reduction		5-Year, Peak-Hour I/I Reduction	
	(ft)	(mg)	(%)	(mg)	(%)	(mgd)	(%)
Berwick Trail	2290	15	52				
Brookwood	2,550	4	8				
Cleeces Ferry (15)	2,143	9.3	50	0.151	66	0.426	62
Clifton Park	38,744	228	62	5.25	43	10.788	40
Foster Ave.	10,445	189	52	3.998	56	7.561	57
Gibson Cr. (GC4 & DR6)	38,006	18	33	1.848	54	2.385	42
Hermitage Hills	34,100	116	47	2.536	46	2.93	32
Hopedale	16,084	289	72	1.376	49	0.271	8
Kenner	2,463	91	88	0.508	31		
LE Nashville (5&6)	7,077	32	11	0.687	56	0.809	22
Madison Heights	716	0.2	7	0.147	98	0.513	96
Nolensville Rd	2,391	43	37	0.884	25	1.016	
OakValley	4,400	89	76	3.868	90	4.331	84
Osage	5,440	334	52			1.98	18
Paragon Mills(P1&2,S3&4)	21,584	171	20	4.119	39	30.853	66
Post Rd	6,931	116	70	3.79	67	5.438	69
Rainbow Terr.	515	4	98	0.087	89	0.235	91
River Dr.	1,259	20	50	1	71	3	83
Riverside Dr.	2,285	7	47	0.463	40	1.841	63
Shelby Park A-1`	40,830	353	73	3.71	77	6.05	71
Smith Springs	59,178	316	38	8.924	51	16.772	48
Sugartree	41,255	668	37	15.38	49	17.27	35
Vandiver	14,500	72	44	2.74	40	4.45	57
Wallace Rd	24,267	0		8.65	69	9.41	55
West Linden	21,005	51	45	0.575	17	0.456	7
Whites Creek	88,000	400	33	12.018	41.4	19.469	42
Williamson Ferry	6,719	11	8	0.4	13	1.8	30

Successful Rehab Factors

- Define goals
- Extensive flow monitoring & standard procedures
- Lateral rehabilitation
- “Targeting” – stop water migration
- Accountability – verify desired results
- Planning for a comprehensive program
  - Piecemeal or “find & fix” approaches are not adequate to stop migration !!

Total System: Pick Priority Area



Work on the top priority area -

- AND KNOCK IT OUT !

Lateral Rehabilitation Effectiveness

- Downington, PA -area 5
  - 38 laterals in 1,513’ CIP - 100% treated
  - 97% reduction - 22 mg annually
- Stege San. Dist, CA - subarea N
  - 111 laterals in 13,400’ Slip-PE & MH - 100%
  - 86% reduction
- Nashville, TN - Oak Valley
  - 63 laterals in 4,400’ CIP - 41% treated
  - 77% reduction (20%-laterals) - 67 mg annually

Over 10,000 service laterals rehabilitated in Nashville’s Program

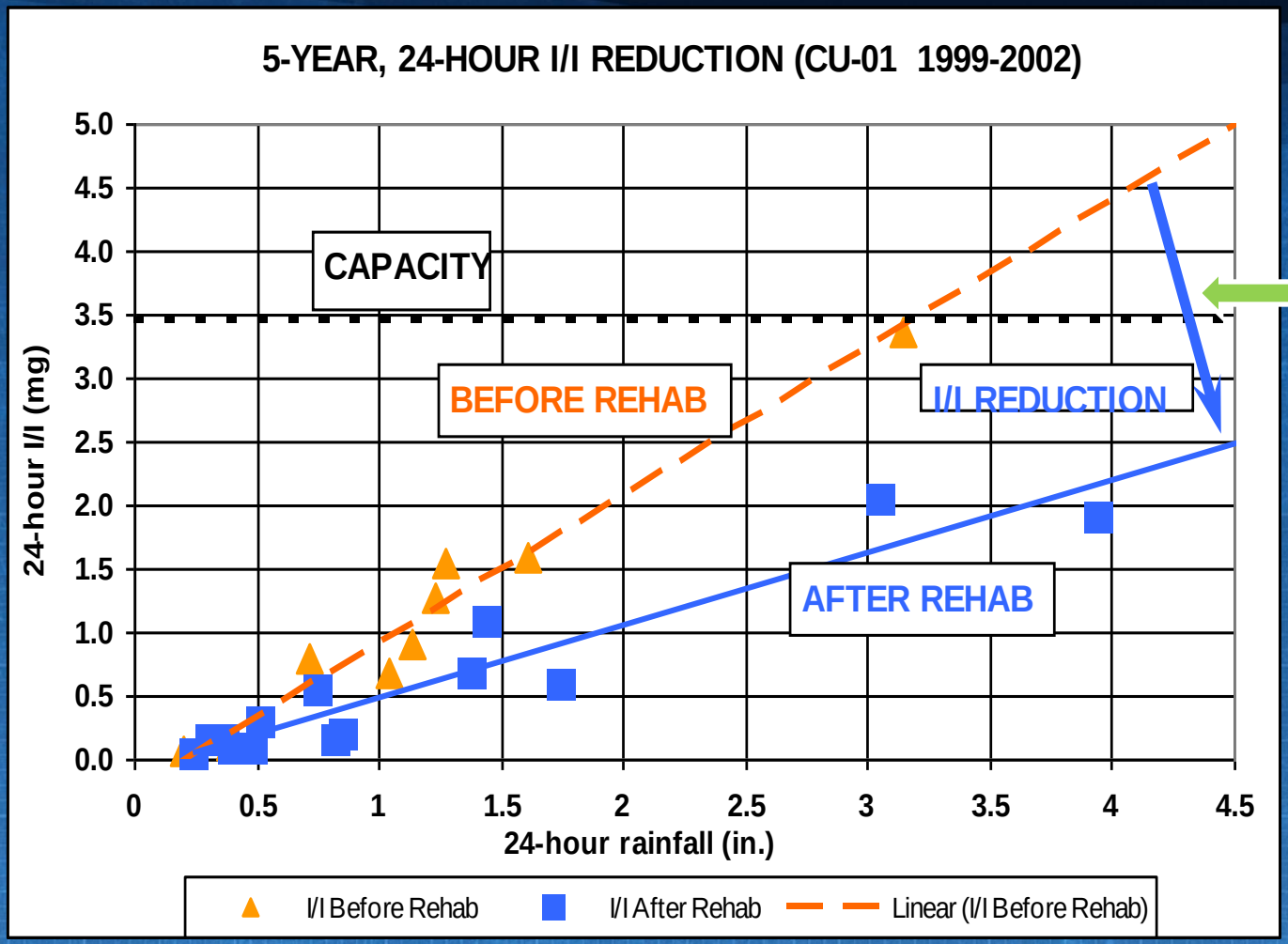
Flow & Rain Monitoring Is A Key Tool

- Target and prioritize basins
- Correctly interpret hydraulic conditions
- Conduct model calibration
- Monitor post-rehabilitation to verify project effectiveness

Documentation

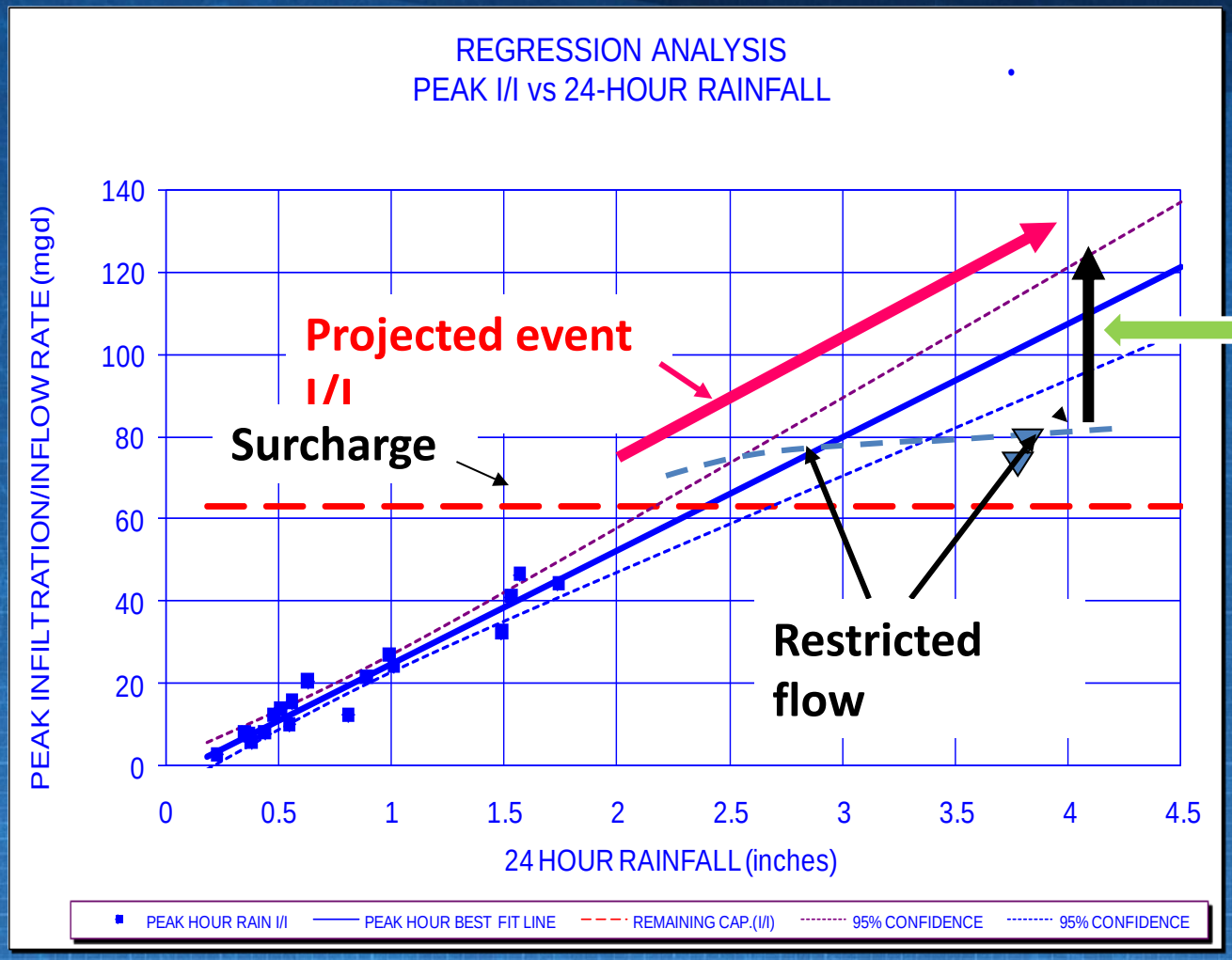
- Reliable Flow Monitoring Data (USEPA – ETV verified equipment)
- Intensive Flow & Rainfall Monitoring (90+ long-term, 700+ temp, 20 rain gauges)
- Standardized (non-proprietary) Analytical Methods for I/I Analysis
- Standardized Criteria for Reporting I/I

Before-after Project Evaluation



50% Reduction

Proper Interpretation Considering Site Hydraulics

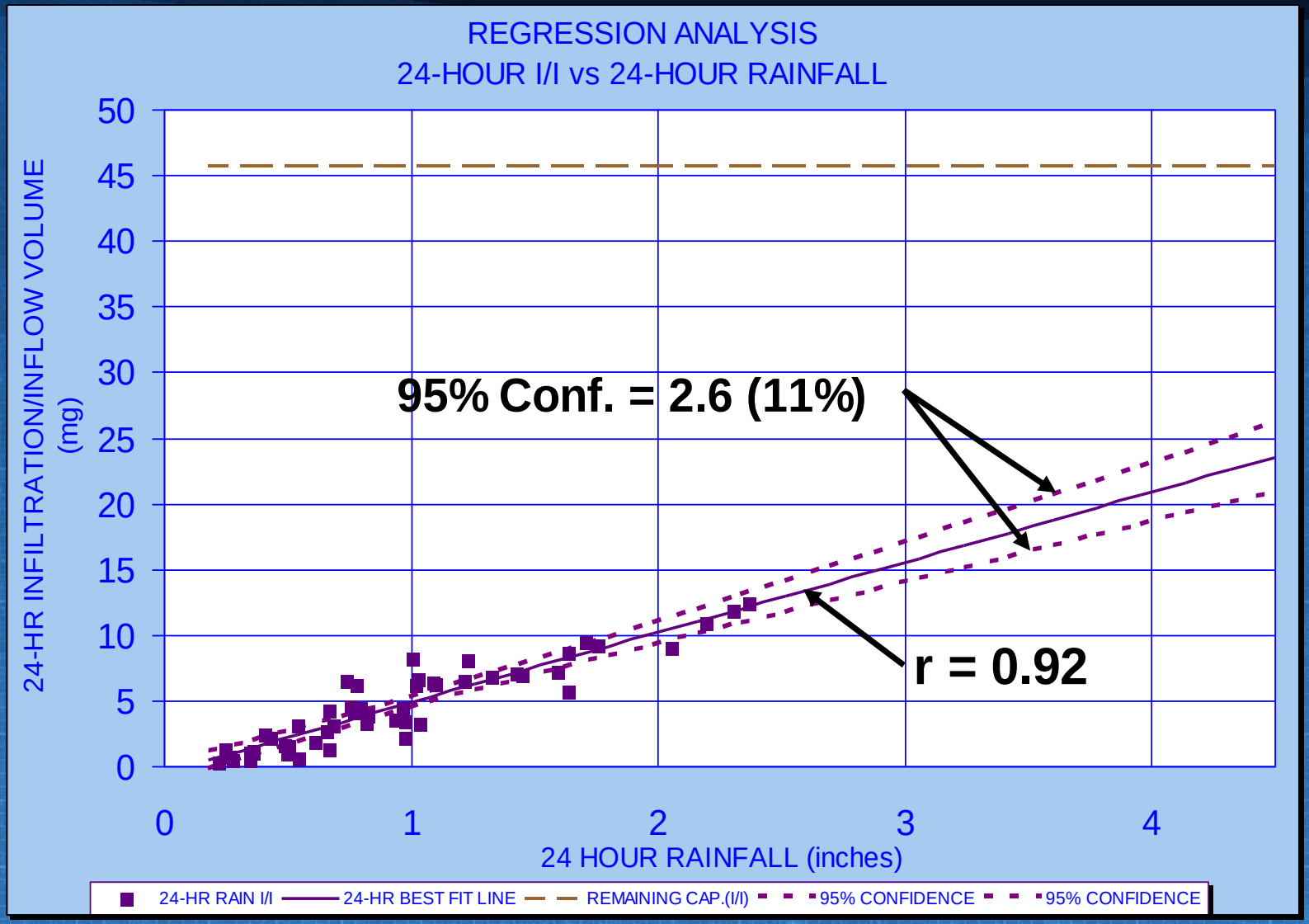


R=0.97, 95% CONF. = 26%

STANDARDIZED STATISTICAL METHODS

- Use statistical tests to evaluate the analytical methodology
- r value: coefficient of linear correlation (r *not related to RTK method)*
- r^2 value: per cent of variation of I/I attributable to 24-hour rainfall
- 95% confidence interval

Standardized I/I Analysis



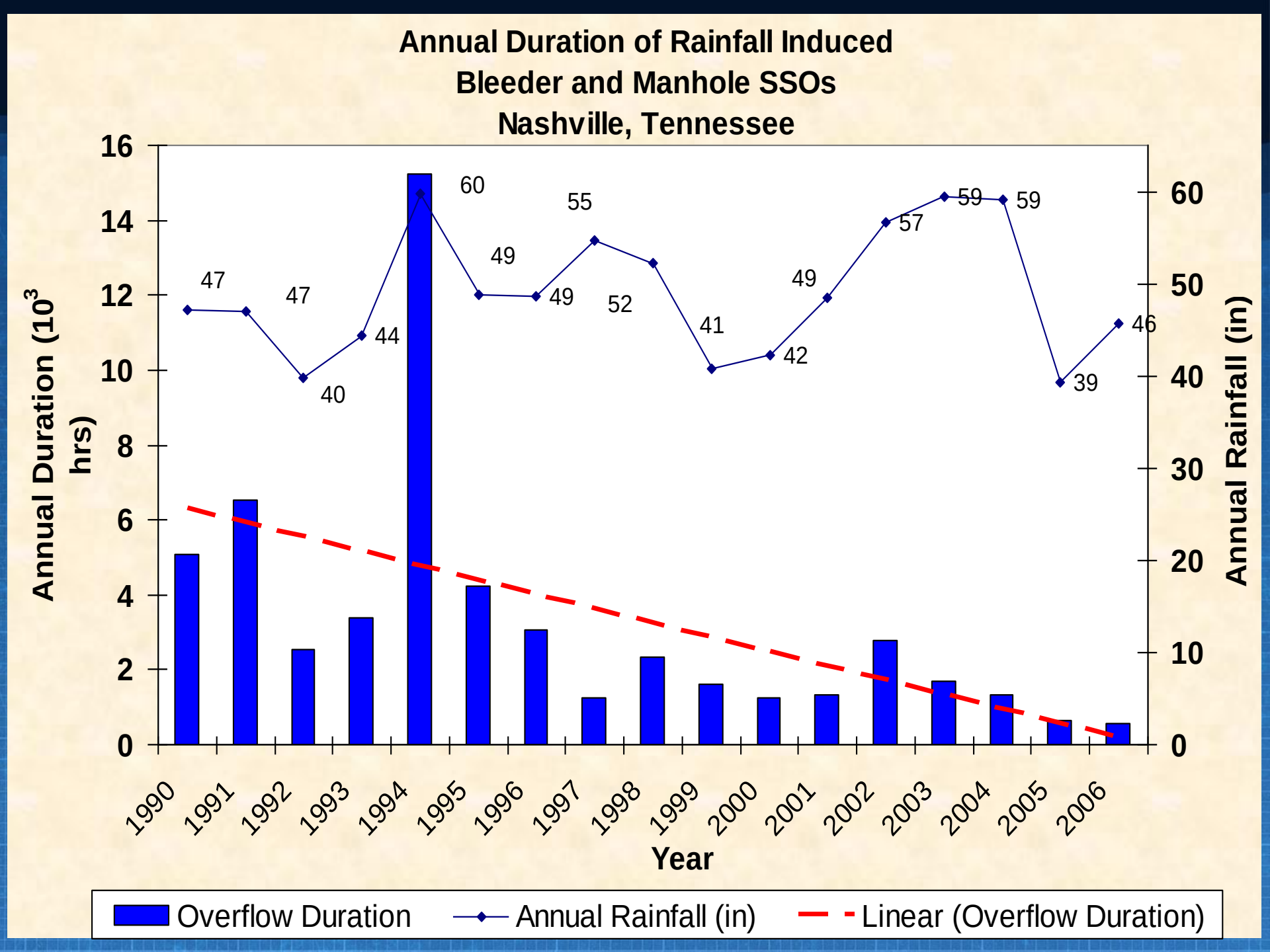
Standardized Approach (summary highlights)

- Design storm (e.g., 5-year, 24-hour event)
- Statistical criteria for QA/QC
- Define rainfall event (e.g., 10 hrs dry prev.)
- Use maximum number of events in period
- Minimize analyst bias (selectivity)

Nashville measured results

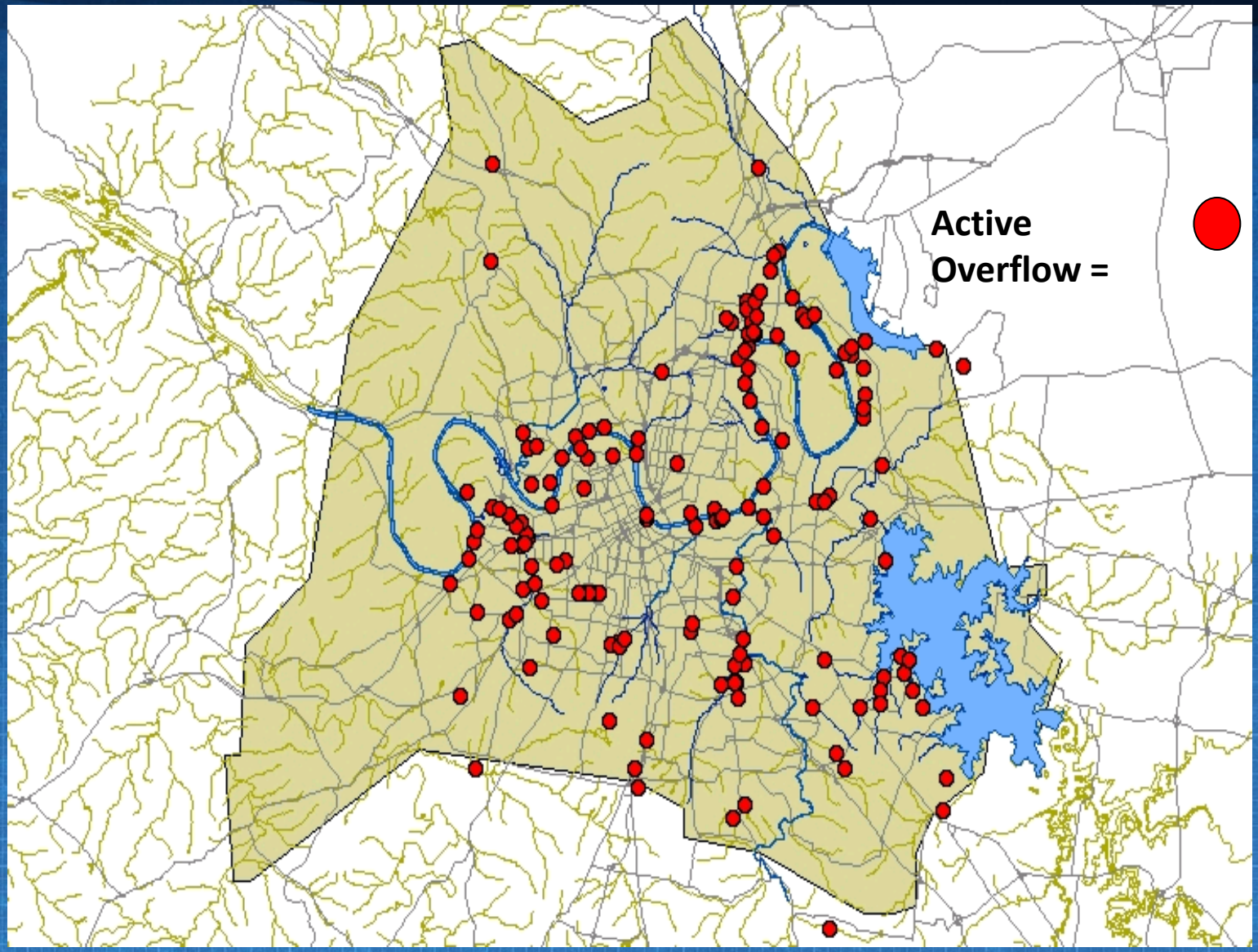
For the 27 areas (94 miles) analyzed so far:

- I/I eliminated annually: 3.647 billion gal.
- Annual I/I eliminated: 49.6%
- 24-hour, 5-year I/I reduction: 53%
- Peak-hour, 5-year I/I reduction : 52.2%


Annual Duration of Rainfall Induced
Bleeder and Manhole SSOs
Nashville, Tennessee
Annual Duration (10^3 hrs)
Annual Rainfall (in)
Year
0
2
4
6
8
10
12
14
16
0
10
20
30
40
50
60
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
47
47
40
44
60
49
49
55
52
41
42
49
57
59
59
39
46
Overflow Duration
Annual Rainfall (in)
Linear (Overflow Duration)

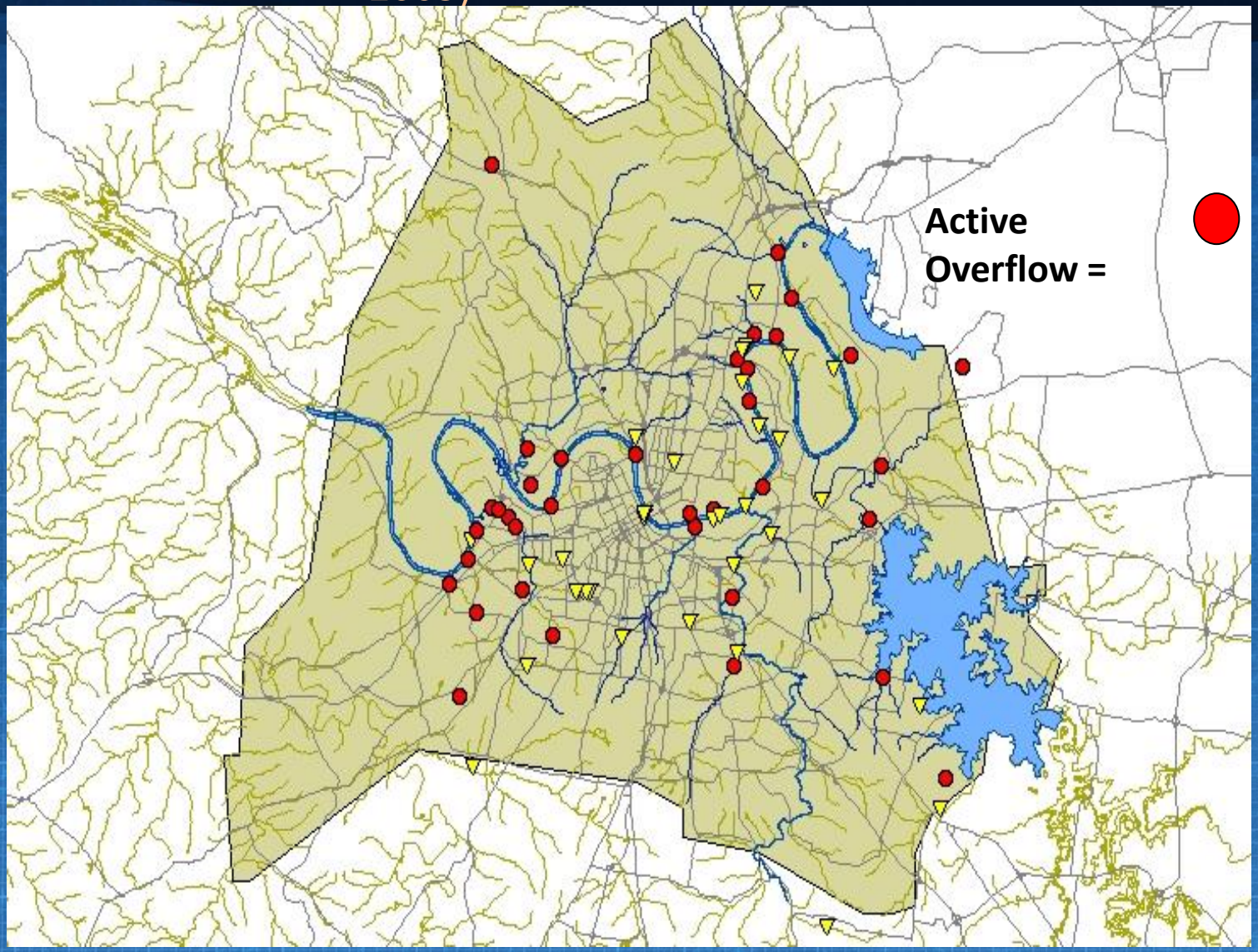
Nashville

157 Potential SSO Locations Identified Since 1990



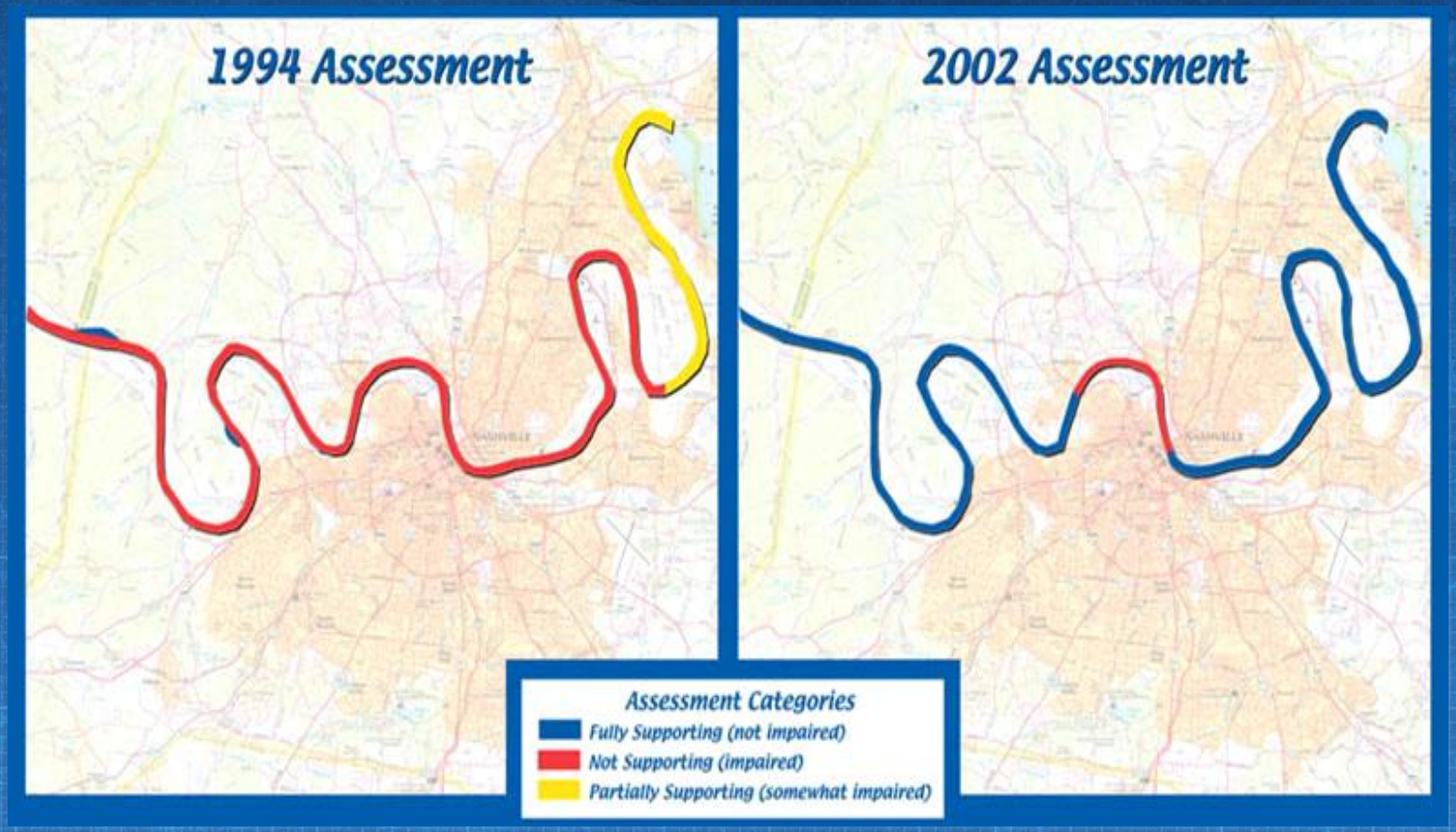
Nashville

34 Active Overflows & Watch list Locations (As of January 2005)



Governor's Ceremony 11-25-2002

Cleaning up the Cumberland



Graphic Courtesy of Tennessee Department of Environment and Conservation

EPA & Governor's Deposting Ceremony
November 2002

- 33 miles "de-posted"
- Many segments on 303d list removed or no longer attributed to collection system failure

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Deputy Governor Justin Wilson, left, and Mayor Bill Purcell listen Monday as Gov. Don Sundquist discusses the efforts to cleanup the Cumberland River.

Cumberland River certified clean

By Megan Moriarty
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It's OK to swim in the Cumberland River again. You can even eat the fish.

Gov. Don Sundquist, Mayor Bill Purcell and officials from various environmental entities gathered Monday at the east bank of the Cumberland River to announce a historic cleanup of the river.

The Cumberland River has been included on the state's list of polluted waters since the mid-1980s as a result of Metro Nashville's sewage system. More than 33 miles of the Cumberland River in Davidson County now meet state and federal water quality standards.

Since 1990, Metro government has invested more than $700 million in its pollution control efforts, and will invest an additional $150 million over the next five years to continue to improve water quality.

"The progress that we're celebrating … is the direct result of the hard work and investment by Metro Nashville staff and leadership over many years," Purcell said. "I'm proud of the progress that we've made and remain committed to continuing efforts to protect and enhance the quality of this great river and its watershed."

Purcell said the progress made cleaning the river is also in large part due to Sundquist.

"This governor … also has made clear today through this effort — as well as in the days past, what we can accomplish when we are together as a city and as a state," Purcell said.

Sundquist thanked Margo Farnsworth, executive director of the Cumberland River Compact, and her non-profit organization for educating citizens and raising awareness of water quality issues.

"We can't stop now," Sundquist said. "Taking us into this river's future is a group of dedicated citizens called the Cumberland River Compact. Margo Farnsworth and her organization have

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◂ FROM PAGE 1

raised awareness about the Cumberland and its tributaries throughout our region.

"They have shown our citizens the impact this river has had on our community, its role in our heritage and its potential for the future. The Compact has set the example we should all follow. We must all get involved if we want to build on the progress we're celebrating today. Clean water depends on every one of us working together."

Farnsworth said it was fitting the announcement fell during the week of Thanksgiving.

"The people in this region have much to celebrate and be thankful for with regard to this river," Farnsworth said.

The 33 miles of river, which now meet the water quality standards, represent an 87 percent reduction in pollution since 1998 in the Davidson County portion of the Cumberland River not meeting standards.

Approximately five miles of the river in Tennessee still remain on the state's list of impaired waters.

"This is a river that has changed and changed for the better," Purcell said. "I think the people of Nashville will appreciate that for many, many years to come."

Strategic goals met

- I/I reduction
- SSO reduction
- Stream improvement

Questions ?