

# Lake Wingra Watershed Management Plan

City of Madison & Friends of Lake Wingra

## 2015 Stormwater Projects

City of Monona

April 14, 2016

Waukesha County-2016 Stormwater Workshop

Jon H. Lindert, P.E., LEED AP



*Friends of Lake Wingra*

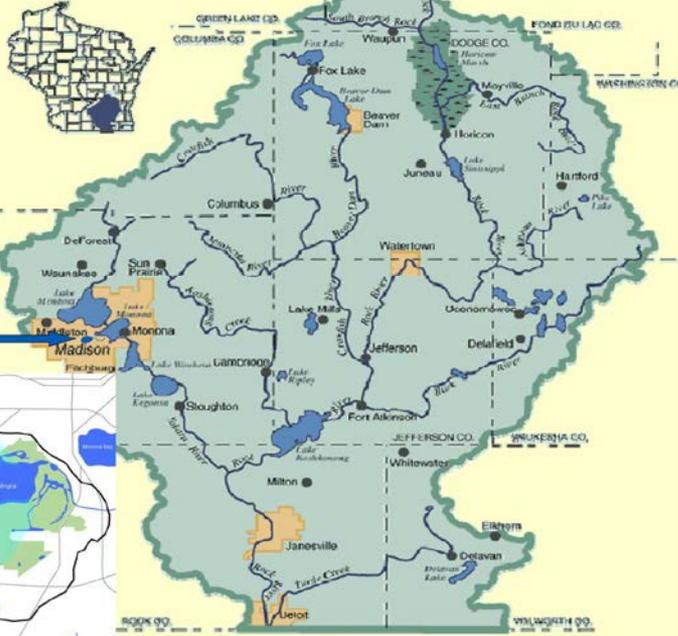


## 1. Lake Wingra Watershed Management Plan-Madison & FoLW

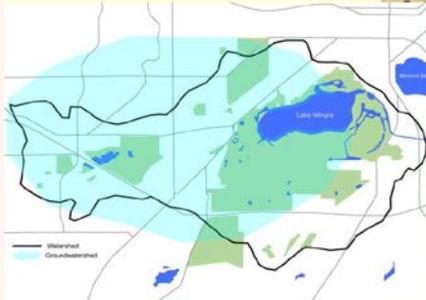
- Chlorides
- Infiltration
- Phosphorus
  - UW-Madison Wind/Waves, Carp, Runoff Study
  - March 2008 Carp Removal
- Leaf Collection Pilot Project

## 2. 2015 Stormwater Projects-Monona

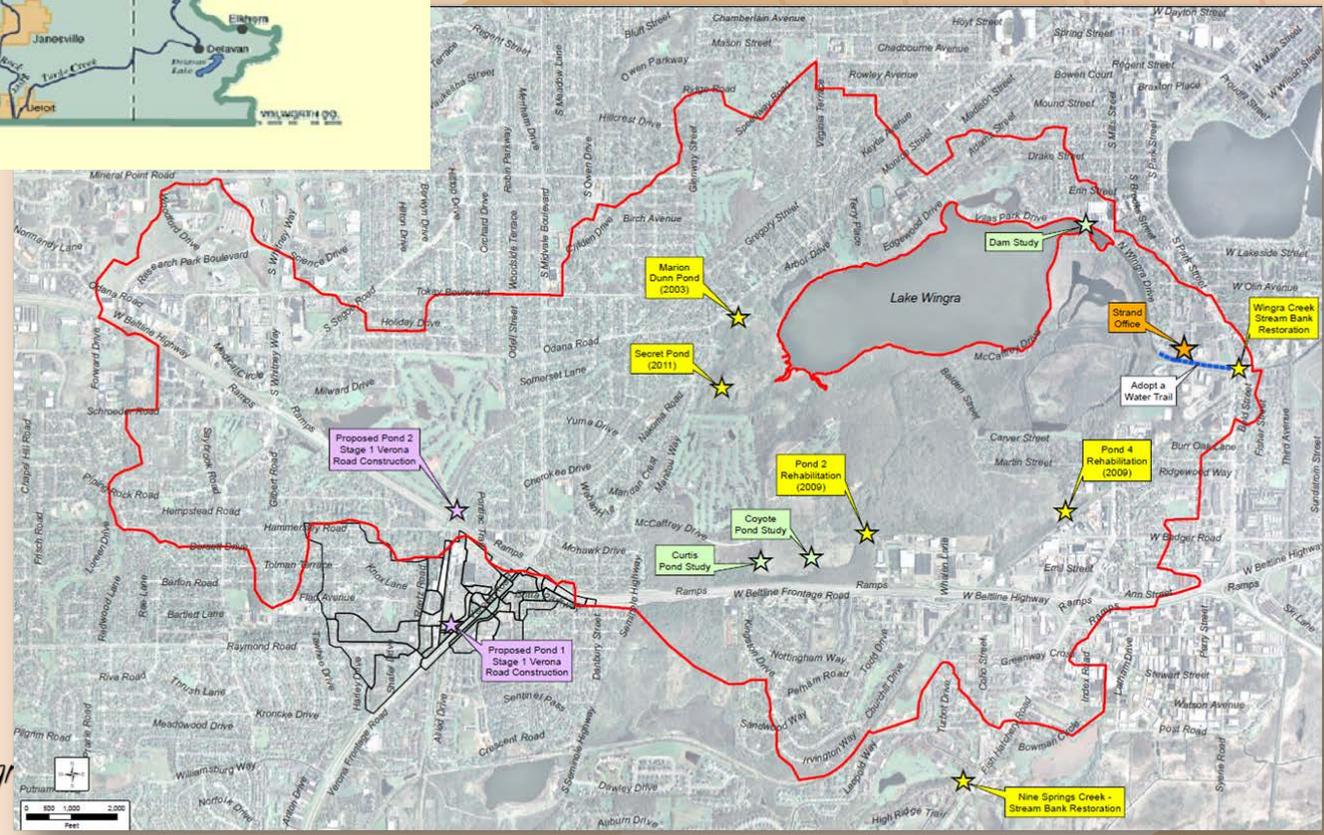
# WI - Rock River Watershed



## Lake Wingra Watershed

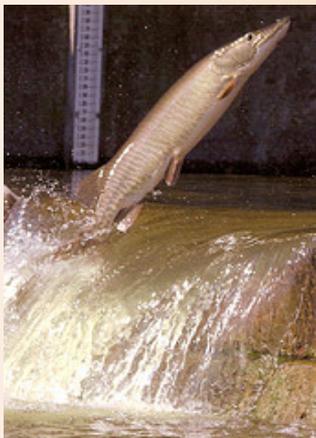


# Watershed



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# Watershed



# Watershed

**Lake Surface Area**

339 acres

**Maximum Depth**

13 feet

**Lake Volume**

102,926,070 cf (2,363 ac-ft)

**Average Water Clarity**

2.5 feet (Secchi Depth)

**Watershed Draining To Lake**

3,636 acres (5.68 sq. mi.)

**Common Fish Species**

Bluegill, Largemouth Bass,  
Muskellunge, Common Carp

**WDNR Designation**

**303(d) Listed Impaired Water for Phosphorus**





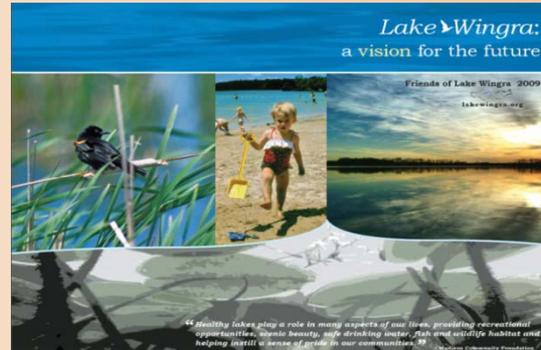
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**Friends of Lake Wingra Founded in 1998**



2003



2009



*Take a Stake In The Lakes*

1998

2002

2006

2010

2014



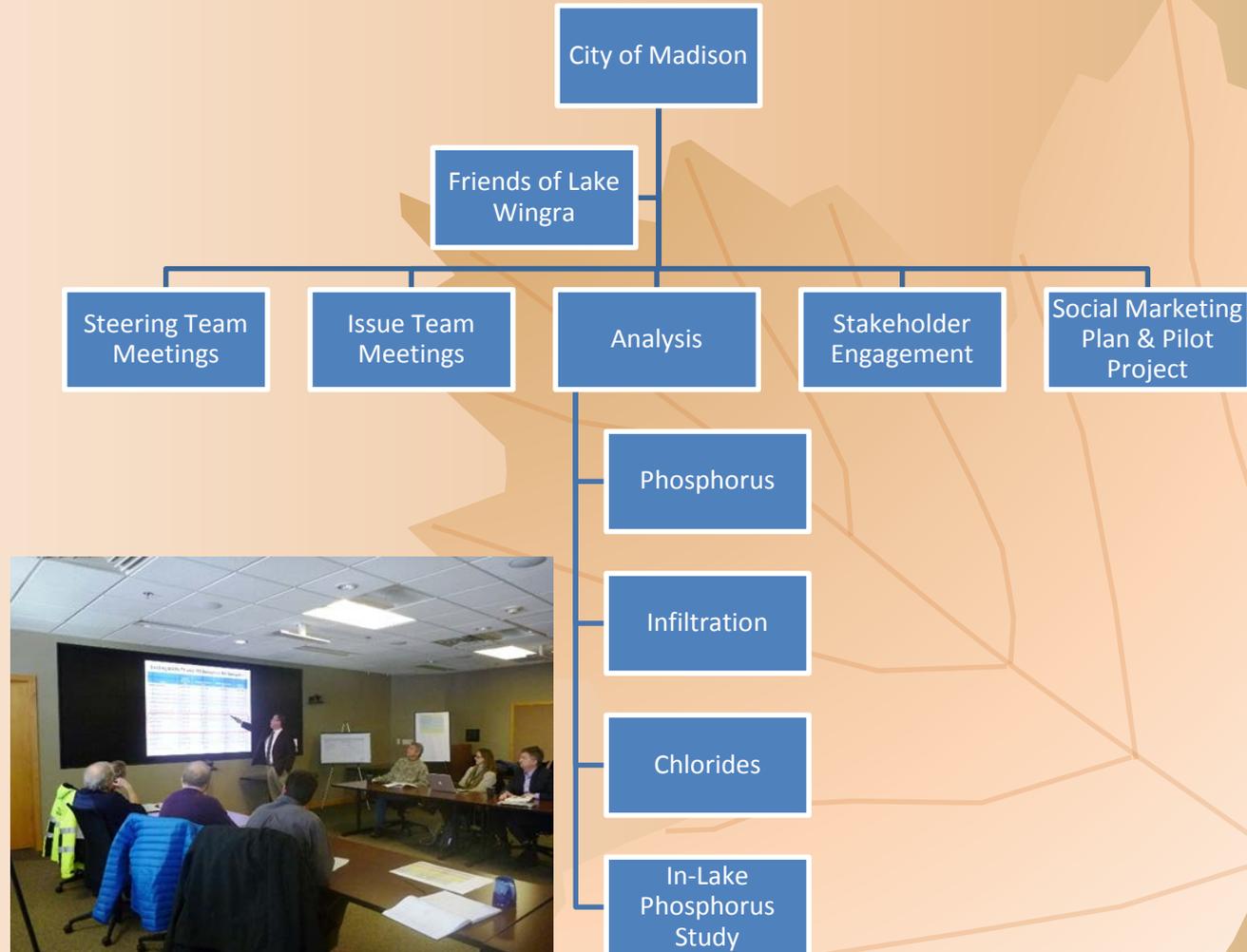
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# Lake Wingra Watershed Plan

## Steering Team Members:

- Greg Fries-Madison
- Genesis Steinhorst-Madison
- District 13 Alderperson
- Roger Bannerman-WDNR
- David Liebl-FOLW
- Jim Lorman-FOLW
- Paul Dearlove-FOLW
- Rebecca Power-FOLW
- Jim Baumann-FOLW
- Mark Wegener-UW-Madison Arboretum
- **Bret Shaw-UW-Madison (Social Marketing)**



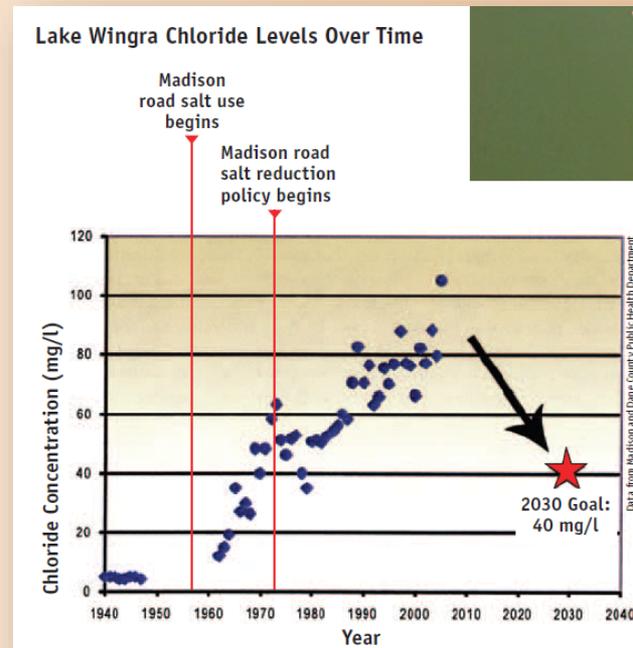
# Watershed Plan Goals

## Phosphorus Reduction

## Road Salt Reduction

## Increased Infiltration

	TP Percent Reduction (Compared to No Controls)	Additional TP Removal Needed
Existing Load		1,900 lbs
Existing Conditions Removal	38.5%	731 lbs
Short-Term Goal	50%	218 lbs
Long-Term Goal	80%	570 lbs
Rock River TMDL (Reach 64)	73%	N/A



	Recover % of Lost Infiltration	Additional Infiltration Needed (million gallons)
Lost Infiltration	NA	742
Existing Infiltration Facilities		28
Short-Term Goal	10%	46
Long-Term Goal	25%	112

Social Marketing Opportunities



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# Community-Based Social Marketing

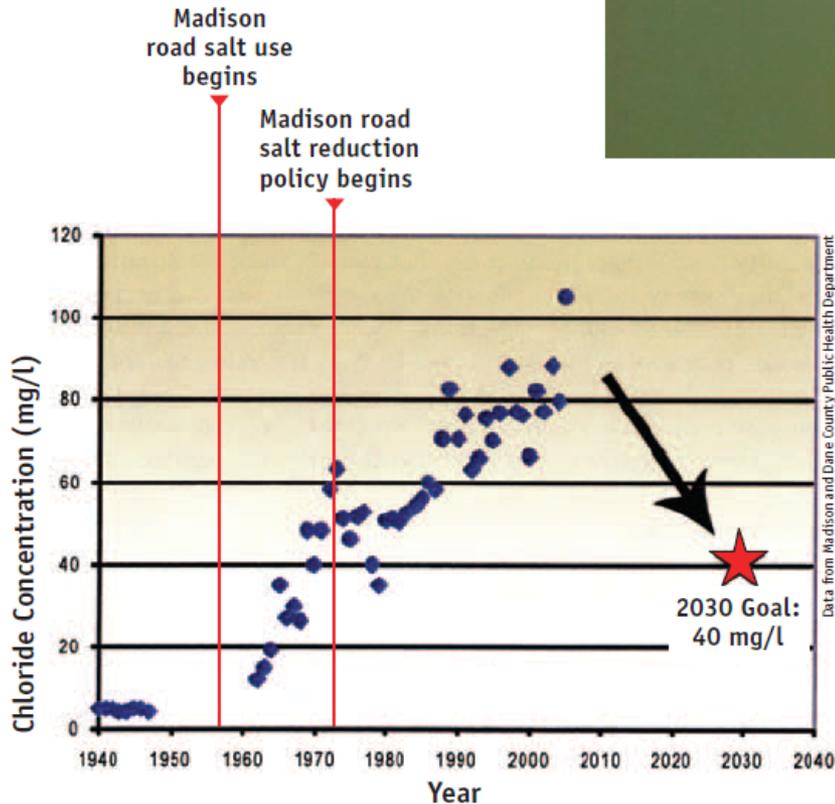
The use of marketing principles and techniques to influence a target audience to voluntarily accept, reject, modify, or abandon a behavior for the benefit of individuals, groups, or society as a whole.

Major components:

1. Identify perceived **barriers** and **benefits** of both current and preferred behavior
2. Use behavior change 'tools' to design more effective programs
  - *Norms, prompts, effective/localized messages, encourage commitment, incentives.*
3. Conduct pilot study to adjust the use of tools
4. Evaluate program and consider broad implementation.

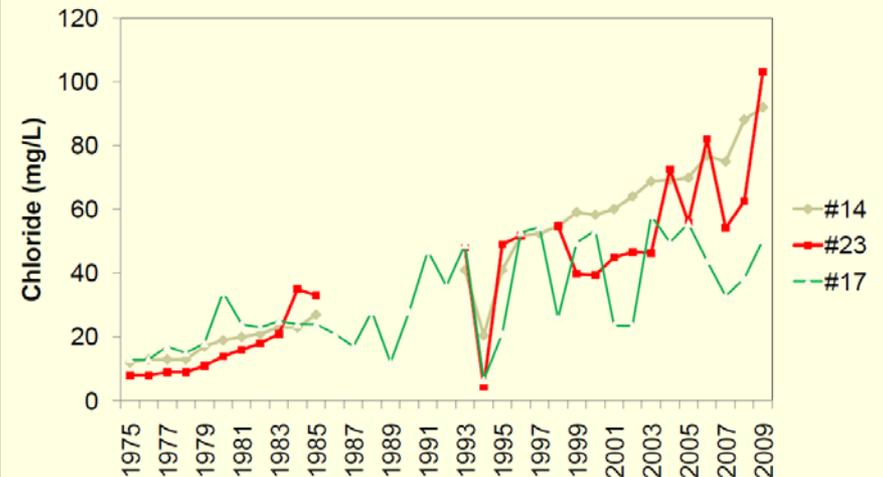
# Chlorides-Problem

Lake Wingra Chloride Levels Over Time



- EPA Chronic Toxicity Limit = 230 mg/L
- WI Chronic Toxicity Limit = 395 mg/L
- EPA Drinking Water Secondary Standard = 250 mg/l

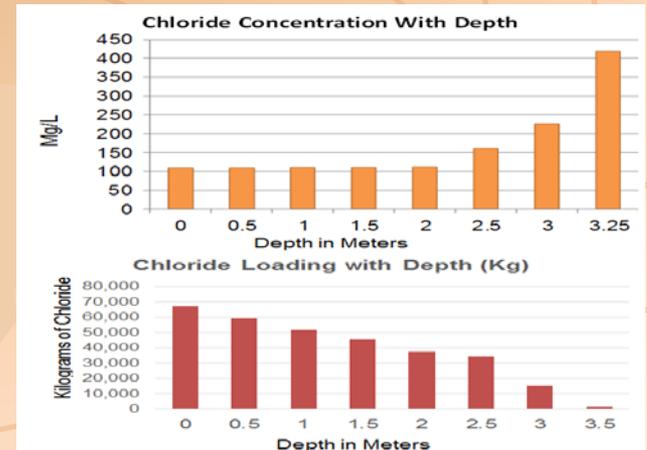
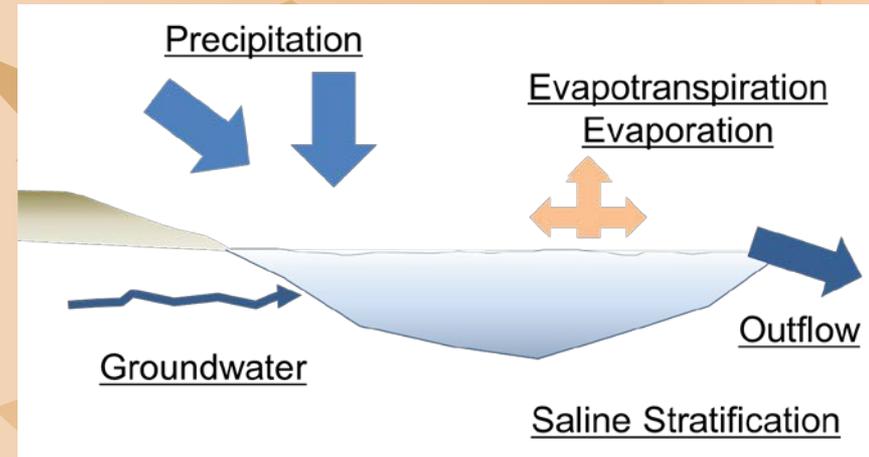
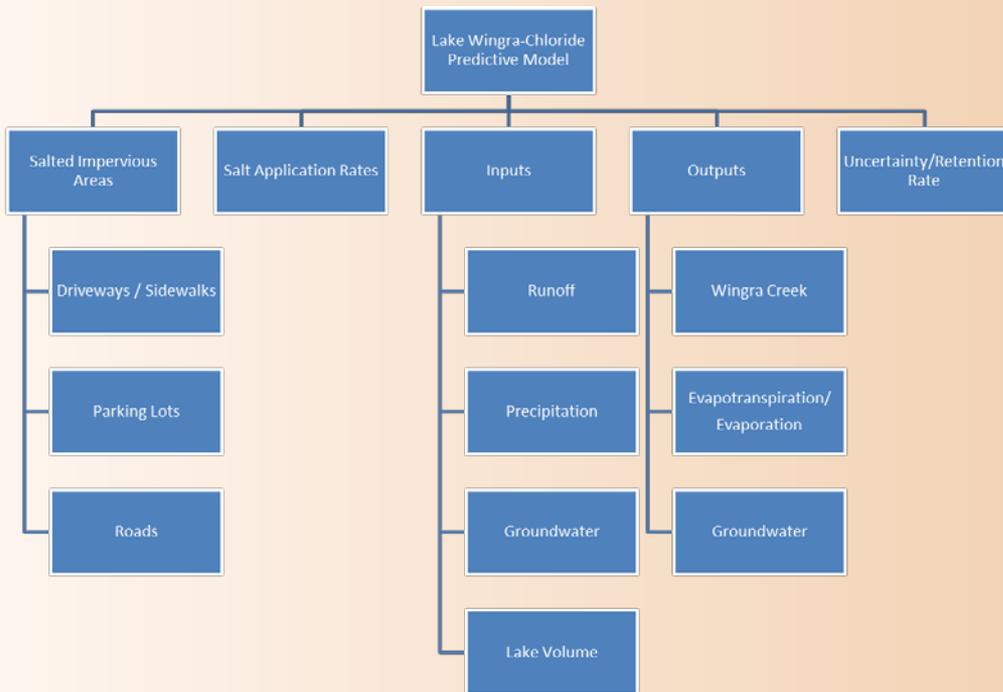
Chloride in Madison Drinking Water Supply Wells



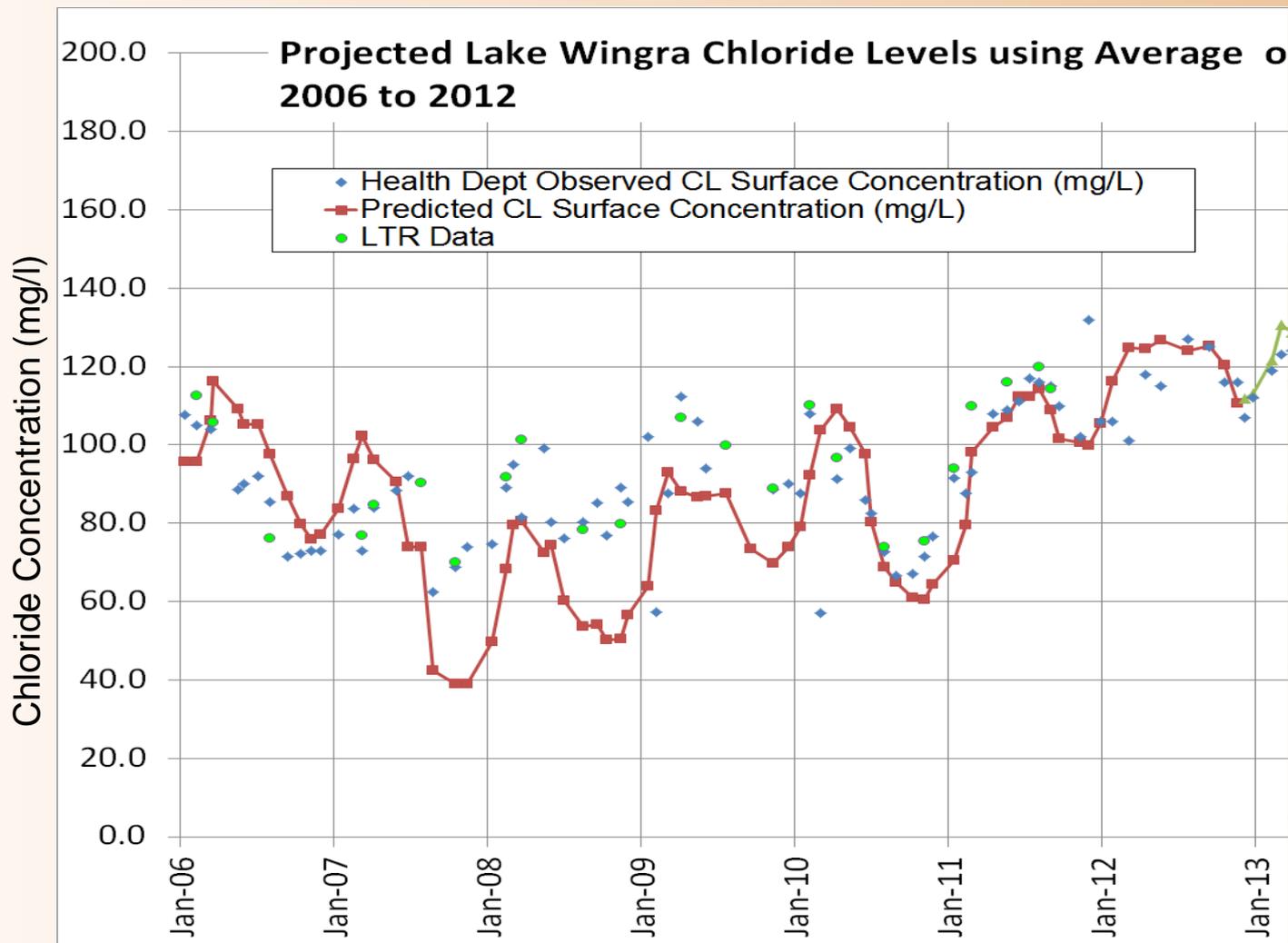
# Chlorides-Analysis

## Predictive Model

## Variables



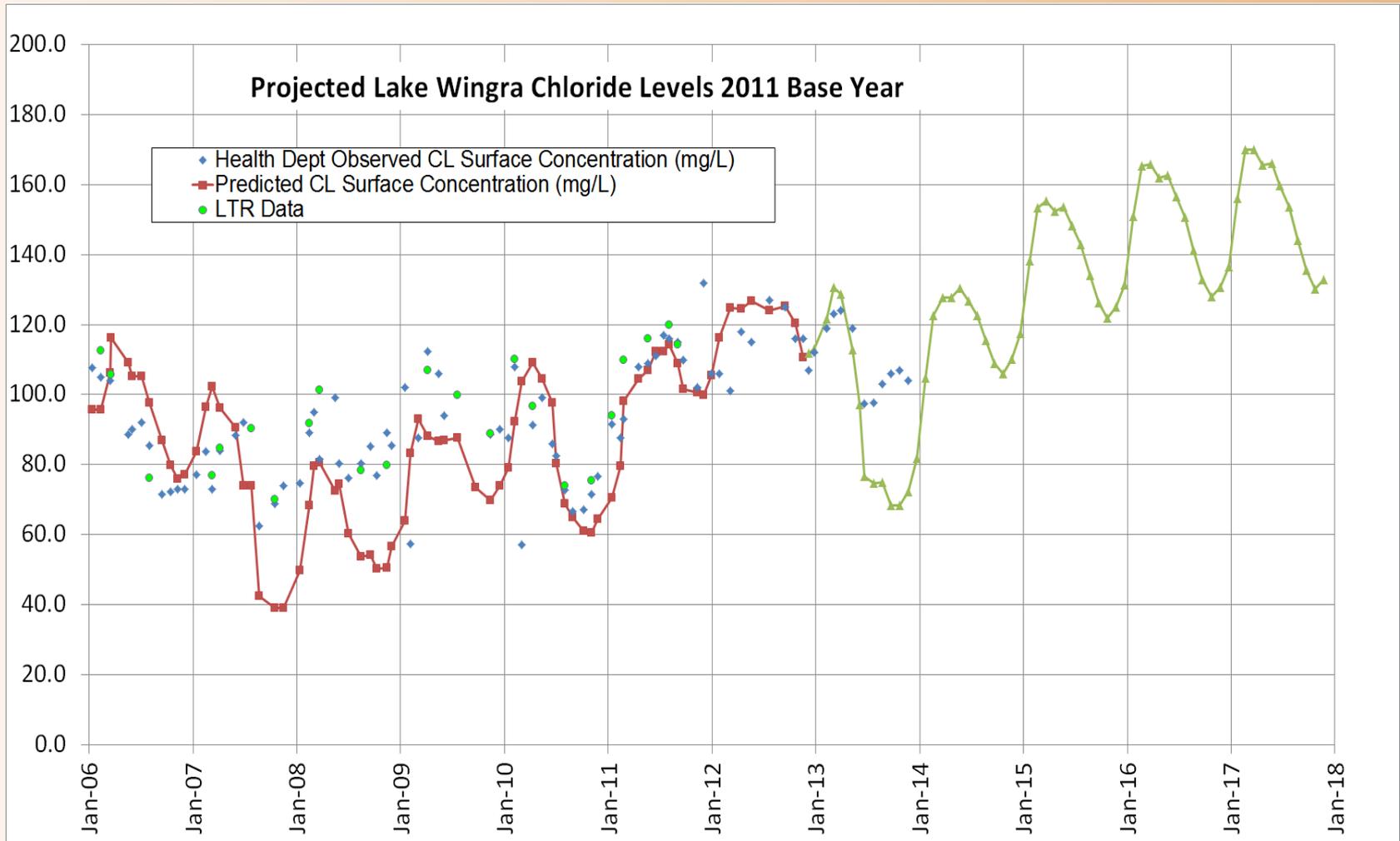
# Chlorides-Analysis



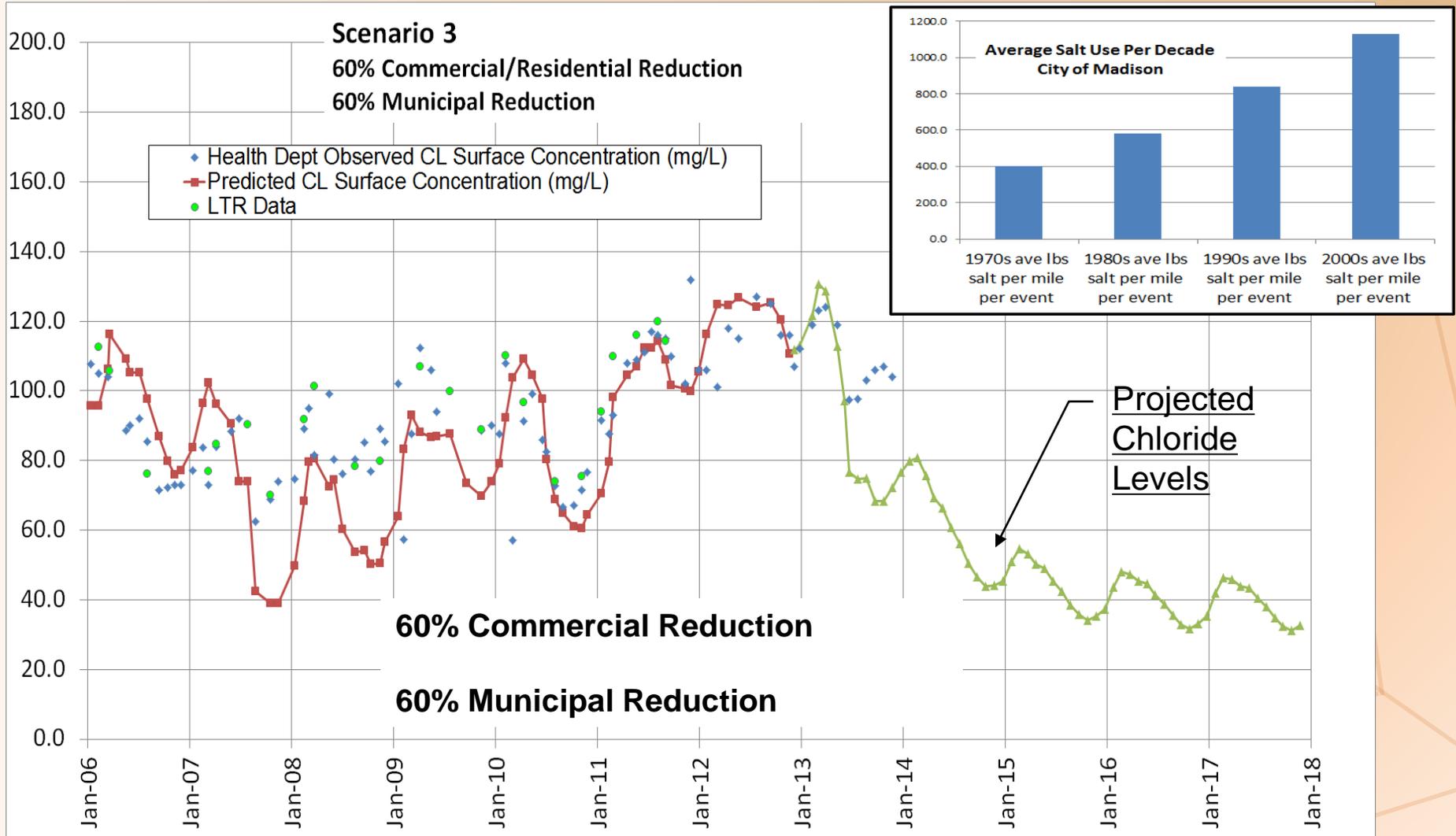
**Required Index Factors (Retention Rates=77%)**

- **4 Similar Studies Found Retention Factor of 55%, 59%, 65% and 77%**

# What happens in Future?



# Chlorides-Solutions



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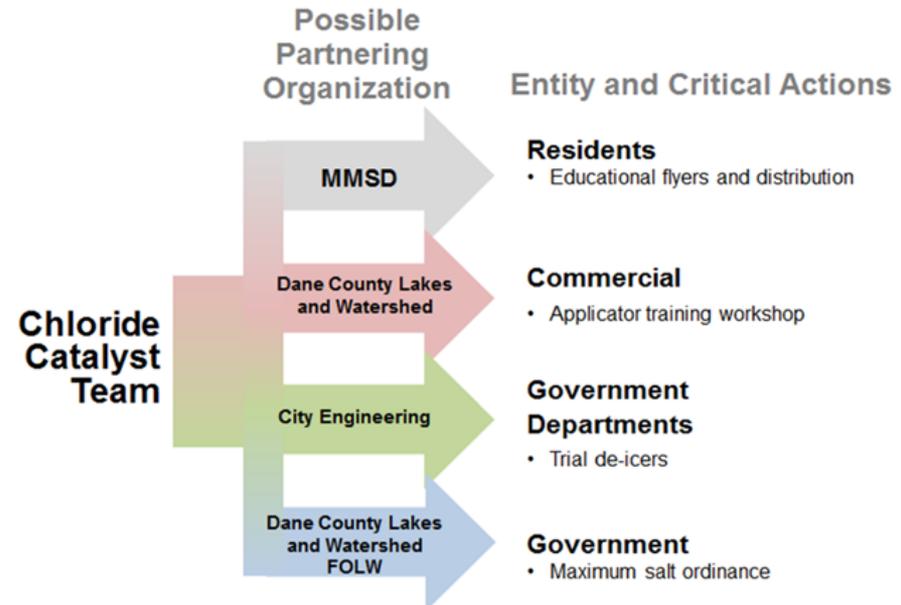


# Chlorides-Measures Being Investigated

## Social Marketing

### Management Measure

1. Implement a Cert Program for Commercial Applicators
2. Provide Sample Contracts for Winter Pavement Maintenance on Web site and with Certification
3. Require Certification for Government Snow Removal Contractors
4. Establish Maximum Salt Guidelines - This measure provides some coverage for litigation for commercial applicators.
5. Establish Maximum Salt Application Rates by Ordinance
6. Expand the Practice of Anti-icing
7. Reduce the Number of Applications per Snow Event
8. Reduce the Salt Route Mileage
9. Investigate Alternate Deicers



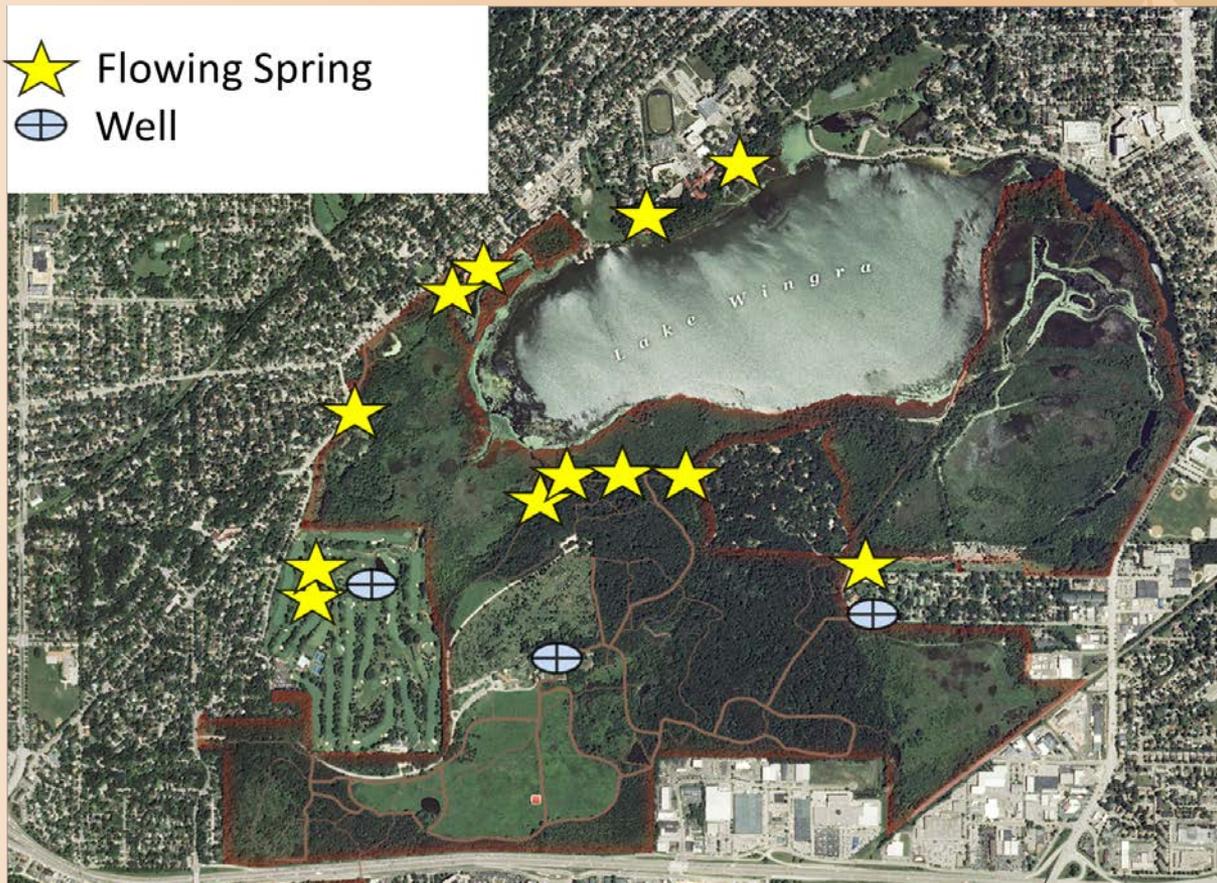

Be **Salt Wise!**

Once you put salt down, it doesn't go away. It washes off surfaces and accumulates in local lakes, streams and drinking water. You can keep sidewalks and driveways safe this winter while protecting our waters by following these simple steps.

- 1. Shovel**  
Clear walkways and other areas before the snow turns to ice. The more snow you remove manually, the less salt you will have to use and the more effective it will be.
- 2. Scatter**  
If you apply salt to pavement, aim for a pattern like this, leaving space between salt grains. A coffee mug full of salt is enough for about 60-70 feet of sidewalk. A hand spreader can help create this pattern.
- 3. Switch**  
When the pavement temperature is below 15 degrees, salt won't work. Switch to a different de-icer (like a blend) that works at a lower temperature, or use sand for traction.

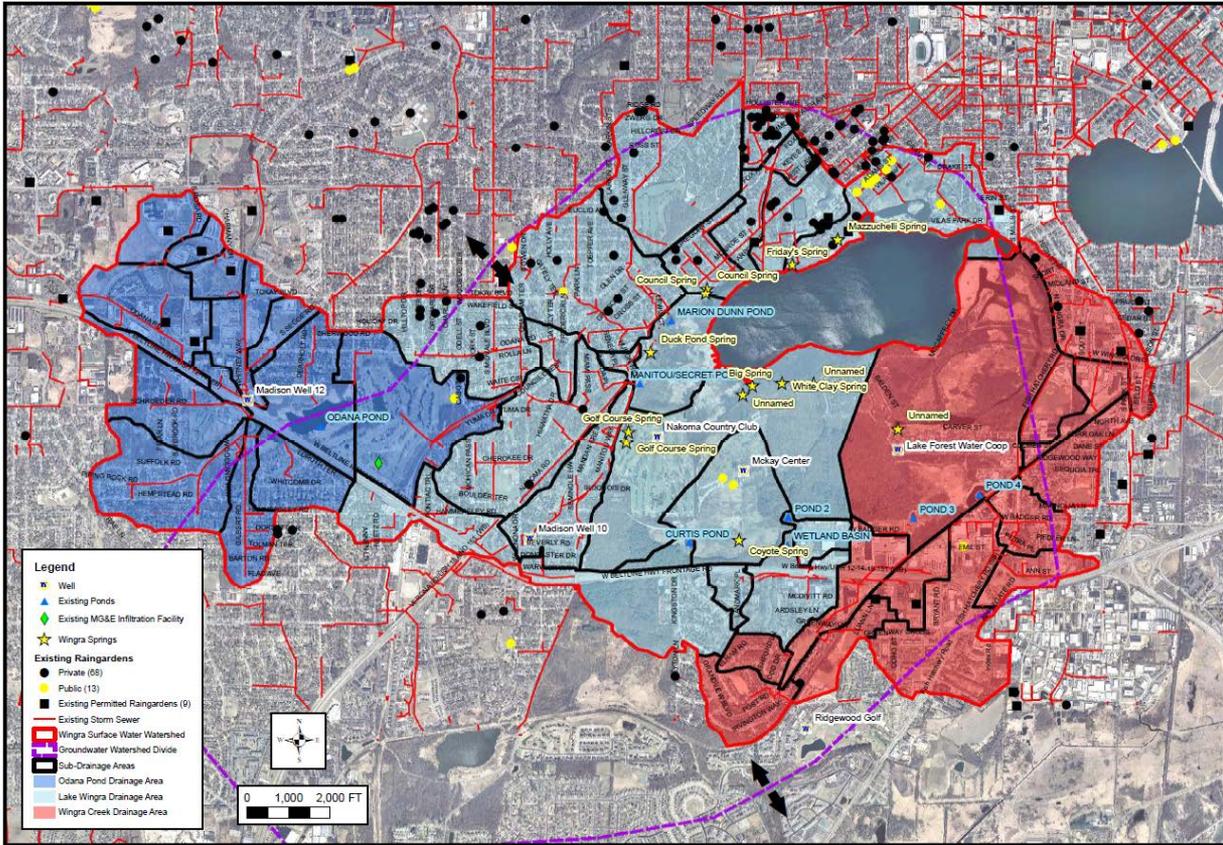
# Infiltration-Problem

- At one time there were 33 springs flowing into Lake Wingra.
- Today, this number has been reduced to 13 springs (shown on the adjacent map)

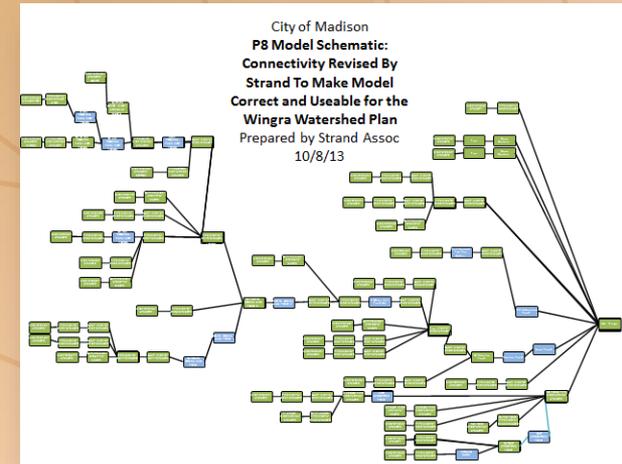


# Infiltration-Analysis

## Inventory Existing BMPs & Programs



*Updated P8  
 Stormwater  
 Quality Model*





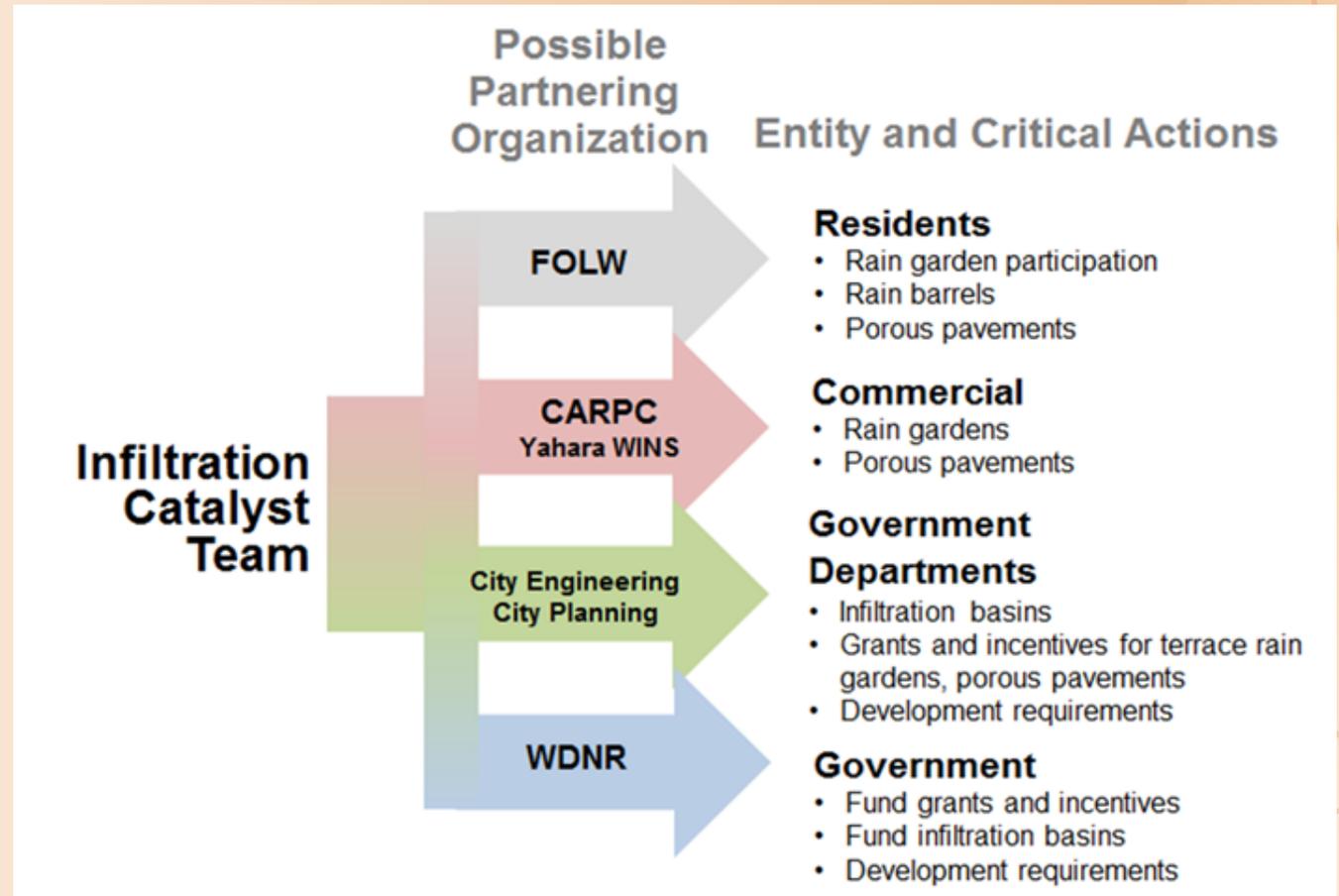
# What needs to be done and how much will it cost to meet Short-Term Infiltration Goal (46 million gallons)?

Facility	Infiltration Performance		Phosphorus Performance		Construction Cost
	Infiltration Performance (gallons)	% of Total Infiltration Volume	TP Reduction Performance (lbs)	% of Total Phosphorus Reduction	
<u>Structural Improvements</u>					
Westmorland Park Bioretention Basin	3,225,929	6.9%	15.5	11.5%	\$ 249,300
Downspout Disconnection Program (35% Watershed Participation)	7,113,174	15.2%	7.8	5.8%	\$ 466,900
Rain Barrel Program (25% Watershed Participation)	2,540,422	5.4%	2.1	1.6%	\$ 151,600
1,000 Private Residential Rain Gardens (Serving Roofs Only)	8,146,286	17.4%	8.9	6.6%	\$ 1,047,600
Devolis Park (Axel Avenue) Bioretention	1,857,353	4.0%	5.9-Drains Downstream	4.4%	\$ 331,200
Arbor Hills Greenway Infiltration (@1.63 in/hr)	4,007,973	8.6%	7.6-Drains Downstream	5.6%	\$ 883,500
Glenway Wet Pond & Infiltration	5,832,741	12.5%	43.2	32.0%	\$ 1,819,400
Grandview Boulevard Bioswale	2,509,056	5.4%	7.2	5.3%	\$ 612,100
60 Private Commercial Rain Gardens (Serving Roofs Only)	977,554	2.1%	1.1	0.8%	\$ 290,200
4 Acres Porous Pavement (Serving 12 acres)	6,647,370	14.2%	19.6	14.5%	\$ 2,471,413
Monroe Street Green Street	1,694,428	3.6%	8.2	6.1%	\$ 532,100
1,000 Terrace Rain Gardens	<u>2,280,960</u>	<u>4.9%</u>	<u>8.0</u>	<u>5.9%</u>	<u>\$ 1,370,500</u>
TOTAL	<b>46,833,247</b>	100%	<b>121.6</b>	100%	<b>\$ 10,225,813</b>

**Need 218, addtl 96 lb**

# Infiltration-Solutions

## Social Marketing



# Phosphorus-Problem



# Phosphorus-Sources



**Carp**



**Leaves in the Street**



**Pet and Waterfowl Waste**



**Streambank Erosion  
Construction Site Erosion**

# Existing Phosphorus Controls in Watershed



## Fertilizer Phosphorus Bans

- Dane County: Jan. 1, 2005
- State of WI: April 1, 2010



## UW-Madison Arboretum Stormwater Treatment Measures

- 2003, 2009, 2011, 2012, 2014
- UW-Madison, City of Madison, Town of Madison, City of Fitchburg, WisDOT



## Erosion Control and Stormwater Ordinances

- City of Madison: Chapter 37
- Dane County: Chapter 14
- Requires controls on public and private developments
- Redevelopment needs to meet 80% TSS Reduction



## City of Madison Initiatives

- Leaf Collection, Street Sweeping
- Alum Treatment Pilot Project
- 1,000 Rain Gardens Initiative
- Terrace Rain Gardens





# Phosphorus Performance of Proposed Phosphorus Reduction Facilities

Facility	TP Reduction Performance (lb)	Construction Cost
<b>Structural Improvements</b>		
Alum Addition At Manitou Pond	139.4	\$ 287,300
Alum Addition At Marion Dunn Pond	64.7	\$ 279,500
Diversion of Basin W102-D-0193-H-MAD-C to Manitou Pond (Alternative 1 and 3)	10.3	\$ 232,900
Streambank Restoration at Henry David Thoreau School	13.9	\$ 296,200
Streambank Restoration on Cherokee Drive (Yuma Drive to Chippewa Drive)	13.3	\$ 369,000
Wingra Park Wet Pond (60% TSS Reduction)	20.6	\$ 1,771,100
Subtotal	262.3	
<b>Nonstructural Improvements</b>		
		Annual Cost
Wetland Harvesting (4.6 acres)	41.4	\$ 43,000
Modified Leaf Collection Methods (\$47,000 Year 1 Capital Cost + \$10,000 Annual Operation Cost, thereafter)	84.6	\$ 57,000
Waterfowl Management (50 Geese Per Year)	8.5	\$ 2,500
Construction Site (12.3 Acres) Erosion Control Enforcement (Enhanced)	138.7	\$ 55,000
Modified Street Sweeping Methods/Schedule	39.0	\$ 47,504
Pet Waste Enforcement	27.3	\$ 45,000
Subtotal	339.5	
<b>TOTAL</b>	<b>601.8</b>	



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Facility	TP Reduction Performance (lb)	OPCC
Alternative 1	217	\$ 10,515,713
Alternative 2	261	\$ 10,513,113
Alternative 3	211	\$ 11,034,413
Alternative 4	260	\$ 10,280,813

Alternative Costs include \$10.2 million for cost of infiltration facilities that get 122 lbs of TP reduction.

# Phosphorus: Phosphorus Reduction Alternatives



<u>Goal</u>	<u># Projects</u>	<u>Approx. Cost</u>
Short-Term Infiltration Goal	12	\$10.2 million
Short-Term TP Reduction Goal	1-3	<u>\$55,000 to \$0.8 million</u>
	TOTAL	\$10.3 to \$11 million



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# In-Lake Phosphorus Study

Spring  
Summer  
Fall  
**Annual**

## Total Phosphorus



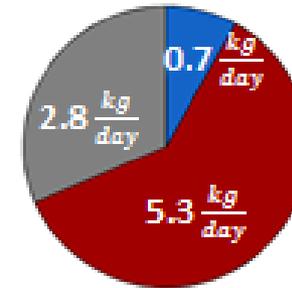
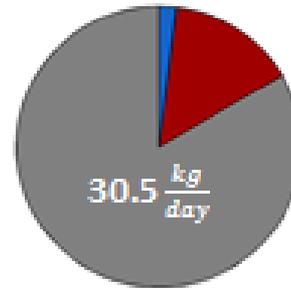
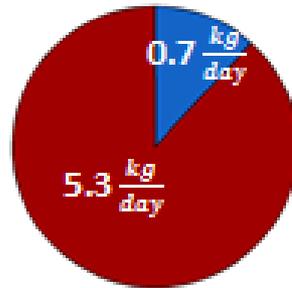
Sunny Day



Rainy Day

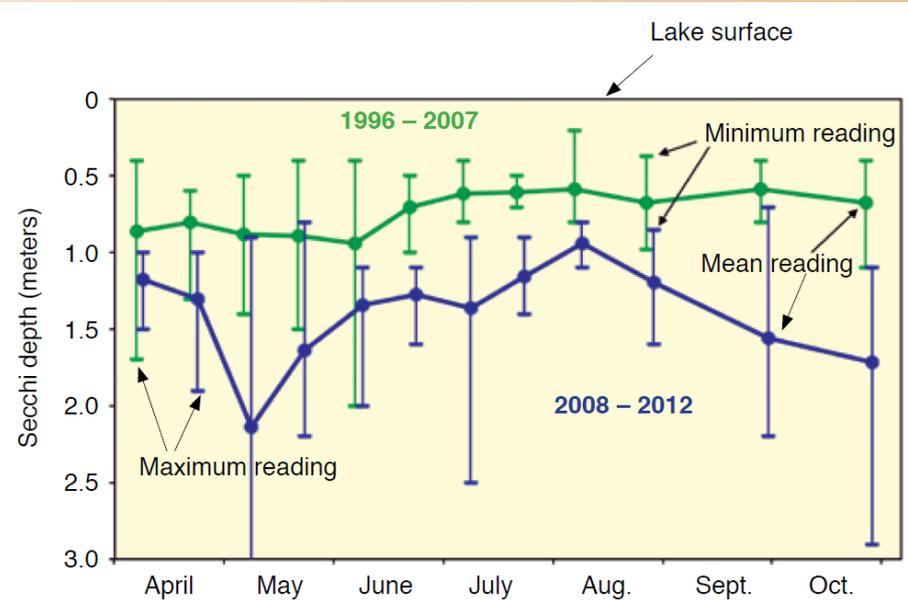


Average



	Clear Day	Rain day	Average
<b>Carp</b>	90% ± 7%	15% ± 8%	60% ± 20%
<b>Wind</b>	10% ± 7%	2% ± 2%	10% ± 6%
<b>Runoff</b>	0% -	83% ± 10%	30% ± 14%

# March 2008 Carp Removal-Lake Wingra



0.056 mg/l TP

0.033 mg/l TP

Figure 8. Secchi disc graph showing seasonal mean, maximum and minimum readings for 12 years (1996-2007) prior to the March 2008 carp removal (green line) and seasonal Secchi readings for 5 years (2008-2012) following carp removal (blue line). (Data source: UW Center for Limnology).

- 6,308 carp removed (48%)
- Data courtesy of David Liebl

# 2014-2015 Pilot Project: Leaf Management



# City Leaf Collection

Each year the City collects approximately 4,700 cubic yards of leaves from curbside in the Wingra watershed. This is equal to 32 inches of leaves over the surface of the football field at Camp Randall



# How Do Leaves Contribute To Phosphorus Levels?

- Leaves on street or near the street leach phosphorus during rain – it is carried directly to Lake Wingra.
- Leaves left out for long periods in pile, create leaf litter, blow, and find their way to the street and storm sewers where they travel to Lake Wingra.
- Substantial phosphorus reductions can occur by being careful on how leaves are managed.



Leaves in street create opportunity for phosphorus runoff



Leaf leaches phosphorus into water

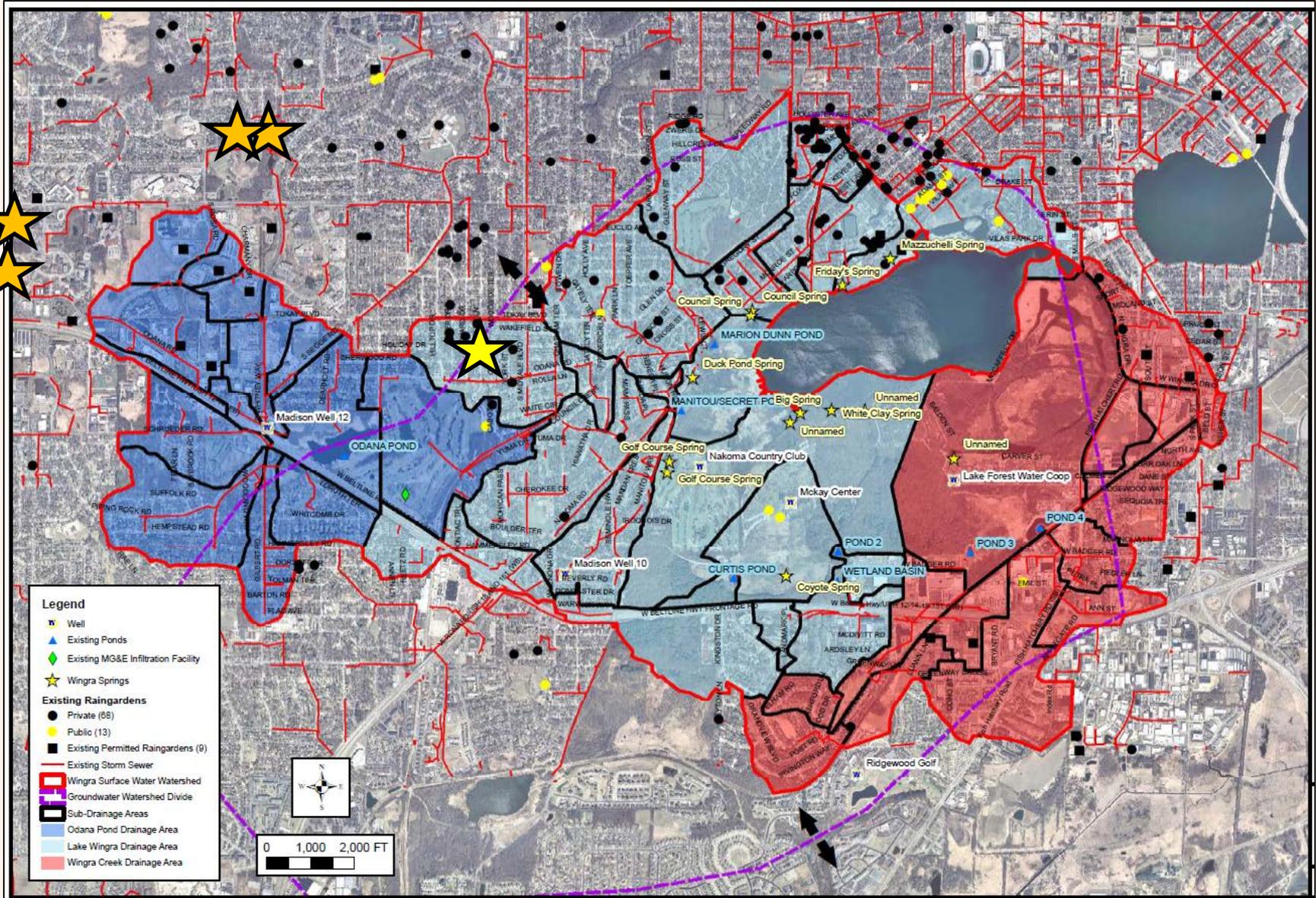
- Seasonal effect on phosphorus
- Better idea of significance of fall contribution to annual load
- Speciation of phosphorus is different in spring (particulate) and fall (dissolved)
- **Leaves as gross solids are not a large part of phosphorus reaching lakes**
- **Timing of leaf collection could be critical to phosphorus reduction**
- Information courtesy of Bill Selbig, USGS, (Fall 2014)



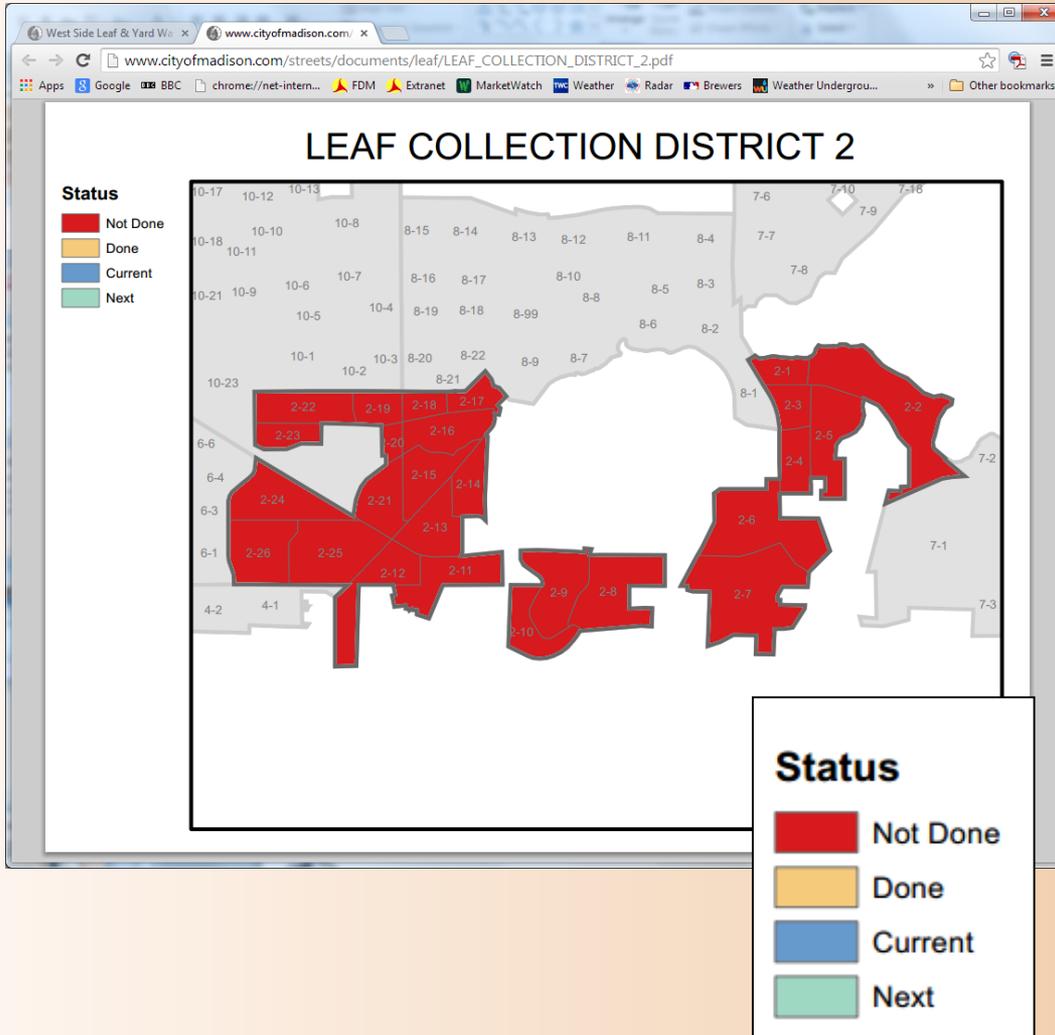
### Type of Leaf Management Program to be Tested

	2013	2014	2015	2016	2017	2018
Control	No Collection	No Collection	No Collection	TBD	TBD	Report
Test	No Collection	Existing	Escalated	TBD	TBD	Report

# USGS Leaf Study Location



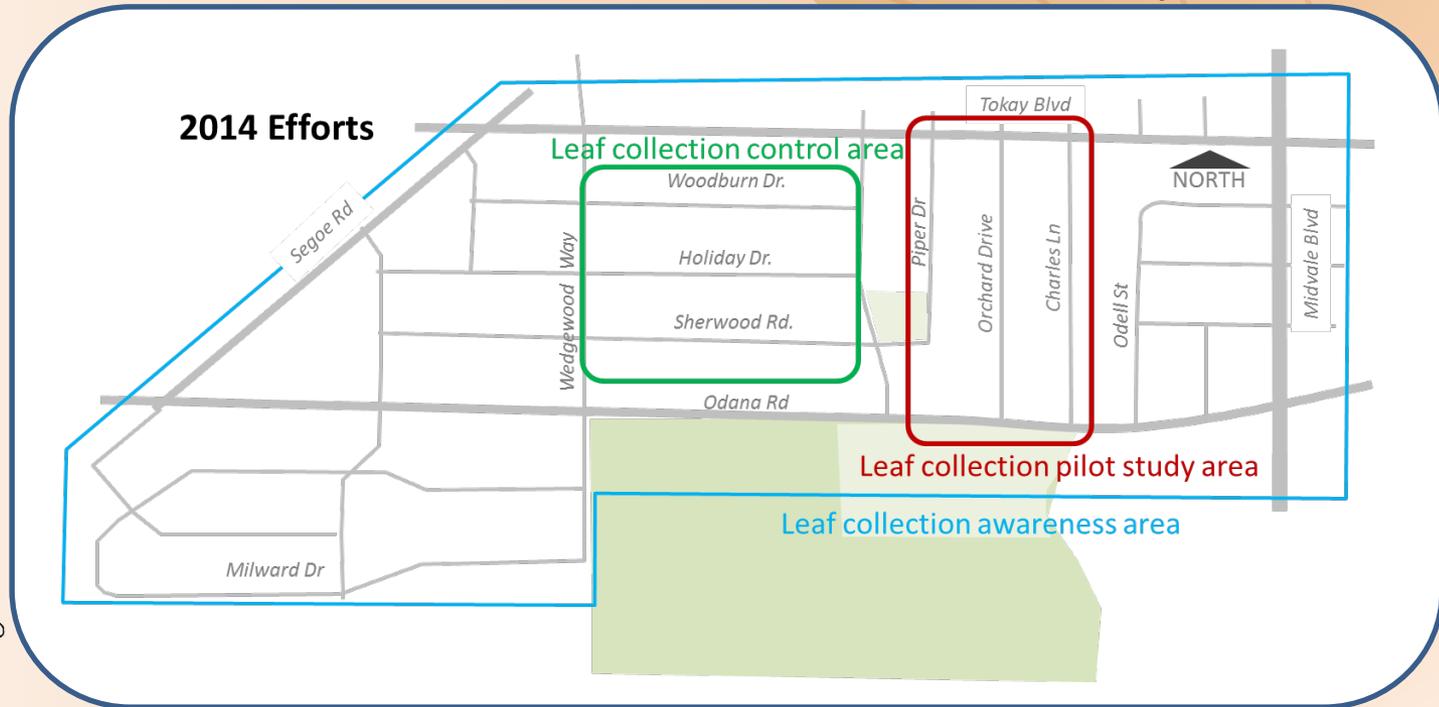
# Current City Leaf Collection Protocol



- Leaves on Terrace
- Push Leaves to Street
- Loader loads leaves into garbage trucks
- Street Sweeping

# 2014 Pilot Project

- The Pilot Project had community members lead the way in environmental stewardship through better leaf management.
- Three areas:
  - Leaf collection awareness area sought to improve leaf management
  - Leaf collection pilot study area (84 homes) received extra focus and monitoring for data collection purposes
  - Leaf collection control area served as an area of comparison





# Pilot Project: Fall 2014 photos day of notification of leaf pick up on Charles Lane



# Pilot Project: Fall 2014 photos 1-2 days prior to leaf pick up on Charles Lane



Lake W...  
...

# Pilot Project: General Observations

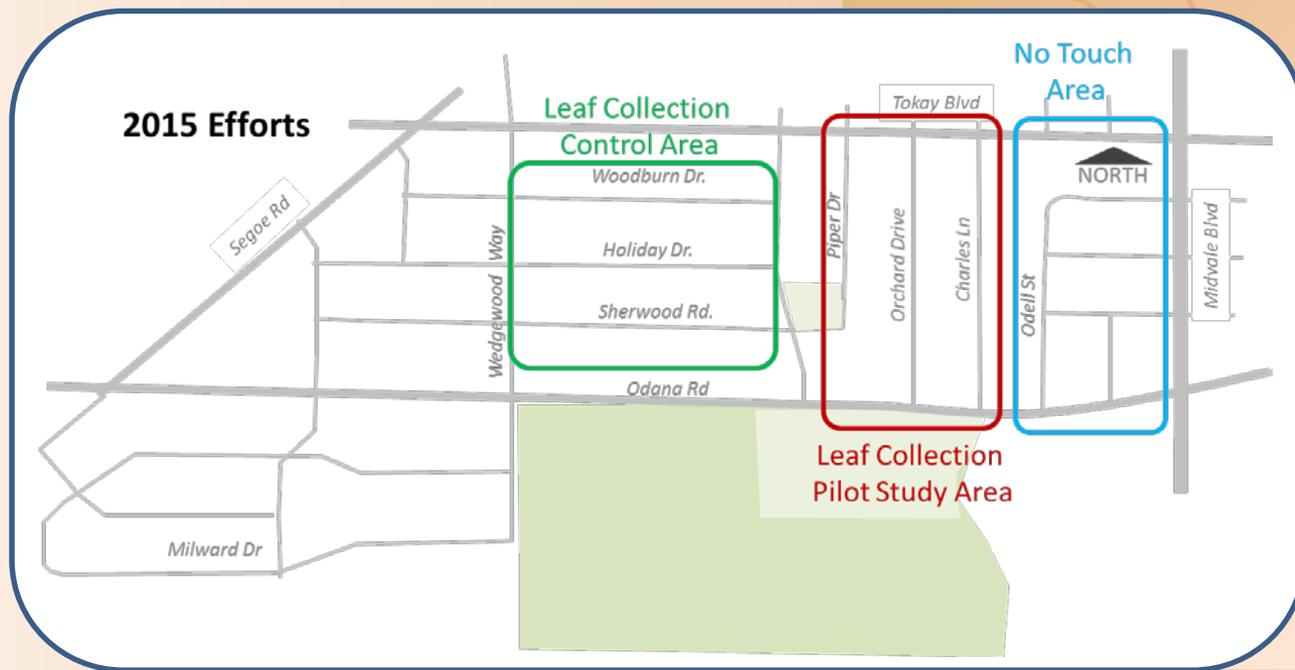
Leaf Pickup Occurrence	Leaves On Terrace	Leaves Out of The Street	Control Area
1	No Data	No Data	More leaves in street
2	46 of 84 (55%)	30 of 46 Piles (65%)	More leaves in street
3	47 of 84 (56%)	29 of 47 Piles (63%)	More leaves in street
4	No Leaves (Snow)	-	More leaves in street

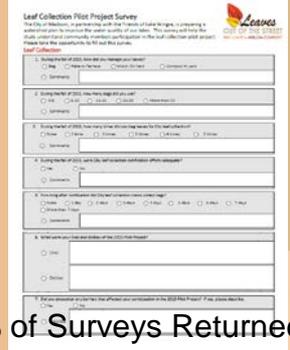


# 2015 Pilot Project

- The Pilot Project will have community members lead the way in environmental stewardship through bagging of leaves.

Leaf Collection Area	Canvassing	Free Bags	Enhanced Notification	Monitoring
Pilot Study	Yes	Yes	Yes (Signs/Emails/New Website)	Yes
Control	Yes	No	No (New website only)	Yes
No Touch	No	No	No (New website only)	Yes





Leaf Collection Pilot Project Survey

1. Are you able to help make Lake Wingra cleaner by practicing good leaf management practices?

2. Please sign me up for email notification of when leaf pickups are going to occur.

3. How many bags of leaves do you have?

4. How many bags of leaves do you have left?

5. How many bags of leaves do you have left?

6. How many bags of leaves do you have left?

7. How many bags of leaves do you have left?

8. How many bags of leaves do you have left?

9. How many bags of leaves do you have left?

10. How many bags of leaves do you have left?

61% of Surveys Returned



**We are NEXT for Leaf Pick-up!**

Bag your leaves soon for City pick-up.

Help keep Lake Wingra clean!




YES! I'd like to help make Lake Wingra cleaner by practicing good leaf management practices.

YES! Please sign me up for email notification of when leaf pickups are going to occur. (Your email will not be shared with other organizations or used for other purposes.)

Email \_\_\_\_\_



- Pilot Project Area
  - 20 Bags Delivered By City to Each Property
  - Additional Bags Available from Roger Bannermann
- Control Area
  - Bags available for purchase at retail stores (ie: Home Depot)
- No Touch Area
  - Rake leaves to terrace, mulch, or compost as currently do.



# 2015 Results-Pilot Study Area

Street Name	Total Number of Homes on Each Block	Number of Homes Bagging Their Leaves	Percent of Homes Participating
Piper Dr.	23	16	70
Orchard Dr.	32	19	59
Charles Ln.	29	18	62
<b>Totals</b>	<b>84</b>	<b>53</b>	<b>63</b>

**Control-16%**



Total Bags Used	Median Number of Bags Used Per Home	Average Number of Bags Used Per Home	Range in Number of Bags Used Per Home
829	6 to 9	12 to 16	1 to 82

**Control-56**



Date	Oct 17	Oct 26	Nov 4	Nov 10	Nov 16	Dec 7
Number of Bags Collected	0	63	307	127	316	16

# 2015 Results



# 2015 Results

## Pilot Study Area-Bagging

Rain Date	Survey Data	Leachable P by Curb Types			Total Leachable P	
		Type 1	Type 2	Type 3	Grams	Pounds
Oct 23	Oct 26	14	14	8	36	0.08
Oct 24	Oct 26	14	14	8	36	0.08
Oct 27	Oct 26	14	14	8	36	0.08
Oct 31	Oct 26	14	14	8	36	0.08
Nov 5	Nov 4	12	2	0	14	0.03
Nov 11	Nov 10	11	2	0	13	0.03
Nov 17	Nov 16	5	5	4	14	0.03
Nov 23	Dec 7	0.4	0	0	0.4	0
<b>Totals</b>		84	65	36	185	<b>0.41</b>

## Control Area

### Estimate of Phosphorus Leached from Leaves in the Control Area During the Fall of 2015

Rain Date	Survey Data	Leachable P by Curb Types, grams			Total Leachable P	
		Type 1	Type 2	Type 3	Grams	Pounds
Oct 23	Oct 23	18	22	6	46	0.1
Oct 24	Oct 23	18	22	6	46	0.1
Oct 27	Oct 23	18	22	6	46	0.1
Oct 31	Oct 30	8	34	53	95	0.2
Nov 5	Nov 6	20	13	12	45	0.1
Nov 11	Nov 6	20	13	12	45	0.1
Nov 17	Nov 13	12	15	8	35	0.08
Nov 23	Nov 20	6	1	0	7	0.02
<b>Totals</b>		120	142	103	365	<b>0.80</b>

# 2015 Pilot Project-Conclusions

- Significant number of residents willing to bag leaves with intensive social marketing effort and free bags.
- Lower participation levels expected with minimal social marketing and homeowner bag purchase.
- Homeowners can play an important role in reducing leaves in the street.
- Efforts should continue to seek improved homeowner participation and most beneficial pickup methods by City.
- MS4 Credit in The Future?
- Incorporate Into WinSLAMM?

# 2015 Stormwater Projects City of Monona



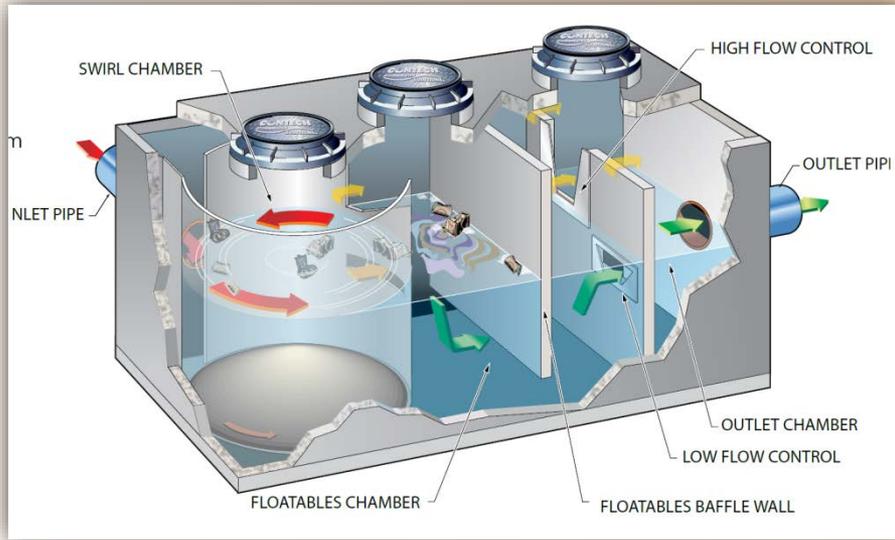
# Agenda

- Project Summary
- Nichols Road Project Site
- Winnequah Road Project Site
- Graham Park Project Site
- Pirate Island Project Site
- Stormwater Quality
- Costs/Grants



- Pipe Upsizing
  - Nichols & Winnequah
- Dredging
  - Nichols, Winnequah, & Graham
- Stormwater Pretreatment Devices (In-Line)
  - Winnequah-2, Graham, Pirate Island

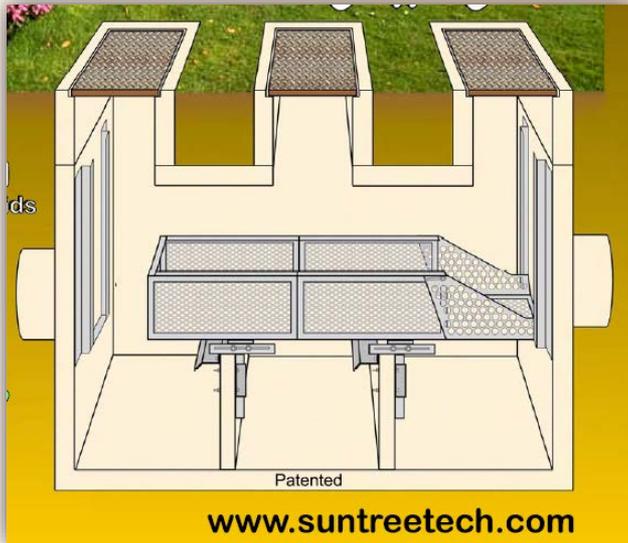
# Stormwater Pretreatment Devices: Vortech



Recommended at:

- Winnequah Road (West and East)
- Possibly Pirate Island

# Stormwater Pretreatment Devices: Suntree Nutrient Separating Baffle Box



Recommended at:

- Graham
- Pirate Island

## Nutrient Separating Baffle Box

### Functional Description

#### During The Storm Event

Captures foliage, litter, sediment, phosphates, hydrocarbons... **Everything!**

Turbulence deflectors prevent captured sediment from re-suspending.

Hydrocarbons collect in front of skimmer and are absorbed by Storm Boom.

Bottom of concrete structure is only 4' below the pipe.

Patented

#### After The Storm Event

Nutrient pollutant load is not lost to static water and flushed out at the next storm event.

Separating organic matter from the static water prevents bacterial buildup.

**No Chance For A Bacterial Discharge!**

During servicing, the screen system hinges off to the side to give easy access to the sediment collected in the lower chambers.

- Pipe Upsizing: 36" RCP to 38" x 60" HERCP w/12" overflow
- Dredging (Upstream and Downstream): 46 CY



# Winnequah Road Site

- Pipe Upsizing: 29" x 45" HERCP to 2' H x 6' W RCP Box w/12" overflow
  - Avoid Existing Sanitary Sewer
- Dredging (Upstream and Minor Downstream): 54 CY
- 2 Pretreatment Devices: Vortechs



# Winnequah Road Site



**Vortechs 4000**  
**(7' x 13', 6.8 acres)**



# Winnequah Road Site

**Vortechs 5000**  
**(8' x 14', 9.9 acres)**



- Pretreatment Device: Suntree NSBB
- Dredging (8 CY)
- Outfall Repair



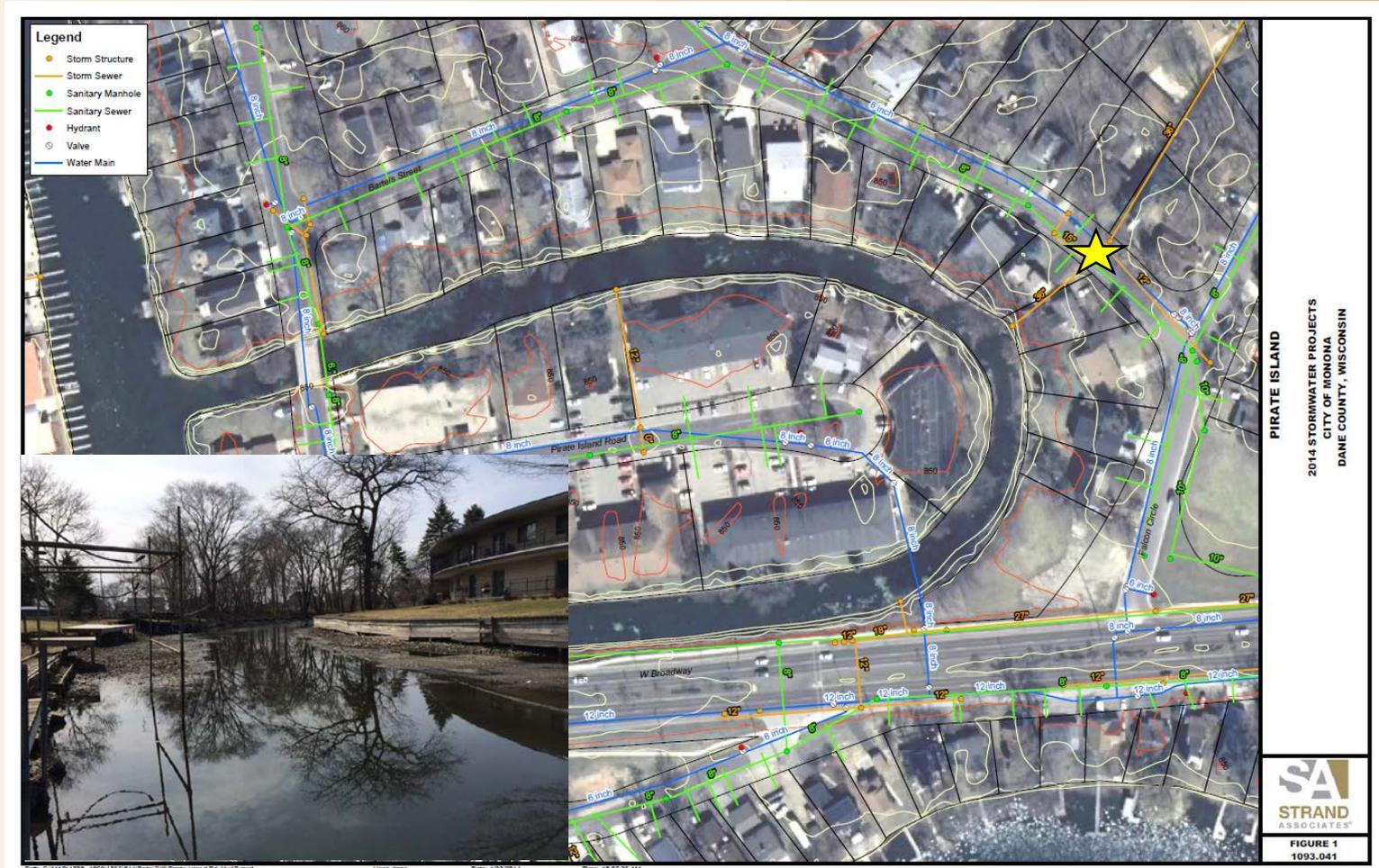
# Graham Park Site

**Suntree NSBB-6-12  
(6' x 12', 41.8 acres)**





- Pretreatment Device: Suntree



# Pirate Island Site

**Suntree NSBB-10-16  
(6' x 12', 117.5 acres)**





# Stormwater Quality Improvement

Location	Annual TSS Removed (lb)	Annual TSS Removed (%)	Annual TP Removed (lb)	Annual TP Removed (%)
Winnequah West	321	20.1%	0.9	13.9%
Winnequah East	444	19.2%	1.24	13.2%
Graham	1,009	10.5%	2.84	7.1%
Pirate Island	<u>2,945</u>	8.9%	<u>7.3</u>	6.2%
<b>Total</b>	<b>4,719 lb</b>		<b>12.3 lb</b>	



Friends of Lake Wingra



Construction Cost	\$622,403	
Strand Engineering Cost	\$51,600	
CGC Engineering Cost	<u>\$1,038</u>	
<b>Total Project Cost</b>	<b>\$675,041</b>	
Yahara WINs P Reducing Grant	\$10,000	
DNR UNPS Construction Grant	\$84,198	
Dane County Urban Water Quality Grant	\$317,400	<b>Top 10 Outfalls</b>
Dane County Bridge Aids Grant	<u>\$140,538</u>	<b>% of Total Project Cost</b>
<b>Grant Total Share</b>	<b>\$552,136</b>	<b>81.8%</b>
<b>Local Share</b>	<b>\$122,905</b>	<b>18.2%</b>

# Lake Wingra Watershed Management Plan

City of Madison & Friends of Lake Wingra

## 2015 Stormwater Projects

City of Monona

April 14, 2016

Waukesha County-2016 Stormwater Workshop

Jon H. Lindert, P.E., LEED AP



*Friends of Lake Wingra*

