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## TECHNICAL MEMORANDUM

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**To:** Pat Tarpey, Lake Winnepesaukee Association  
Lake Waukewan and Winona Lake Study Advisory Committee

**From:** Forrest Bell, FB Environmental

**Subject:** Waukewan & Winona Lake Watershed BMP Matrix

**Date:** October 29, 2014

**cc:** Whitney Baker, FB Environmental

**att:** *Waukewan & Winona Watershed BMP Matrix Spreadsheet*

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This memo summarizes the process of creating the BMP matrix for the Waukewan Lake & Lake Winona watershed.

### Overview:

Beach erosion, inadequate shoreline buffers, poorly maintained roads, and winter sand inputs all contribute to the current state of the water quality in Lake Waukewan and Winona Lake. The watershed survey conducted on April 22 and 23, 2014 documented more than 60 issues persisting today within the watershed contributing sediment and other pollutants to various waterbodies throughout the watershed. The Lake Winnepesaukee Association and the Lake Waukewan and Winona Lake Study Advisory Committee have begun the task of educating residents about the potential adverse effects of soil erosion and phosphorus as part of the watershed planning process and through recent projects.

By modeling results of pollutant reductions expected from addressing the 64 identified sites, we can estimate the total P load currently contributed by these selected locations throughout the watershed. Currently, 248.7 lbs of P enters Lake Waukewan and Winona Lake annually from these areas. Ideally, if all 64 problem sites identified in the 2014 watershed survey were treated with BMPs, and all new development contained proper phosphorus controls, these annual P loadings would be significantly reduced. The top twenty BMP sites alone would remove approximately 229 lbs of phosphorus per year from entering the Lake. This would account for 92% of the total estimated P load per year contributed by all surveyed problem areas. On average, the top 20 BMPs will cost an estimated \$623 per pound of phosphorus removed.

It is important to note that, while the focus of the BMP Matrix is on phosphorus, the treatment of stormwater will result in the reduction of many other kinds of harmful pollutants that could have a negative impact on these waters. These pollutants would likely include:

- Nutrients (e.g. nitrogen)
- Bacteria and viruses
- Heavy metals (cadmium, nickel, zinc)
- Petroleum products
- Road sand/salt

## Waukegan Lake & Lake Winona BMP Matrix:

### EPA Region 5 spreadsheet model

The EPA Region 5 Model was used to calculate the reduction in pollutant load in response to the implementation of BMPs in the Lake Waukegan and Winona Lake watershed. The Region 5 Model provides a gross estimate of sediment and nutrient load reductions from the implementation of agricultural and urban BMPs. While it is recognized that this system has limitations, it does provide a uniform system of estimating relative pollutant loads.

During the 2014 watershed survey in the Lake Waukegan and Winona Lake watershed, measurements were collected at each identified site. The measurements document the area of any observed surface erosion or exposed/bare soil, the average dimensions of any gully erosion observed at each site (depth, width and length), and the height and lengths of eroded streambanks observed during the survey.

These measurements are used as inputs in the Region 5 Model to calculate the reduction in pollutant load expected if these eroded areas were addressed by installing the recommended BMP.

### Estimated Cost for BMP implementation

Technical staff conducting the watershed survey also made in-field recommendations for each identified site in the watershed. Based on these recommendations, FBE was able to provide estimates of cost for each recommended BMP. Cost estimates were based roughly on the table below:

<b>BMP Type</b>	<b>Materials</b>	<b>Labor</b>	<b>Total</b>	<b>Reference</b>
Vegetated Buffer (20')	\$ 400	\$ 80	\$ 480	CCSWCD (2008). Table of Estimated Costs for Conservation Practices
New Culvert (20' X18")	\$ 500	\$ 1,000	\$ 1,500	CCSWCD (2008). Table of Estimated Costs for Conservation Practices
Gravel and grading (200' x 16')	\$ 500	\$ 860	\$ 1,360	CCSWCD (2008). Table of Estimated Costs for Conservation Practices
Dripline/infiltration trench (18"x20'x8")	\$ 150	\$ 110	\$ 260	CCSWCD (2008). Table of Estimated Costs for Conservation Practices
Rubber waterbar (16')	\$ 320	\$ 60	\$ 380	CCSWCD (2008). Table of Estimated Costs for Conservation Practices
Grass-lined ditch (100')	\$ 175	\$ 400	\$ 575	CCSWCD (2008). Table of Estimated Costs for Conservation Practices
Rock-lined ditch (100')	\$ 350	\$ 400	\$ 750	CCSWCD (2008). Table of Estimated Costs for Conservation Practices
Erosion control mulch (30' x 30' x 4")	\$ 350	\$ 120	\$ 470	CCSWCD (2008). Table of Estimated Costs for Conservation Practices
Plunge Pool	\$1.25/sq. ft.	\$75/hr	-	Correspondence with J. Houle - University of NH Stormwater Center
Guard Rail	\$20/ Linear ft.	\$75/hr	-	Correspondence with J. Houle - University of NH Stormwater Center
Retention Swales	\$1.35/sq. ft.	\$75/hr	-	Correspondence with J. Houle - University of NH Stormwater Center
Recycled Asphalt	\$3.80/sq. ft.	\$75/hr	-	Correspondence with J. Houle - University of NH Stormwater Center
Check dams & turnouts	\$500-600 ea.	\$75/hr	-	Correspondence with J. Houle - University of NH Stormwater Center
Paving (driveway)	\$3.80/sq. ft.	\$75/hr	-	Correspondence with J. Houle - University of NH Stormwater Center
Open-top Culvert	\$ 100	\$ 50	\$ 150	Estimate based on current lumber prices
Retaining Walls	\$40/sq. ft.	\$75/hr	-	Estimates from two landscaping companies for block/concrete walls: <a href="http://www.landscapingnetwork.com/walls/retaining-cost.html">http://www.landscapingnetwork.com/walls/retaining-cost.html</a> <a href="http://www.bahlerbrothers.com/blog/bid/111056/How-much-do-Retaining-Walls-Cost">http://www.bahlerbrothers.com/blog/bid/111056/How-much-do-Retaining-Walls-Cost</a>
Concrete curbing	\$15/linear foot	Included in material	-	

Estimates were also provided for annual maintenance cost for each BMP. The initial cost of the BMP was combined with the annual cost of each BMP over a ten year period (initial cost + (annual maintenance cost x 10 yrs)) to calculate a 10-year BMP cost for each site. This 10-year cost estimate was then used to determine the 10-year cost per lb. and per kg of phosphorus removed by each BMP per year.

### Prioritization of BMPs

All surveyed sites were prioritized by two factors. First, priority was given to sites assessed as having a higher environmental impact to water quality. Second, sites were then sorted by cost per lb. of phosphorus removed by the recommended BMP each year. The resulting prioritized list can be found in Appendix A.

### Top 20 BMP List

The top 20 BMPs from the prioritized list of all identified survey sites was extracted from the list and account for 92% of the total estimated P load per year contributed by all surveyed problem areas. On average, the top 20 BMPs will cost an estimated \$623 per pound of phosphorus removed.

**Appendix A**  
Prioritized BMP Matrix of All Surveyed Sites

### Waukewan Prioritized Sites

Site	Location	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (lbs/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
1-09 C	Waukewan St. (W of site 1-09 B)	Town Road	Bare soil- adjacent parking lot, winter sand	Remove winter sand early spring, reseed bare soil and thinning grass on adjacent property	Low	15.8	13.4	6.1	\$575	\$75	\$1,325	\$218	Low	Low
2-07	100 Forest Hill road	Private paved road	Slight to moderate ditch erosion (will get worse with big storms), slight road shoulder erosion, lots of winter sand	Vegetate ditch or armor with stone, vegetate shoulder	Low	13.8	13.8	6.3	\$1,150	\$50	\$1,650	\$264	Medium	Low
1-21	Waukewan ditches from Rt. 104 to bottom of hill at Wall Street	Town Road	Moderate to severe ditch erosion, moderate road shoulder erosion, winter sand	Vegetate ditch, reshape ditch, install sediment pools, vegetation mats or riprap	High	12.6	10.7	4.9	\$2,000	\$250	\$4,500	\$927	Medium	Medium
2-08	Picket fence & Winona (across from cemetery)	State and Private Road Intersection	Severe ditch erosion at one point along road, ditch turnout is plugged- will take out road at some point, moderate surface erosion, bare soil	Change ditch cross-section & remove plug and/or stabilize new ditch, install detention pond?	Medium	17.9	17.9	8.1	\$3,625	\$250	\$6,125	\$754	High	High
1-08 A	Waukewan Swimming Bath House Parking Lot	Municipal/ Public	Moderate surface erosion, slight road shoulder erosion, bare soil in parking area, winter sand-snow dump area with lots of snow and winter sand adjacent to catchbasin that outlets directly to lake.	Add new surface material to parking area (crushed stone?) to prevent movement of sand, vegetate shoulder, Re-seed grassed areas, armor catchbasin outlet at beach and create plunge pool.	Medium	10.5	8.9	4.0	\$1,260	\$300	\$4,260	\$1,055	Medium	Medium
2-03 B	Rd ditch near 28 Forest Hill Rd	Private Rd	Moderate surface erosion, moderate ditch erosion, moderate road shoulder erosion, bare soil, winter sand	Armor ditch with stone, install check dams, vegetate shoulder	Medium	8.9	8.9	4.0	\$2,400	\$500	\$7,400	\$1,833	High	High
2-05	Other side of 36 Forest Hill	Private Road	Moderate surface erosion, moderate ditch erosion, moderate road shoulder erosion, bare soil, winter sand	Armor ditch with stone, install check dams, add another cross culvert and divert to level spreader	Medium	8	8	3.6	\$4,100	\$300	\$7,100	\$1,957	High	High
2-02	Robin Way	Private dirt road	Moderate surface erosion, moderate ditch erosion, moderate road shoulder erosion, bare soil	Armor ditch with stone, vegetate shoulder, remove railroad ties and direct to a vegetated swale	Medium	5.2	5.2	2.4	\$3,600	\$150	\$5,100	\$2,162	Medium	Medium
1-06	Waukewan St.	Town Road	Slight surface erosion, slight road shoulder erosion, bare soil, shoreline erosion from ice action, road sediment into catch basin and ditch along railroad tracks that outfalls directly to the lake	Vegetate shoulder, remove winter sand, redirect water from culvert away from lake and install a detention basin.	Low	6.3	5.4	2.4	\$3,000	\$250	\$5,500	\$2,245	High	High

### Waukegan Prioritized Sites

Site	Location	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (lbs/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
1-04	84 Pike Island Rd.	Private Road	Severe surface erosion, severe ditch erosion, severe road shoulder erosion, bare soil, lots of winter sand	Armor inlet/outlet, install ditch and armor with stone, install turnouts, vegetate shoulder, Pave road?	High	1.6	1.6	0.7	\$3,150	\$250	\$5,650	\$7,785	High	High
2-06	Indian Trail Rd & Chapman Point	Private Road	General gravel road maintenance, poor crown, bare soil, moderate surface erosion, winter sand, wrong aggregate mix?	Build-up road/add new surface material, reshape crown, vegetate shoulder	Medium	18	18	8.2	\$8,300	\$2,500	\$33,300	\$4,079	High	High
2-24	Mayo Farms Cottages + Campground	Commercial	Slight road shoulder erosion, winter sand, undercut streambank with erosion and lack of vegetation, fields mowed to streambank	Vegetate shoulder, establish buffer	High	1.2	1.2	0.5	\$5,000	\$100	\$6,000	\$11,023	High	Medium
1-02 A	Next to 110 Water St-culvert/crossing upstream	Town Road	Moderate surface erosion, moderate road shoulder erosion, bare soil, streambank erosion, winter sand. Stormwater from Rd has created gullies toward crossing/stream, small stream flows to Waukegan- lots of inputs from winter sand and road shoulder	Vegetate shoulder, reshape ditch and armor with stone, install turnouts away from stream into woods, reseed bare soil & thinning grass	High	0.7	0.7	0.3	\$2,075	\$250	\$4,575	\$14,409	Medium	High
1-02 B	Next to 110 Water St. (downstream side)	Town Road	Moderate surface erosion, moderate road shoulder erosion, lots of winter sand, streambank erosion	Vegetate ditch, reshape ditch and armor with stone, install turnouts away from stream, reseed bare soil & thinning grass	High	0.7	0.6	0.3	\$1,475	\$250	\$3,975	\$14,606	Medium	High
1-22	Red Gate Road	Town Road	Moderate surface erosion, undersized ditches on either side of road, moderate road shoulder erosion, winter sand, gravel road that slopes towards the lake	install turnouts, install ditch, buildup road with new surface material.	High	2.5	2.5	1.1	\$13,720	\$500	\$18,720	\$16,508	High	High
1-17	Rt. 104 stream crossing, Reservoir Brook, upstream	State Road	slight surface erosion, unstable inlet/outlet (top erosion headwall), moderate ditch erosion	armor inlet/outlet, vegetate ditch, armor ditch with stone, reshape ditch	Low	0.4	0.4	0.2	\$1,300	\$100	\$1,000	\$5,512	Medium	Medium

### Waukewan Prioritized Sites

Site	Location	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (lbs/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
1-07	Waukewan St. next to beach area (south end)	Town Road	Moderate surface erosion, shoreline erosion	Install runoff diverter (waterbar), or create infiltration and sediment capture with stone, add to buffer, reseed bare soil and thinning grass	Medium	0.6	0.5	0.2	\$1,100	\$100	\$2,100	\$9,259	Medium	Low
1-09 A	Stream Crossing West of Beach area, Waukewan St.	Town Road	Unstable inlet, severe ditch erosion, moderate to severe road shoulder erosion, bare soil, winter sand, severe undercut streambank with lack of vegetation and erosion	Armor inlet of large road crossing, stabilize road shoulder/ditch to prevent undercutting, vegetate shoulder on upstream side, and add to buffer on downstream side of crossing.	Medium	1.2	1.2	0.5	\$3,280	\$200	\$5,280	\$9,700	High	Medium
1-19 A	Reservoir St between 20 and 22	Town Road	Moderate to severe surface erosion, unstable outlet, clogged culvert, slight to moderate road shoulder erosion, bare soil, winter sand	Armor outlet, vegetate ditch, reshape ditch, vegetate shoulder, work with owner to clean/vegetate bank	High	0.4	0.4	0.2	\$2,550	\$100	\$3,550	\$19,566	Medium	Medium
1-24 A	Waukewan Street next to 107 (stream crossing)	Town Road	Moderate surface erosion, unstable inlet/outlet, moderate road shoulder erosion	Armor inlet/outlet, vegetate shoulder around streambank	Medium	0.3	0.3	0.1	\$1,000	\$50	\$1,500	\$11,023	Medium	Medium
1-13	Wall Street culvert	Town Road	Moderate surface erosion, moderate road shoulder erosion, gravel road deposits lots of sediment into stream at crossing, stormwater from Waukewan Street flows to this spot and into ditch/drainage	Vegetate shoulder, water retention swales, create fore bays to trap sediment from eroding road shoulder and ditch,	High	1.2	1.2	0.5	\$2,900	\$500	\$12,900	\$23,700	High	High
1-18	Rt. 1049 Reservoir Brook crossing	State Road	Unstable outlet, broken culvert, undersized culvert, delta in stream	Armor outlet, enlarge culvert	High	0.6	0.4	0.2	\$4,500	\$0	\$4,500	\$24,802	High	High
2-01	9 Winona Shores (on rd)	Private Road	Slight surface erosion, slight road shoulder erosion, bare soil, road drainage intermittent, culvert under road, erosion of both shoulders	Vegetate shoulder (downstream and upstream)	Low	0.4	0.4	0.2	\$1,000	\$50	\$1,500	\$8,267	Medium	Low
1-08 C	RR tracks behind beach bath house on Waukewan St.	RR ROW	Slight to moderate ditch erosion, unknown pipes draining to ditch eroding slope above, lots of water in ditches.	Armor inlet/outlet (place stone at pipe outlets), armor ditch with stone, investigate pipes from adjacent residence.	Low	0.4	0.4	0.2	\$850	\$100	\$1,850	\$10,196	Medium	Low

### Waukegan Prioritized Sites

Site	Location	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (lbs/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
1-02 C	Next to 108 + 110 Water St.	Residential	Undercut shoreline, lack of shoreline vegetation, inadequate shoreline vegetation, shoreline erosion	Mulch/erosion control mix, establish buffer, add to buffer	Medium	0.5	0.4	0.2	\$2,390	\$50	\$2,890	\$15,928	Medium	Low
1- 19 B	Reservoir Rd Stream Crossing	Residential	Slight to moderate surface erosion, bare soil, undercut shoreline with lack of/inadequate shoreline vegetation	Mulch/erosion control mix, water retention swales (lots of parked vehicles and equipment on property), establish buffer, add to buffer, reseed bare soil and thinning soil	Medium	0.7	0.7	0.3	\$4,800	\$50	\$5,300	\$16,692	High	Medium
1-23	Bonney Shore Road	Private Road	Moderate surface erosion, moderate ditch erosion, slight road shoulder erosion, winter sand	Vegetate and/or armor ditches, line turnouts/ sediment capturing basins so they can be cleaned out	Medium	1.8	1.8	0.8	\$4,000	\$1,000	\$14,000	\$17,147	High	Medium
1-03 A	Next to 87/88 Pike Island Rd (culvert)	Private Road	Sever surface erosion, unstable inlet, crushed/broken inlet, severe ditch erosion, severe road shoulder erosion, winter sand, gravel Rd - poor surface material and no crown	Replace culvert, reshape ditch and armor ditch with stone, install turnouts and check dams, Build up/add new surface material (gravel) to road or pave, reshape to crown.	High	0.8	0.6	0.3	\$7,330	\$250	\$9,830	\$36,119	High	High
1-15	23 Wall Street on Road	Town Road	Moderate surface erosion, unstable inlet/outlet, culvert slightly crushed, moderate road shoulder erosion, sediment from road into stream ditch	armor inlet/outlet, replace/enlarge/lengthen culvert, vegetate ditch or armor with stone, vegetate shoulder	High	0.5	0.5	0.2	\$5,720	\$250	\$8,220	\$36,244	High	High
2-17	Saywood Brook @ Waukegan Road (Winona Rd intersection)	State Road	Slight road shoulder erosion, undercut streambank (slightly), inadequate shoreline vegetation	Vegetate shoulder, investigate origin of pipe that outlet from property to the stream, vegetate shoulder/stabilize near culverts	Low	0.4	0.4	0.2	\$1,920	\$50	\$2,420	\$13,338	Medium	Low
1-01	Across from 72 Water St.	Town Road	Moderate surface erosion, moderate road shoulder erosion, bare soil. Lots of bare soil drains to catch basin and outfalls directly at lake across the st.	Vegetate Shoulder, install detention basin and direct flow away from lake, stabilize cleared lot and road shoulder	Medium	0.9	0.8	0.4	\$5,000	\$250	\$7,500	\$20,668	High	High
1-03 B	88 Pike Island Rd	Driveway	Slight surface erosion, bare soil	Armor inlet/outlet, install runoff diverters- direct runoff away from stream and into the woods	Low	0.2	0.2	0.1	\$1,160	\$25	\$1,410	\$15,543	Medium	Low



**Waukewan Prioritized Sites**

Site	Location	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (lbs/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
1-03 C	84 Pike Island Rd?	Driveway	Slight surface erosion, bare soil	Armor inlet/outlet, install runoff diverters	Low	0.2	0.2	0.1	\$1,160	\$25	\$1,410	\$15,543	Medium	Low
1-16	Wall Street culvert	Town Road	moderate surface erosion, moderate to severe ditch erosion, moderate road shoulder erosion, road sediment into stream-heavy inputs	Armor inlet/outlet, enlarge culvert, armor ditch and create turnouts vegetate shoulder.	High	0.2	0.2	0.1	\$2,750	\$250	\$5,250	\$57,871	High	Medium
1-05	74 Pike Island Rd	Private Road	Moderate surface erosion, unstable outlet, partially buried/clogged culvert, moderate ditch erosion, moderate road shoulder erosion, bare soil	Armor inlet and outlet, remove clog and clean out culvert, install ditch and armor with stone, install turnouts away from crossing, vegetate road shoulder, install plunge pool to slow flow down slope	High	0.3	0.3	0.1	\$5,470	\$250	\$7,970	\$58,570	High	High
1-08 B	Catchbasin at corner of RR tracks and Waukewan St.	Town Road	Slight surface erosion, slight to moderate ditch erosion, lots of winter sand, slight road shoulder erosion	Armor ditch with stone and vegetate shoulder to prevent movement of sediment to catchbasin that outlets at beach. Remove winter sand.	Low	0.2	0.2	0.1	\$875	\$125	\$2,125	\$23,424	Medium	Medium
1-12	Catch basin outlet to Waukewan at bend in waukewan St.(at Wall St corner)	Town Road	Slight surface erosion, slight road shoulder erosion, lots of sediment into drainage ditch	install armored ditch, vegetate shoulder	Low	0.1	0.1	0.0	\$675	\$50	\$1,175	\$25,904	Low	Low
1-14	Wall Street culvert # 2	Town Road	Moderate surface erosion, moderate road shoulder erosion, road sediment into stream from gravel road	Vegetate ditch, vegetate shoulder, install detention basin and water retention swales to capture sediment	Medium	0.4	0.4	0.2	\$2,900	\$500	\$7,900	\$43,541	High	High
2-03 A	28 Forest Hill Road (driveway)	Driveway (paved)	Moderate surface erosion, bare soil, winter sand build-up in riprap ditch along driveway	Install turnouts, clean out sediment from riprap ditch (and other debris), vegetate shoulder, reseed bare soil and thinning grass	Medium	0.1	0.1	0.0	\$1,500	\$50	\$2,000	\$44,092	Medium	Low
1-11	At bend of Waukewan St. near Wall St. (un-named stream crossing)	Town Road	Moderate surface erosion, slight road shoulder erosion, undercut streambank (upstream), lots of road sediment from sanding, pipe (green pvc) outlet in down-stream side from yard across st.	Install ditch near crossing headwalls and armor with stone, install turnout, vegetate/stabilize shoulder	Medium	0.2	0.2	0.1	\$1,675	\$250	\$4,175	\$46,022	Medium	Medium
1-20	Right branch of Sawmill Shores	Town Road	Slight road shoulder erosion	Vegetate shoulder	Low	0.1	0.1	0.0	\$1,200	\$50	\$1,700	\$37,479	Medium	Low

### Waukewan Prioritized Sites

Site	Location	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (lbs/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
2-09	Saywood brook on Seminole Road (culvert under RR tracks where it goes under the road)	RR ROW?	Undersized culvert on the downstream side, probably more water than used to be there and eroding downstream bank, large amount of eroded debris	Either replace culvert or armor bank	Medium	0.2	0.2	0.1	\$6,000	\$0	\$6,000	\$66,139	Low	Low
1-24 B	Stream Crossing near 107 Waukewan St (buffer)	Residential	Undercut shoreline with lack of/inadequate vegetation	Establish buffer, add to buffer	Low	0.1	0.1	0.0	\$1,920	\$50	\$2,420	\$53,352	Low	Low
1-09 B	Culvert West of Site 1-09 A near driveway of #82 Waukewan St.	Town Road, Driveway	Slight surface erosion, unstable inlet, slight to moderate ditch erosion, slight road shoulder erosion, bare soil, winter sand	Armor inlet, vegetate shoulder, establish buffer	Low	0.1	0.1	0.0	\$1,680	\$250	\$4,180	\$92,153	Medium	Low
2-22	Snake River crossing inlet to Waukewan	State Road	Winter sand, moderate road shoulder erosion, lack of shoreline vegetation, stormwater created gully has eroded slope towards water carrying trash etc.	Create curbing to direct flow away from lake and to a detention area, stabilize shoreline/road shoulder, establish buffer	High	0	0	0.0	\$2,130	\$100	\$3,130	n/a	Medium	High
2-04	36 Forest Hill	Private road	unstable inlet/outlet, hanging culvert into plunge pool with eroded bank, bare soil	armor inlet and outlet, Install plunge pool at outlet, vegetate shoulder	Low	0	0	0.0	\$1,875	\$100	\$2,875	n/a	Medium	Medium
2-23	Waukewan Rd, driveway adjacent w/ cut wood	State Road	Slight ditch erosion, winter sand, slight road shoulder erosion, unknown source of water drains directly to lake	Vegetate shoulder, establish buffer	Low	0	0	0.0	\$480	\$50	\$980	n/a	Low	Low
1-10 A	Waukewan St. next to Carder Lane (see photo for utility pole)	Town Road	Unstable inlet/outlet, slight road shoulder erosion, bare soil, winter sand	Armor inlet/outlet, vegetate shoulder, reseed bare soil and thinning grass	Low	0.1	0	0.0	\$700	\$75	\$1,450	n/a	Medium	Low
1-10 B	House next to Carder Ln on Waukewan St.	Residential	Lack of streambank vegetation, inadequate vegetation, mowed close to streambanks	Establish buffer, add to buffer	Low	0	0	0.0	\$960	\$25	\$1,210	n/a	Medium	Low

### Winona Prioritized Sites

Site	Location	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (lbs/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
2-13 A	Shoreline along Winona Rd, guardrail near 692 Winona Rd	State Road	Slight surface erosion, undercut shoreline, erosion on the shoreline, road is slumping toward lake	Need to armor and stabilize shoreline where Rd is closest to lake	High	78.8	66.9	30.3	\$25,000	\$200	\$27,000	\$890	High	High
2-13 B	Ditch across from site 2- 13 A on Winona Rd	State Road	Slight surface erosion, moderate ditch erosion, bare soil	vegetate ditch and armor with stone	Medium	11.3	10.1	4.6	\$1,500	\$200	\$3,500	\$764	Medium	Medium
2-19	Catchbasins on Hawkins Pond Rd + Piper Rd median	Town Road	Lots of winter sand, 2 catchbasins on corner that drain to Hawkins Pond outlet, road slopes to this intersection with lots of winter sand entering catchbasins, slight ditch erosion, slight surface erosion, slight road shoulder erosion	Create ditch to sediment retention area to collect runoff before entering CB, remove winter sand in early spring to reduce sediment inputs, OR redirect outlet of CB away from lake	Medium	6.3	5.4	2.4	\$1,275	\$100	\$2,275	\$929	Medium	High
2-12 A	Winona Rd at boat launch near Snake River	Municipal/Public	Slight surface erosion, slight road shoulder erosion, bare soil, winter sand, water flows off Rd and erodes boat launch parking areas	Create swales to direct water from Rd into woods, add new surface material (pea stone?) to parking areas, water retention swales	Medium	17.1	14.5	6.6	\$4,380	\$250	\$6,880	\$1,046		
2-14	Ditch on Winona	State Road	Moderate ditch erosion, slight surface erosion, slight road shoulder erosion	Armor ditch with stone, vegetate ditch	Medium	8.4	7.1	3.2	\$2,000	\$150	\$3,500	\$1,087	Medium	Medium
2-16 A	Hawkins Pond Boat Launch	Boat access	Slight surface erosion, slight road shoulder erosion, bare soil, winter sand, water from Rd is eroding areas of the boat launch parking lots and into Pond	Add new surface material (crushed stone to prevent sediment movement off site, install runoff diverter (waterbar), rain garden near launch/slope, infiltration trench to collect runoff before it enters parking area	Medium	11	9.4	4.3	\$3,684	\$200	\$5,684	\$1,333	High	Medium
2-11	Purdy property- Bay View	Residential	Lack of shoreline vegetation, slumping streambank, bare soil, slight surface erosion	Add vegetation, stabilize streambank (should not just add rock), water retention swales (move runoff away from stream), establish buffer, add to buffer, reseed bare soils and thinning grass	Medium	2.1	2.1	1.0	\$3,920	\$75	\$4,670	\$4,903	High	High
2-12 B	Winona Lake / Snake River boat launch at Winona Rd.	Municipal/Public	Moderate surface erosion, bare soil	Install runoff diverter (waterbar), rain garden on either side of launch	Medium	0.6	0.6	0.3	\$1,380	\$50	\$1,880	\$6,908	Medium	Medium

### Winona Prioritized Sites

Site	Location	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (lbs/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
2-20	Piper Hill Rd, Hawkins Pond outlet crossing downstream side	Town Road	Slight road shoulder erosion, winter sand forming delta down into stream	Install sediment pools to control winter sand	High	0.4	0.4	0.2	\$1,950	\$100	\$2,950	\$16,259	Medium	High
2-15	Both ends of Lambert RD (hills to stream)	Town Road	Bare soil, bringing lots of sand downstream, delta in stream, winter sand, slight surface erosion, slight ditch erosion, slight road shoulder erosion	Install turnouts and level spreader, reshape ditch, vegetate ditch	High	0.4	0.4	0.2	\$2,075	\$100	\$3,075	\$16,948	Medium	Medium
2-10	On RR tracks off Winona on Snake River by sign C41	RR ROW	Continued historic sand movement, monitor in the future, lots of sand in channel, moderate surface erosion (deposition in stream at crossing), delta in stream	Armor inlet/outlet? Stabilize bare/eroding soils at crossing, vegetate slopes	Medium	1.2	1.2	0.5	\$5,000	\$100	\$6,000	\$11,023	High	High/Low
2-16 B	Rd Ditches near boat launch at Hawkins Pond	Town Road	Moderate ditch erosion, slight road shoulder erosion, bare soil, winter sand	Vegetate ditch, armor ditch with stone, install turnouts	Medium	0.4	0.4	0.2	\$1,275	\$100	\$2,275	\$12,539	Medium	Medium
2-21 A	Corner of Winona Rd and Hawkins Pond Rd-upstream Hawkins Pond stream crossing	State and Town	Lots of winter sand deposited from road into stream, lack of shoreline vegetation, slight surface erosion, slight ditch erosion, slight road shoulder erosion	Vegetate shoulder, add to buffer, install sediment pools to capture winter sand, sweep roads and remove winter sand before movement toward stream	High	0.3	0.3	0.1	\$1,000	\$100	\$11,000	\$80,836	Medium	High
2-21 B	Downstream Side of crossing at intersection of Winona Rd and Hawkins Pond Rd (Hawkins Pond outlet stream- downstream side of crossing)	Residential	Slight surface erosion, slight road shoulder erosion, winter sand, lack of shoreline vegetation, tar lined ditch brings water from Rd and adjacent driveway into stream	Vegetate shoulder, establish buffer, add to buffer, remove tar-lined ditch and replace with infiltrating /sediment capturing structure to treat runoff properly	Medium	0.1	0.1	0.0	\$1,560	\$100	\$2,560	\$56,438	Medium	Medium
2-18	Piper Hill Road, Bear Pond stream crossing	Town Road	Undersized culvert (is currently under water), moderate road shoulder erosion, lots of winter sand, Looks like road need to be built up and new crossing constructed- water is almost to Rd level	Enlarge culvert, armor inlet and outlet extending headwalls to prevent road shoulder slumping, vegetate/stabilize shoulder, water within 4' of road shoulder- lots of sediment input	Medium	0.4	0.2	0.1	\$9,560	\$200	\$11,560	\$127,427	High	High

**Appendix B**  
BMP Matrix - Top 20 Sites

### Lake Waukewan Top 20 BMP Sites

Site	Location	Town	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
1-09 C	Waukewan St. (W of site 1-09 B)	Meredith	Town Road	Bare soil- adjacent parking lot, winter sand	Remove winter sand early spring, reseed bare soil and thinning grass on adjacent property	Low	15.8	6.1	\$575	\$75	\$1,325	\$218	Low	Low
2-07	100 Forest Hill Road	Meredith	Private paved road	Slight to moderate ditch erosion (will get worse with big storms), slight road shoulder erosion, lots of winter sand	Vegetate ditch or armor with stone, vegetate shoulder	Low	13.8	6.3	\$1,150	\$50	\$1,650	\$264	Medium	Low
1-21	Waukewan ditches from Rt. 104 to bottom of hill at Wall Street	Meredith	Town Road	Moderate to severe ditch erosion, moderate road shoulder erosion, winter sand	Vegetate ditch, reshape ditch, install sediment pools, vegetation mats or riprap	High	12.6	4.9	\$2,000	\$250	\$4,500	\$927	Medium	Medium
2-08	Picket fence & Winona (across from cemetery)	New Hampton	State and Private Road Intersection	Severe ditch erosion at one point along road, ditch turnout is plugged- will take out road at some point, moderate surface erosion, bare soil	Change ditch cross-section & remove plug and/or stabilize new ditch, install detention pond?	Medium	17.9	8.1	\$3,625	\$250	\$6,125	\$754	High	High
1-08 A	Waukewan Swimming Bath House Parking Lot	Meredith	Municipal/Public	Moderate surface erosion, slight road shoulder erosion, bare soil in parking area, winter sand-snow dump area with lots of snow and winter sand adjacent to catchbasin that outlets directly to lake.	Add new surface material to parking area (crushed stone?) to prevent movement of sand, vegetate shoulder, Re-seed grassed areas, armor catchbasin outlet at beach and create plunge pool.	Medium	10.5	4.0	\$1,260	\$300	\$4,260	\$1,055	Medium	Medium
2-03 B	Road ditch near 28 Forest Hill Rd	Meredith	Private Rd	Moderate surface erosion, moderate ditch erosion, moderate road shoulder erosion, bare soil, winter sand	Armor ditch with stone, install check dams, vegetate shoulder	Medium	8.9	4.0	\$2,400	\$500	\$7,400	\$1,833	High	High
2-05	Other side of 36 Forest Hill	Meredith	Private Road	Moderate surface erosion, moderate ditch erosion, moderate road shoulder erosion, bare soil, winter sand	Armor ditch with stone, install check dams, add another cross culvert and divert to level spreader	Medium	8	3.6	\$4,100	\$300	\$7,100	\$1,957	High	High
2-02	Robin Way	Meredith	Private dirt road	Moderate surface erosion, moderate ditch erosion, moderate road shoulder erosion, bare soil	Armor ditch with stone, vegetate shoulder, remove railroad ties and direct to a vegetated swale	Medium	5.2	2.4	\$3,600	\$150	\$5,100	\$2,162	Medium	Medium
1-06	Waukewan St.	Meredith	Town Road	Slight surface erosion, slight road shoulder erosion, bare soil, shoreline erosion from ice action, road sediment into catch basin and ditch along railroad tracks that outfalls directly to the lake	Vegetate shoulder, remove winter sand, redirect water from culvert away from lake and install a detention basin.	Low	6.3	2.4	\$3,000	\$250	\$5,500	\$2,245	High	High
1-04	84 Pike Island Rd.	Meredith	Private Road	Severe surface erosion, severe ditch erosion, severe road shoulder erosion, bare soil, lots of winter sand	Armor inlet/outlet, install ditch and armor with stone, install turnouts, vegetate shoulder, Pave road?	High	1.6	0.7	\$3,150	\$250	\$5,650	\$7,785	High	High
2-06	Indian Trail Rd & Chapman Point	Meredith/New Hampton T/L	Private Road	General gravel road maintenance, poor crown, bare soil, moderate surface erosion, winter sand, wrong aggregate mix?	Build-up road/add new surface material, reshape crown, vegetate shoulder	Medium	18	8.2	\$8,300	\$2,500	\$33,300	\$4,079	High	High

### Lake Waukewan Top 20 BMP Sites

Site	Location	Town	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
2-24	Mayo Farms Cottages + Campground	Center Harbor	Commercial	Slight road shoulder erosion, winter sand, undercut streambank with erosion and lack of vegetation, fields mowed to streambank	Vegetate shoulder, establish buffer	High	1.2	0.5	\$5,000	\$100	\$6,000	\$11,023	High	Medium
1-02 A	Next to 110 Water St-culvert/crossing upstream	Meredith	Town Road	Moderate surface erosion, moderate road shoulder erosion, bare soil, streambank erosion, winter sand. Stormwater from Rd has created gullies toward crossing/stream, small stream flows to Waukewan- lots of inputs from winter sand and road shoulder	Vegetate shoulder, reshape ditch and armor with stone, install turnouts away from stream into woods, reseed bare soil & thinning grass	High	0.7	0.3	\$2,075	\$250	\$4,575	\$14,409	Medium	High
1-02 B	Next to 110 Water St. (downstream side)	Meredith	Town Road	Moderate surface erosion, moderate road shoulder erosion, lots of winter sand, streambank erosion	Vegetate ditch, reshape ditch and armor with stone, install turnouts away from stream, reseed bare soil & thinning grass	High	0.7	0.3	\$1,475	\$250	\$3,975	\$14,606	Medium	High
1-22	Red Gate Road	Meredith	Town Road	Moderate surface erosion, undersized ditches on either side of road, moderate road shoulder erosion, winter sand, gravel road that slopes towards the lake	install turnouts, install ditch, buildup road with new surface material.	High	2.5	1.1	\$13,720	\$500	\$18,720	\$16,508	High	High
1-17	Rt. 104 stream crossing, Reservoir Brook, upstream	Meredith	State Road	slight surface erosion, unstable inlet/outlet (top erosion headwall), moderate ditch erosion	armor inlet/outlet, vegetate ditch, armor ditch with stone, reshape ditch	Low	0.4	0.2	\$1,300	\$100	\$1,000	\$5,512	Medium	Medium
1-07	Waukewan St. next to beach area (south end)	Meredith	Town Road	Moderate surface erosion, shoreline erosion	Install runoff diverter (waterbar), or create infiltration and sediment capture with stone, add to buffer, reseed bare soil and thinning grass	Medium	0.6	0.2	\$1,100	\$100	\$2,100	\$9,259	Medium	Low
1-09 A	Stream Crossing West of Beach area, Waukewan St.	Meredith	Town Road	Unstable inlet, severe ditch erosion, moderate to severe road shoulder erosion, bare soil, winter sand, severe undercut streambank with lack of vegetation and erosion	Armor inlet of large road crossing, stabilize road shoulder/ditch to prevent undercutting, vegetate shoulder on upstream side, and add to buffer on downstream side of crossing.	Medium	1.2	0.5	\$3,280	\$200	\$5,280	\$9,700	High	Medium
1-19 A	Reservoir St between 20 and 22	Meredith	Town Road	Moderate to severe surface erosion, unstable outlet, clogged culvert, slight to moderate road shoulder erosion, bare soil, winter sand	Armor outlet, vegetate ditch, reshape ditch, vegetate shoulder, work with owner to clean/vegetate bank	High	0.4	0.2	\$2,550	\$100	\$3,550	\$19,566	Medium	Medium
1-24 A	Waukewan Street next to 107 (stream crossing)	Meredith	Town Road	Moderate surface erosion, unstable inlet/outlet, moderate road shoulder erosion	Armor inlet/outlet, vegetate shoulder around streambank	Medium	0.3	0.1	\$1,000	\$50	\$1,500	\$11,023	Medium	Medium
							<b>Total</b>	<b>54.2</b>			<b>\$128,610</b>	<b>\$2,371</b>		

Lake Winona Top 15 BMP Sites

Site	Location	Town	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
2-13 A	Shoreline along Winona Rd, guardrail near 692 Winona Rd		State Road	Slight surface erosion, undercut shoreline, erosion on the shoreline, road is slumping toward lake	Need to armor and stabilize shoreline where Rd is closest to lake	High	78.8	30.3	\$25,000	\$200	\$27,000	\$890	High	High
2-13 B	Ditch across from site 2-13 A on Winona Rd		State Road	Slight surface erosion, moderate ditch erosion, bare soil	vegetate ditch and armor with stone	Medium	11.3	4.6	\$1,500	\$200	\$3,500	\$764	Medium	Medium
2-19	Catchbasins on Hawkins Pond Rd + Piper Rd median		Town Road	Lots of winter sand, 2 catchbasins on corner that drain to Hawkins Pond outlet, road slopes to this intersection with lots of winter sand entering catchbasins, slight ditch erosion, slight surface erosion, slight road shoulder erosion	Create ditch to sediment retention area to collect runoff before entering CB, remove winter sand in early spring to reduce sediment inputs, OR redirect outlet of CB away from lake	Medium	6.3	2.4	\$1,275	\$100	\$2,275	\$929	Medium	High
2-12 A	Winona Rd at boat launch near Snake River		Municipal/Public, State Rd	Slight surface erosion, slight road shoulder erosion, bare soil, winter sand, water flows off Rd and erodes boat launch parking areas	Create swales to direct water from Rd into woods, add new surface material (pea stone?) to parking areas, water retention swales	Medium	17.1	6.6	\$4,380	\$250	\$6,880	\$1,046		
2-14	Ditch on Winona		State Road	Moderate ditch erosion, slight surface erosion, slight road shoulder erosion	Armor ditch with stone, vegetate ditch	Medium	8.4	3.2	\$2,000	\$150	\$3,500	\$1,087	Medium	Medium
2-16 A	Hawkins Pond Boat Launch		Boat access	Slight surface erosion, slight road shoulder erosion, bare soil, winter sand, water from Rd is eroding areas of the boat launch parking lots and into Pond	Add new surface material (crushed stone to prevent sediment movement off site, install runoff diverter (waterbar), rain garden near launch/slope, infiltration trench to collect runoff before it enters parking area	Medium	11	4.3	\$3,684	\$200	\$5,684	\$1,333	High	Medium
2-11	Purdy property- Bay View		Residential	Lack of shoreline vegetation, slumping streambank, bare soil, slight surface erosion	Add vegetation, stabilize streambank (should not just add rock), water retention swales (move runoff away from stream), establish buffer, add to buffer, reseed bare soils and thinning grass	Medium	2.1	1.0	\$3,920	\$75	\$4,670	\$4,903	High	High
2-12 B	Winona Lake / Snake River boat launch at Winona Rd.		Municipal/Public, Boat access	Moderate surface erosion, bare soil	Install runoff diverter (waterbar), rain garden on either side of launch	Medium	0.6	0.3	\$1,380	\$50	\$1,880	\$6,908	Medium	Medium
2-20	Piper Hill Rd, Hawkins Pond outlet crossing downstream side		Town Road	Slight road shoulder erosion, winter sand forming delta down into stream	Install sediment pools to control winter sand	High	0.4	0.2	\$1,950	\$100	\$2,950	\$16,259	Medium	High



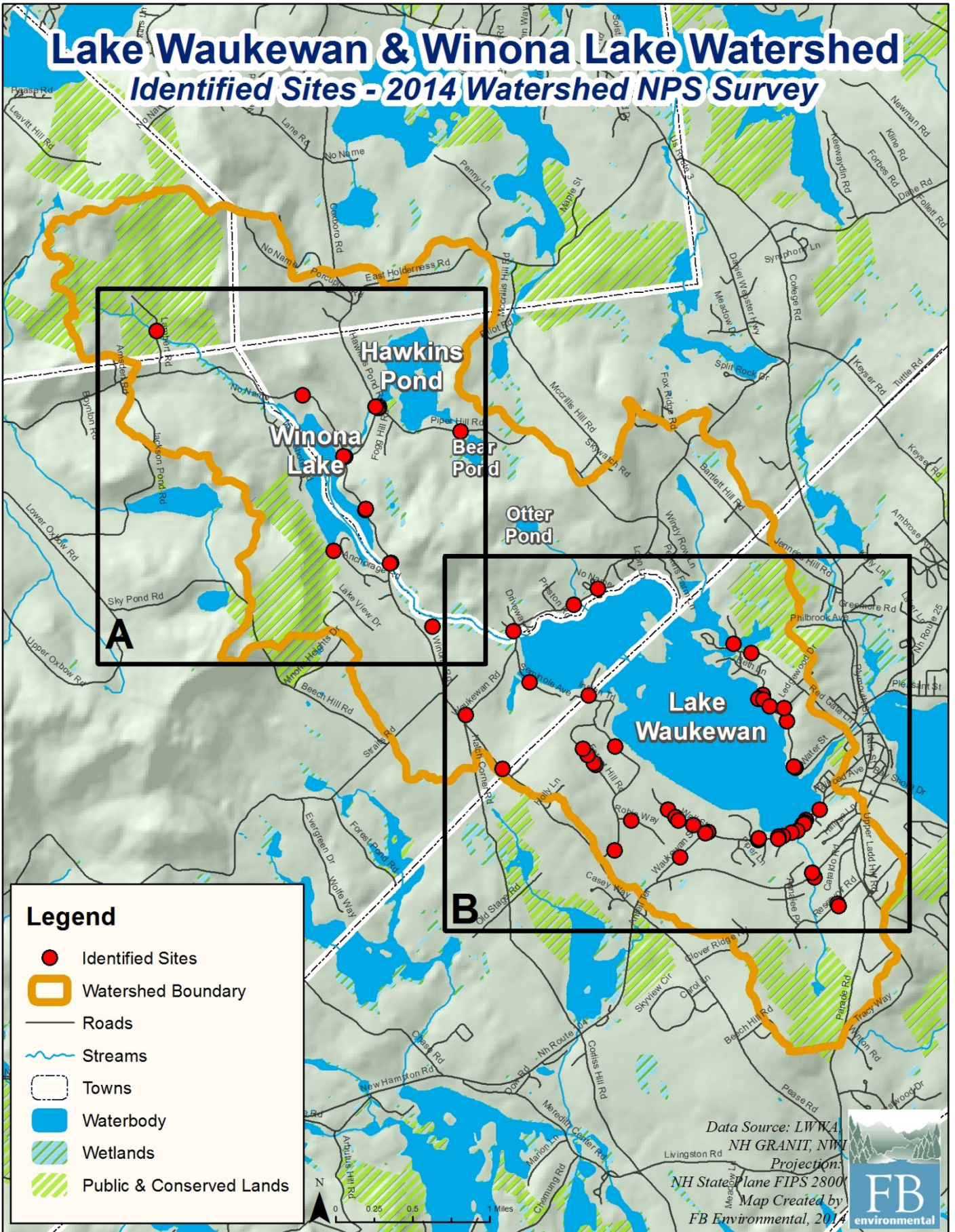
Lake Winona Top 15 BMP Sites

Site	Location	Town	Land Use	Issues	Recommendations	Impact rating	Sediment (t/yr)	Phosphorus (kg/yr)	BMP Cost Estimate	BMP Annual Maintenance Cost Estimate	10-yr Cost	10-yr Cost for TP Removed (\$/kg)	Cost	Technical Level
2-15	Both ends of Lambert RD (hills to stream)		Town Road	Bare soil, bringing lots of sand downstream, delta in stream, winter sand, slight surface erosion, slight ditch erosion, slight road shoulder erosion	Install turnouts and level spreader, reshape ditch, vegetate ditch	High	0.4	0.2	\$2,075	\$100	\$3,075	\$16,948	Medium	Medium
2-10	On RR tracks off Winona on Snake River by sign C41		RR ROW	Continued historic sand movement, monitor in the future, lots of sand in channel, moderate surface erosion (deposition in stream at crossing), delta in stream	Armor inlet/outlet? Stabilize bare/eroding soils at crossing, vegetate slopes	Medium	1.2	0.5	\$5,000	\$100	\$6,000	\$11,023	High	High/Low
2-16 B	Rd Ditches near boat launch at Hawkins Pond		Town Road	Moderate ditch erosion, slight road shoulder erosion, bare soil, winter sand	Vegetate ditch, armor ditch with stone, install turnouts	Medium	0.4	0.2	\$1,275	\$100	\$2,275	\$12,539	Medium	Medium
2-21 A	Corner of Winona Rd and Hawkins Pond Rd-upstream Hawkins Pond stream crossing		State and Town Road Insection	Lots of winter sand deposited from road into stream, lack of shoreline vegetation, slight surface erosion, slight ditch erosion, slight road shoulder erosion	Vegetate shoulder, add to buffer, install sediment pools to capture winter sand, sweep roads and remove winter sand before movement toward stream	High	0.3	0.1	\$1,000	\$100	\$11,000	\$80,836	Medium	High
2-21 B	Downstream Side of crossing at intersection of Winona Rd and Hawkins Pond Rd (Hawkins Pond outlet stream- downstream side of crossing)		Residential	Slight surface erosion, slight road shoulder erosion, winter sand, lack of shoreline vegetation, tar lined ditch brings water from Rd and adjacent driveway into stream	Vegetate shoulder, establish buffer, add to buffer, remove tar-lined ditch and replace with infiltrating /sediment capturing structure to treat runoff properly	Medium	0.1	0.0	\$1,560	\$100	\$2,560	\$56,438	Medium	Medium
2-18	Piper Hill Road, Bear Pond stream crossing		Town Road	Undersized culvert (is currently under water), moderate road shoulder erosion, lots of winter sand, Looks like road need to be built up and new crossing constructed-water is almost to Rd level	Enlarge culvert, armor inlet and outlet extending headwalls to prevent road shoulder slumping, vegetate/stabilize shoulder, water within 4' of road shoulder-lots of sediment input	Medium	0.4	0.1	\$9,560	\$200	\$11,560	\$127,427	High	High
							<b>Total</b>	<b>54.0</b>			<b>\$94,809</b>	<b>\$1,755</b>		

**Appendix C**  
BMP Matrix Maps – All Sites

# Lake Waukewan & Winona Lake Watershed

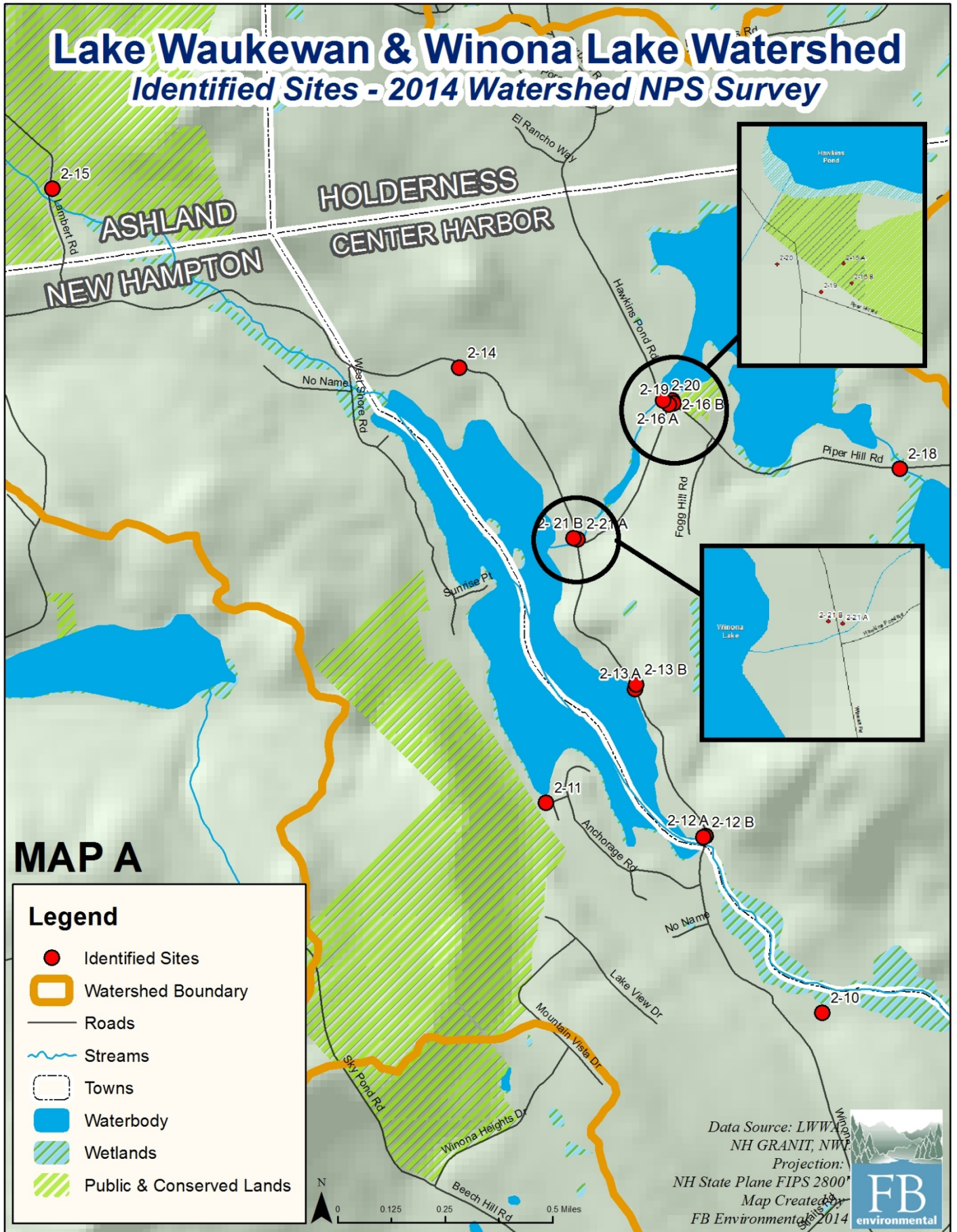
## Identified Sites - 2014 Watershed NPS Survey





# Lake Waukewan & Winona Lake Watershed

## Identified Sites - 2014 Watershed NPS Survey



**MAP A**

**Legend**

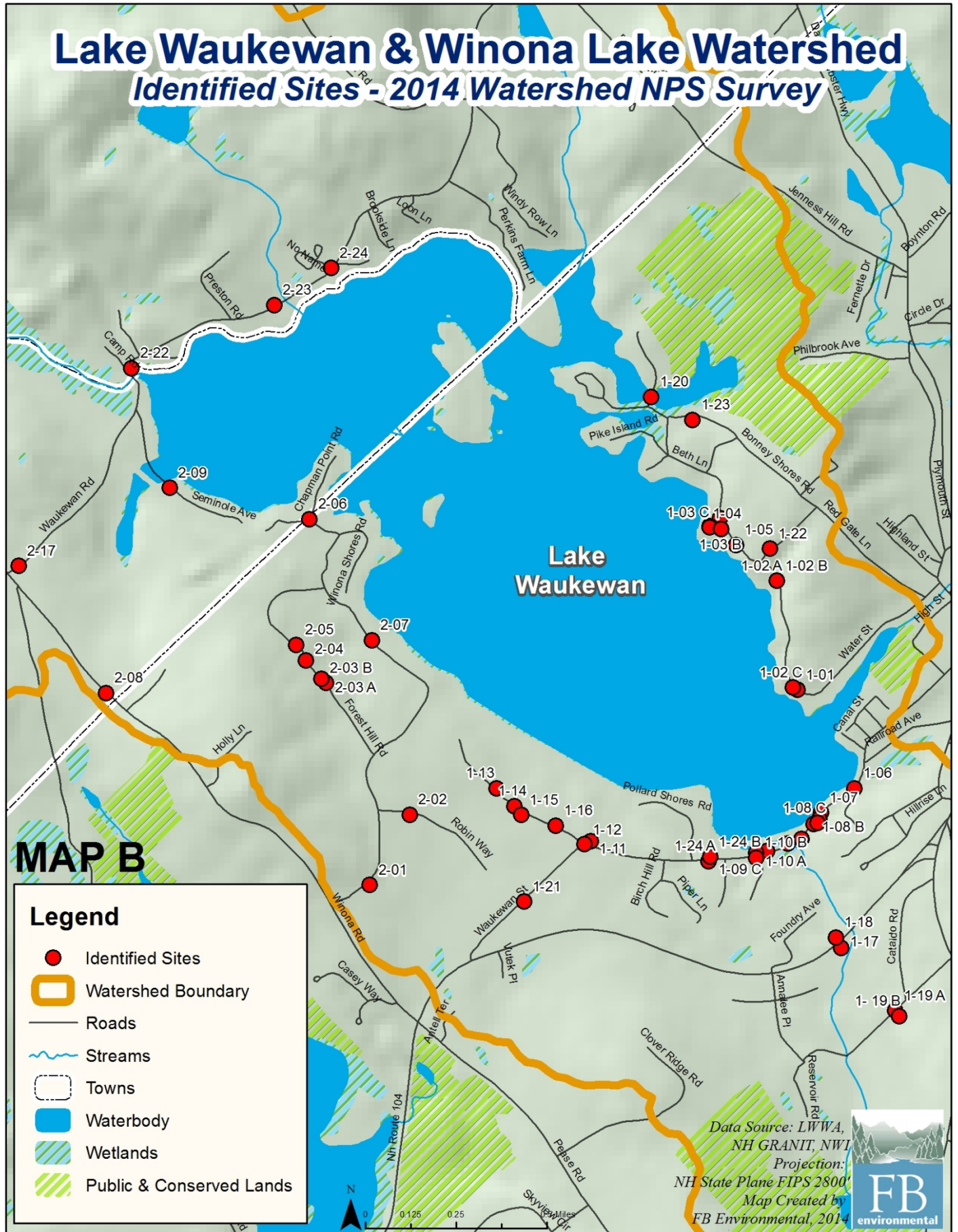
- Identified Sites
- Watershed Boundary
- Roads
- ~ Streams
- Towns
- Waterbody
- Wetlands
- Public & Conserved Lands

Data Source: LWWM  
 NH GRANT, NWP  
 Projection:  
 NH State Plane FIPS 2800'  
 Map Created by  
 FB Environmental 2014





# Lake Waukewan & Winona Lake Watershed Identified Sites - 2014 Watershed NPS Survey

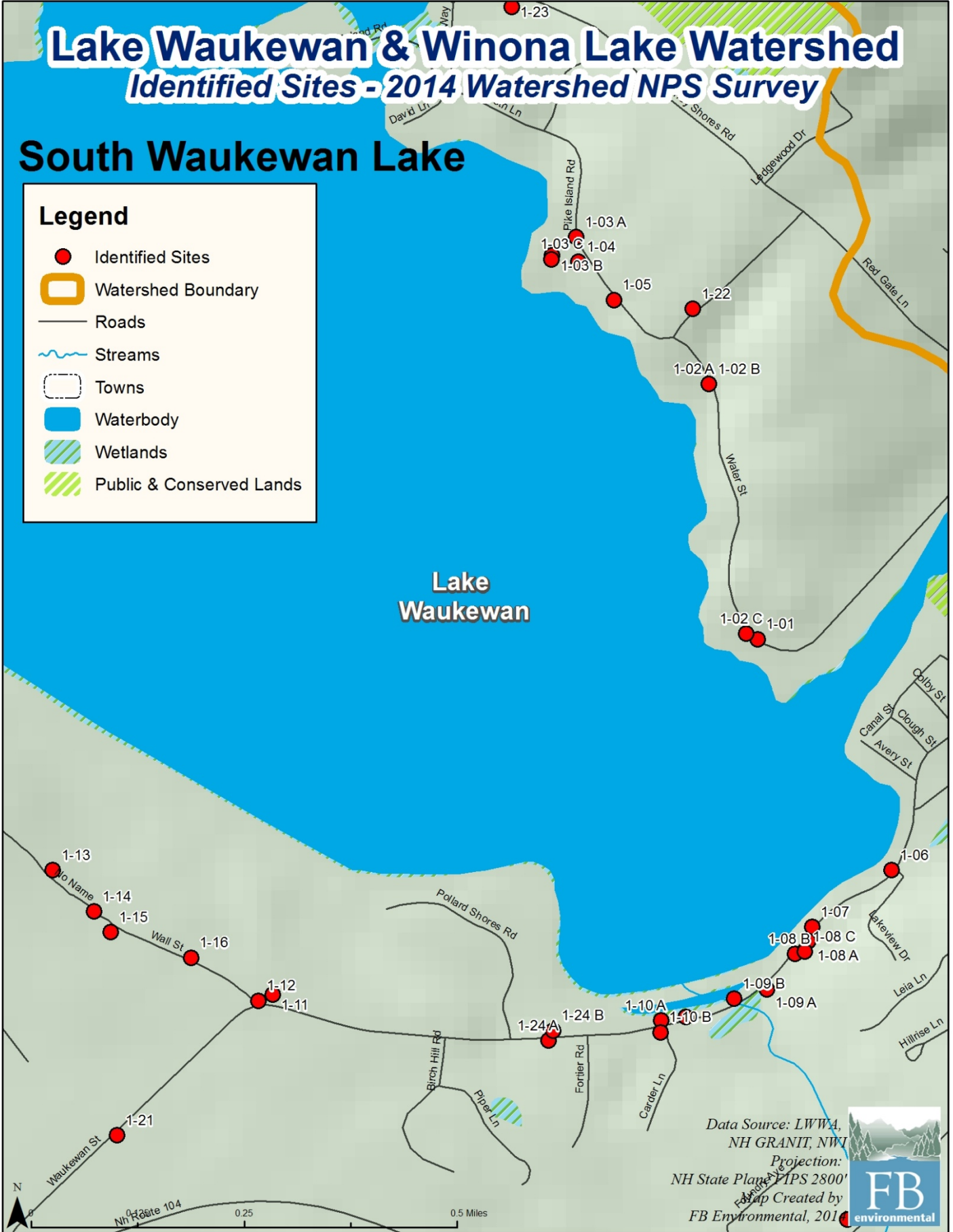


# Lake Waukewan & Winona Lake Watershed Identified Sites - 2014 Watershed NPS Survey


## South Waukewan Lake

**Legend**

- Identified Sites
- Watershed Boundary
- Roads
- Streams
- Towns
- Waterbody
- Wetlands
- Public & Conserved Lands



Data Source: LWWA,  
NH GRANIT, NW  
Projection:  
NH State Plane  
Map Created by  
FB Environmental, 2014

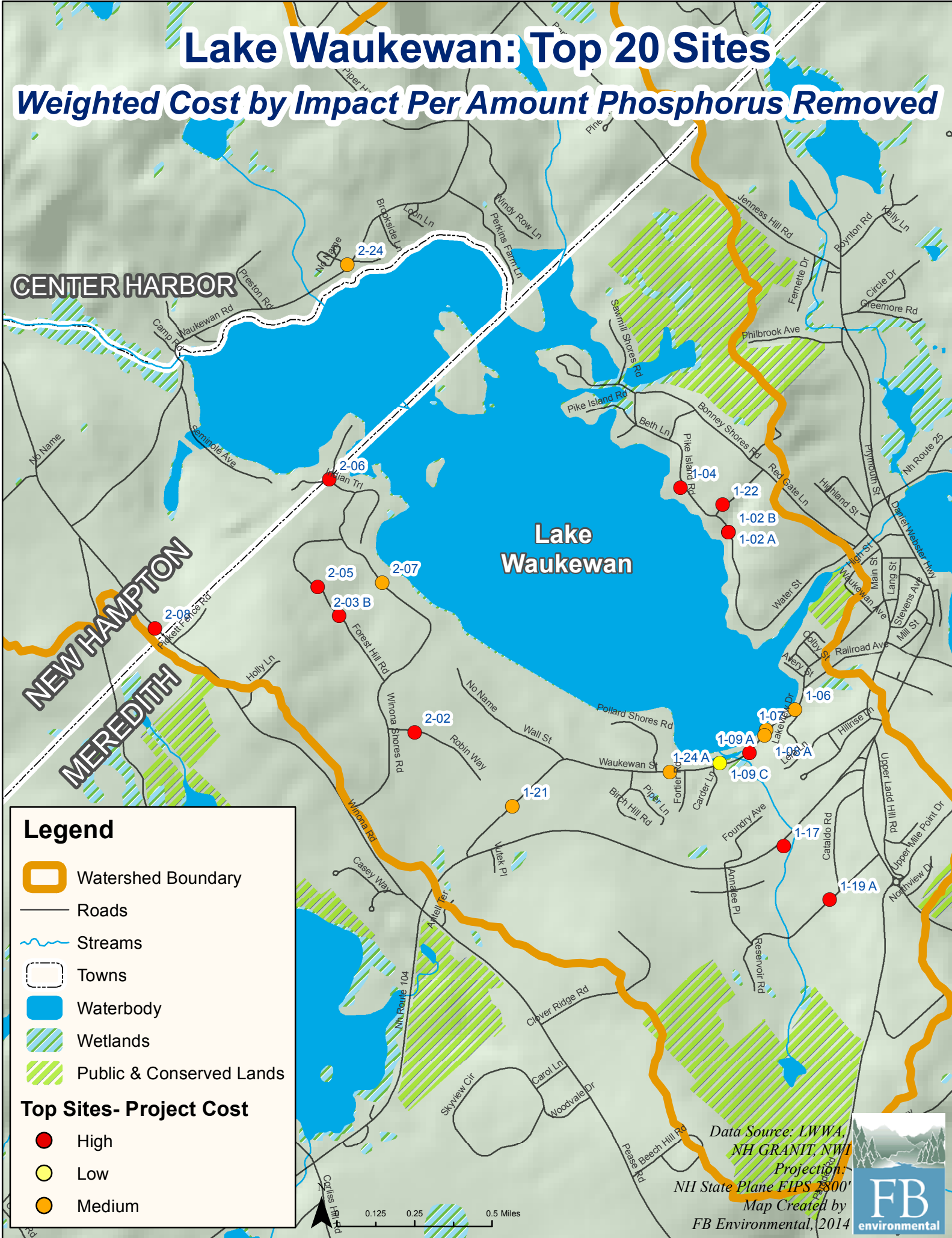


**Appendix D**  
BMP Matrix Maps – Top 20 Sites










# Lake Waukewan: Top 20 Sites




**Weighted Cost by Impact Per Amount Phosphorus Removed**



## Legend

-  Watershed Boundary
-  Roads
-  Streams
-  Towns
-  Waterbody
-  Wetlands
-  Public & Conserved Lands

## Top Sites- Project Cost

-  High
-  Low
-  Medium

0.125 0.25 0.5 Miles

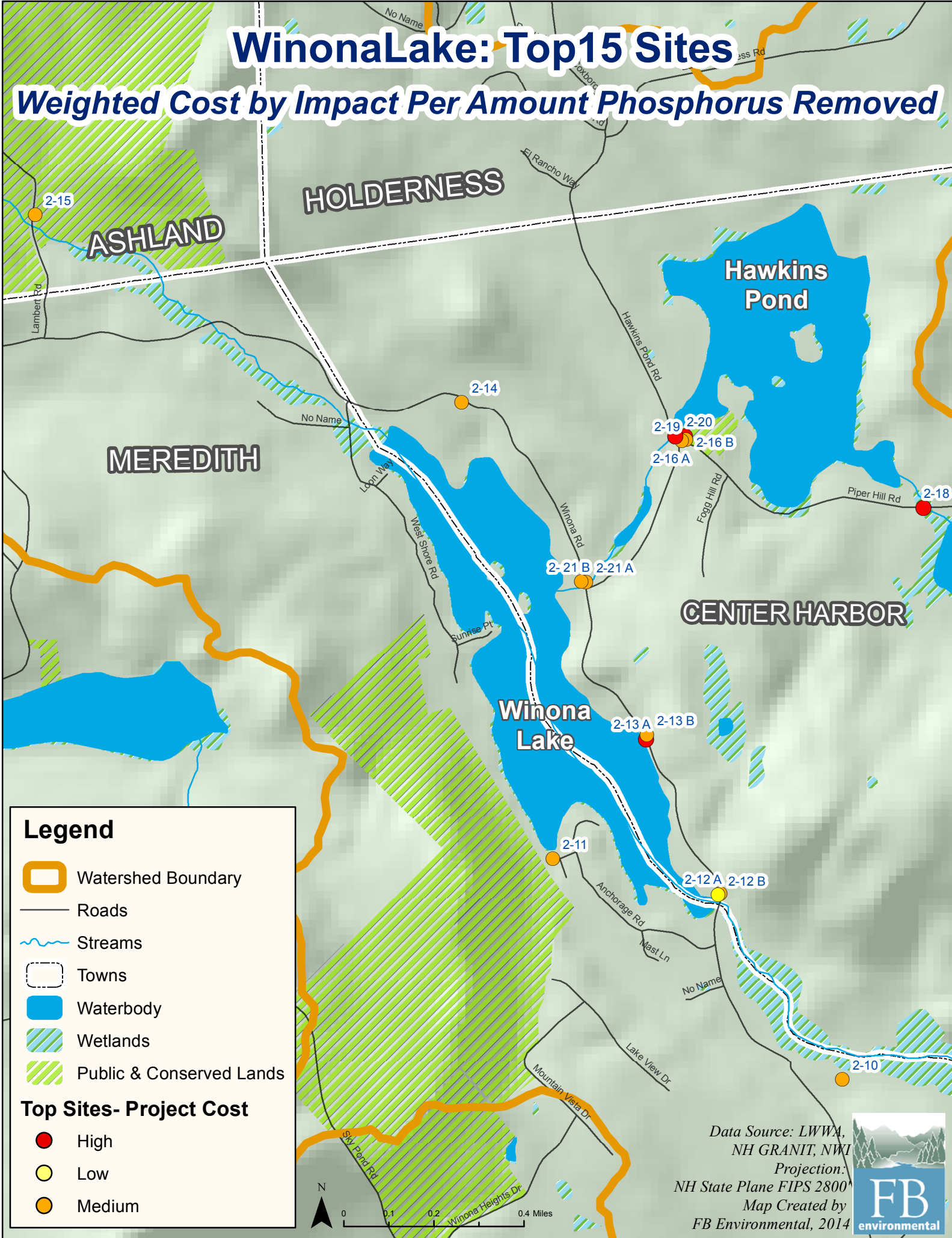
Data Source: LWWA,  
NH GRANIT, NHI  
Projection:  
NH State Plane FIPS 2800'  
Map Created by  
FB Environmental, 2014





# Winona Lake: Top 15 Sites

## Weighted Cost by Impact Per Amount Phosphorus Removed



### Legend

- Watershed Boundary
- Roads
- Streams
- Towns
- Waterbody
- Wetlands
- Public & Conserved Lands

### Top Sites- Project Cost

- High
- Low
- Medium

Data Source: LWXA,  
NH GRANIT, NWI  
Projection:  
NH State Plane FIPS 2800  
Map Created by  
FB Environmental, 2014

