Loon Lake Watershed Wetland Prioritization

Wetland ID	Flows into	Flows into	Flows into	Flows into	Flows into	Flows into	Wetland Size (acres)	Watershed Size (acres)	Watershed to Wetland Ratio	GIS/RUSLE Priority
155	162	255	Lake				14.6	973.5	66.8	1
271	280	Lake					94.1	391.3	4.2	2
166	Lake						17.6	701.9	39.9	3
203	255	Lake					49.8	533.1	10.7	4
191	175	255	Lake				73.3	435.1	5.9	5
186	Lake						74.0	424.2	5.7	6
101	Lake						13.1	413.5	31.5	7
237	255	Lake					11.2	300.5	26.7	8
318	Lake						7.7	270.6	35.2	9
114	255	Lake					5.8	291.5	50.6	10
117	114	255	Lake				5.0	272.2	54.1	11
324	Lake						12.0	275.0	23.0	12
349	363	358	Lake				8.6	204.8	23.9	13
207	191	175	255	Lake			28.3	209.8	7.4	14
315	317	324	Lake				39.2	185.0	4.7	15
370	374	Lake					11.3	225.4	19.9	16
200	203	255	Lake				7.6	243.3	32.0	17
108	136	145	166	Lake			13.3	258.3	19.4	18
35	89	255	Lake				5.3	171.4	32.1	19
84	86	155	162	255	Lake		9.5	181.7	19.2	20
319	311	Lake					39.1	158.4	4.0	21
150	154	Lake					16.4	222.2	13.5	22
363	358	Lake					33.7	254.0	7.5	23
53	47	50	52	89	255	Lake	95.8	211.2	2.2	24
106	155	162	255	Lake			5.2	151.3	29.4	25
238	237	255	Lake				3.3	120.2	37.0	26
21	Lake						3.3	123.3	37.6	27
279	Lake						3.3	92.2	27.5	28
229	271	280	Lake				14.9	91.7	6.2	29
381	Lake						14.2	99.8	7.0	30

Table 1.16 Wetland restoration priorities for the Loon Lake watershed. GIS priority rankings are based on a combination of erosion rates and size of watershed draining to each wetland (wetlands having watershed to wetland area ratios greater than 75:1 are excluded).

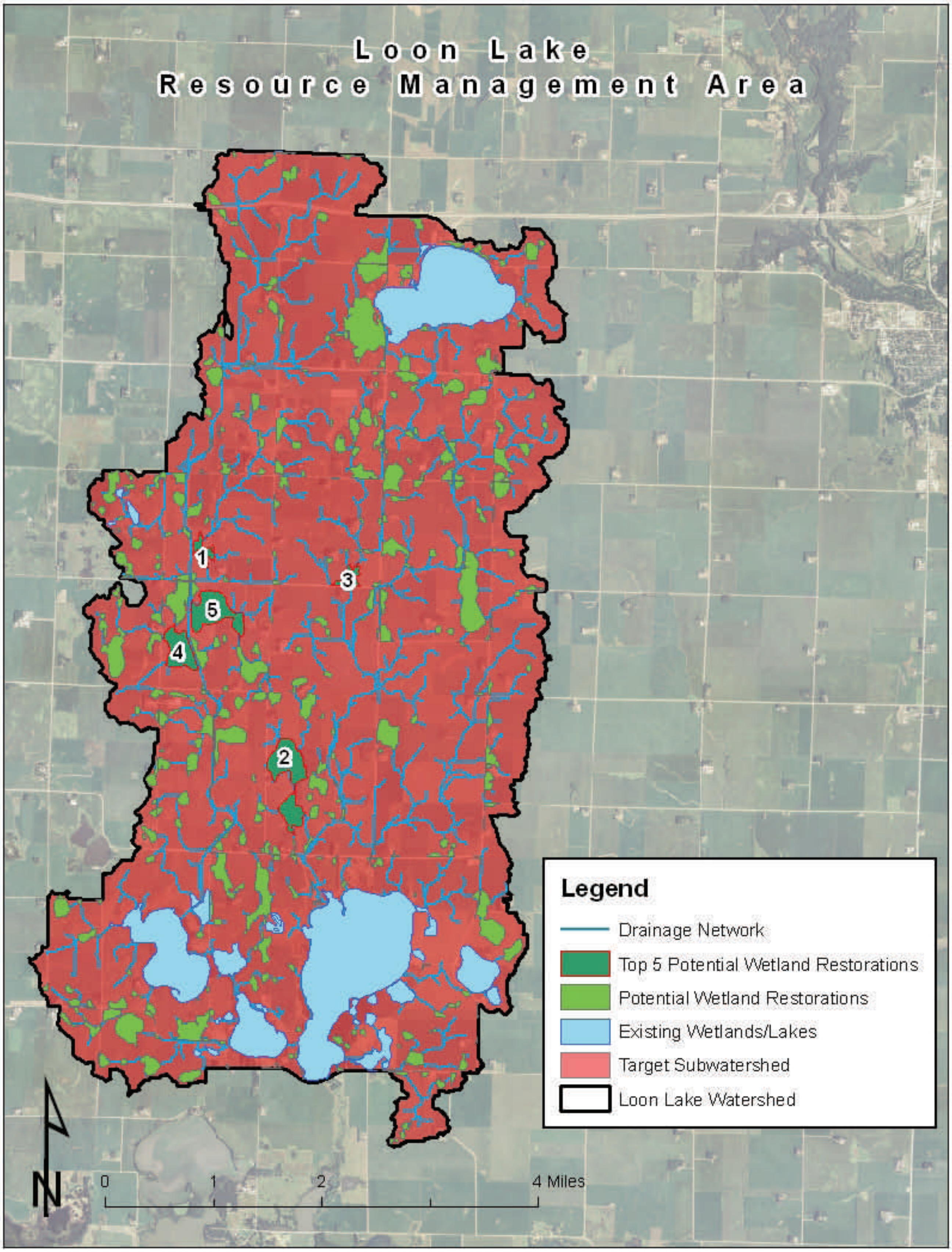


Figure 1.90 Loon Lake Priority Wetland Restoration

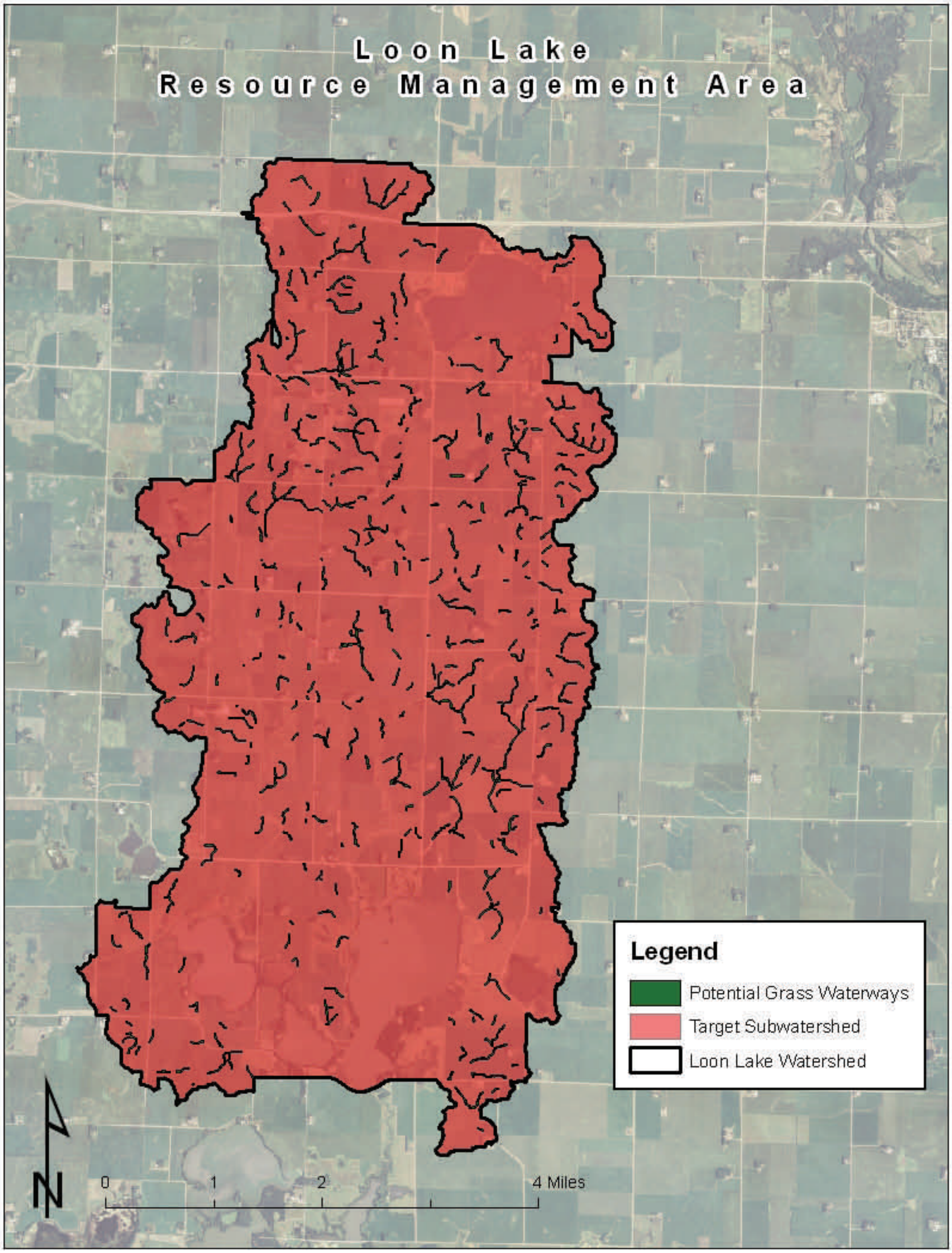


Figure 1.91 Loon Lake Priority Ephemeral Gullies

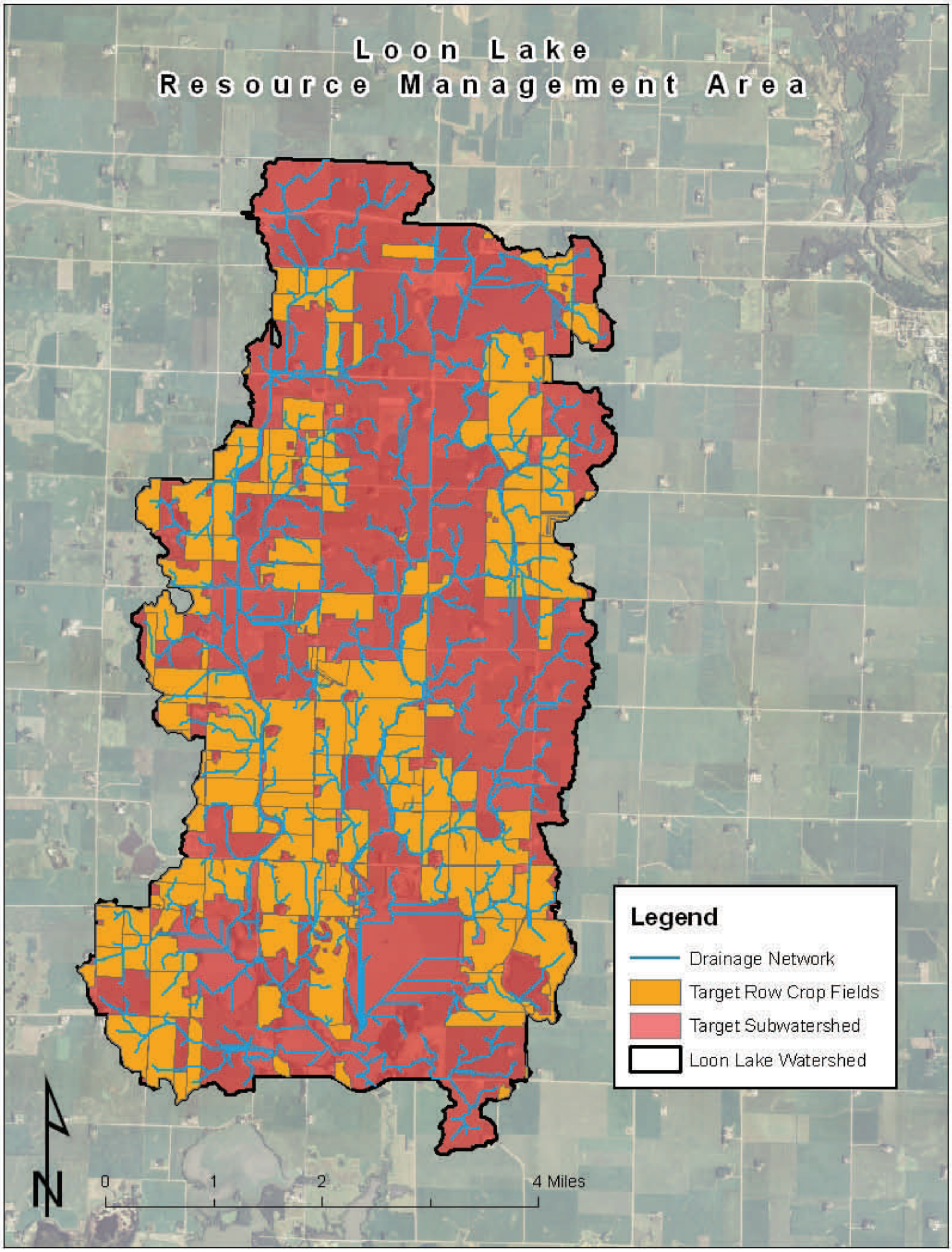


Figure 1.92 Loon Lake Target Row Crop Fields

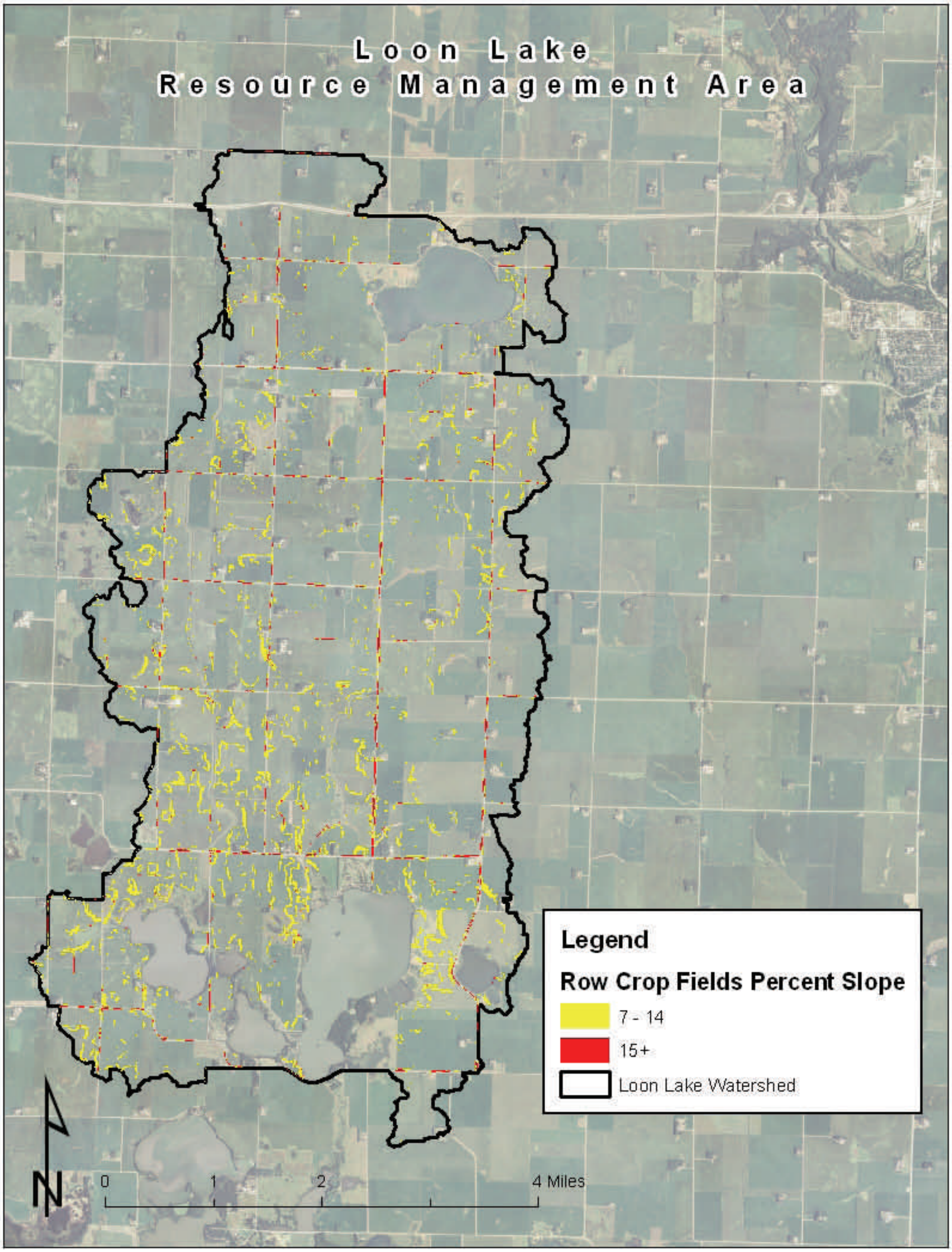


Figure 1.93 Loon Lake Target Row Crop Slopes

APPENDIX A: SOCIAL DYNAMICS ASSESSMENT

Objective **–** Reduce the amount of pollutant and runoff coming from Urban Resource Management Areas.

Description **–** The Urban Areas of the Iowa Great Lakes have undergone many hydrological changes since the pioneers first settled the Iowa Great Lakes. The reduction of wetlands and the switch from prairies to impervious surfaces left these areas of the watershed very degraded.

When healthy, a series of shallow wetlands provide important watershed protection to the lakes of the Watershed. These areas also provided critical fishery and wildlife habitats. A holistic approach is needed to restore ecological health and water quality within the areas identified as urban resource management areas. A combination of both watershed and lake management practices is needed to reach the project objective.

Sediment, nutrients, and water volume loadings from the urban areas should be reduced utilizing Low Impact Development and other conservation practices. Low Impact Development practices help to reduce runoff, filter pollutants, and cool the water before it reaches the lake. The figures to follow show where the majority of runoff comes from in the Urban RMA's as well as storm sewer intakes. In addition, there are figures that show storm sewer intakes that are easily retrofitted to rain garden/bio-retention cells. The Low Impact Development practices to be used include, but are not limited to, rain gardens, bio-retention cells, infiltration trenches, grassy swales, soil amendments/improvements, deep tillage, deep aeration, and others.

<u>Pollution Reduction</u>
The Iowa Great Lakes has a significant area of urban or urbanizing land. The density of urban area is proportional to the amount of runoff from a site. When runoff comes from an urban area it is nearly all unfiltered and contains a high level of pollutants to include phosphorous, nitrates, zinc, copper, antifreeze, and motor oil. Areas where more than 50% of a rain even runs off into the storm sewer system should be treated with Low Impact Development (LID) Practices to reduce the overall runoff from a high level to a moderate or less level. Using assigned LID to treat these areas will reduce the pollutant level as well as the "flashy" rise and fall of the lakes water level. This flashy water level is a cause of shoreline erosion and poor emergent vegetation growth.

Using a variety of practices recommended in the <u>Statewide Urban Design and Specifications</u> in the locations with the highest runoff value will give the greatest benefit for the dollars spent. In addition, a culture of ordinances and regulations which favor low impact development on existing and new construction sites should be encouraged. The goal is to reduce the reduce the runoff value from more than 60% runoff to 30% runoff or less on those sites with high runoff values. Using LID practices, the runoff will be slower, less in volume, and carry fewer pollutants with it. According to the Iowa Stormwater Management Manual the practices identified in its pages reduce pollution by around 30% to as much as 85% by using these criteria. The pollution caused by urban runoff will be reduced proportionately with the runoff volume creating a pollution reduction in all urban areas from 30% to 60%.

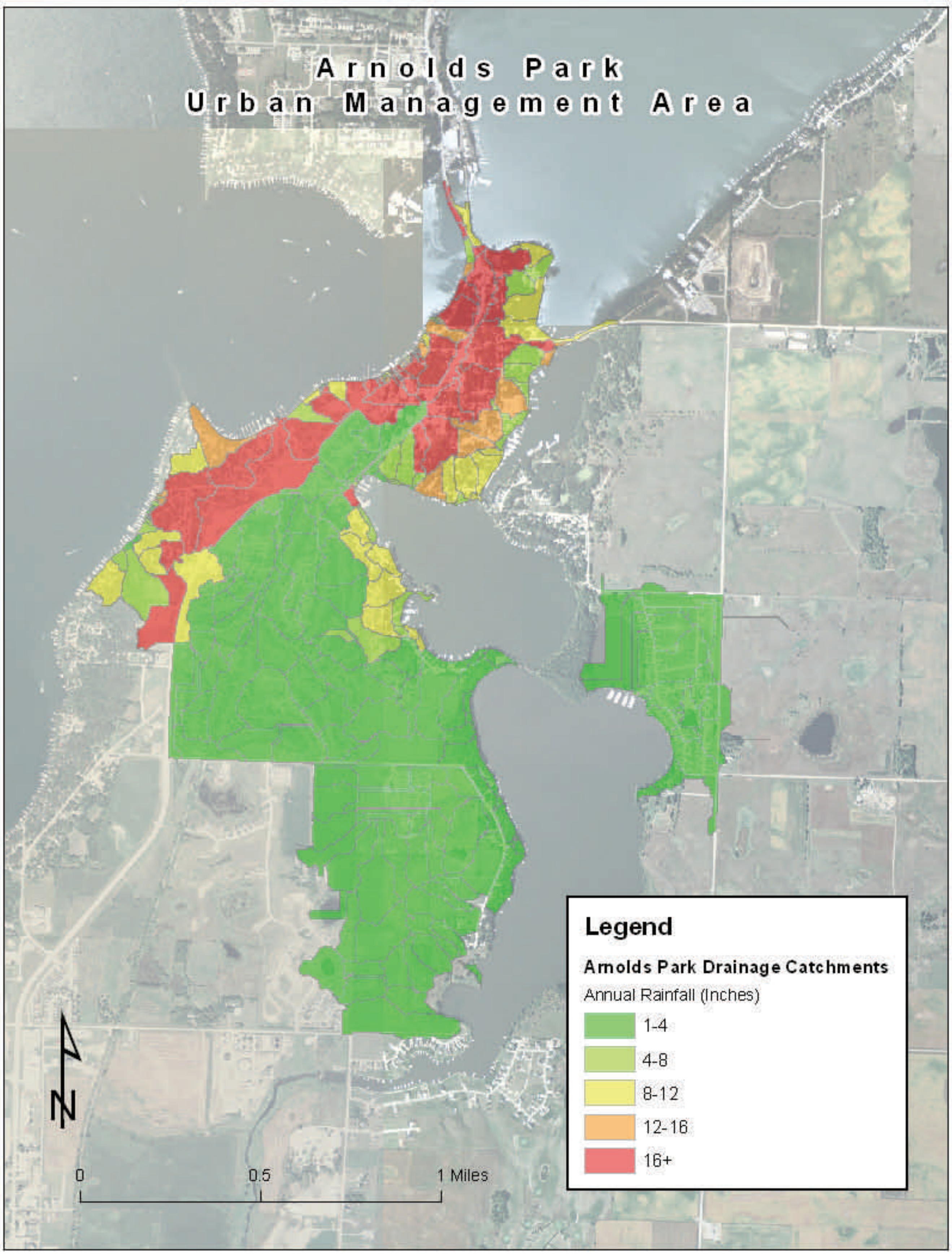


Figure 1.94 Arnolds Park Drainage Catchments

Figure 1.95 Arnolds Park Storm Sewer locations

Figure 1.96 Arnolds Park Easily Retrofitted Storm Sewers

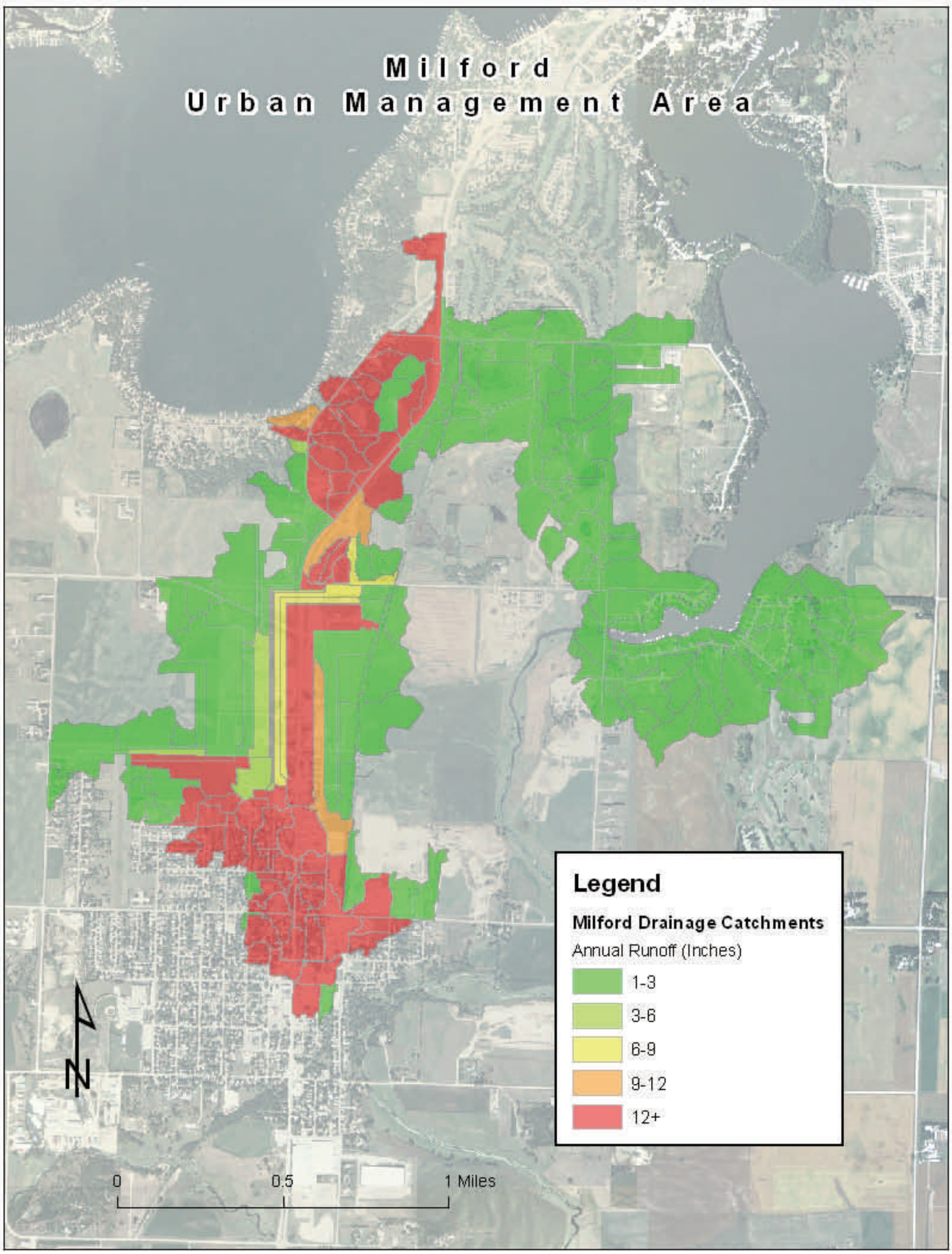


Figure 1.97 Milford Drainage Catchments

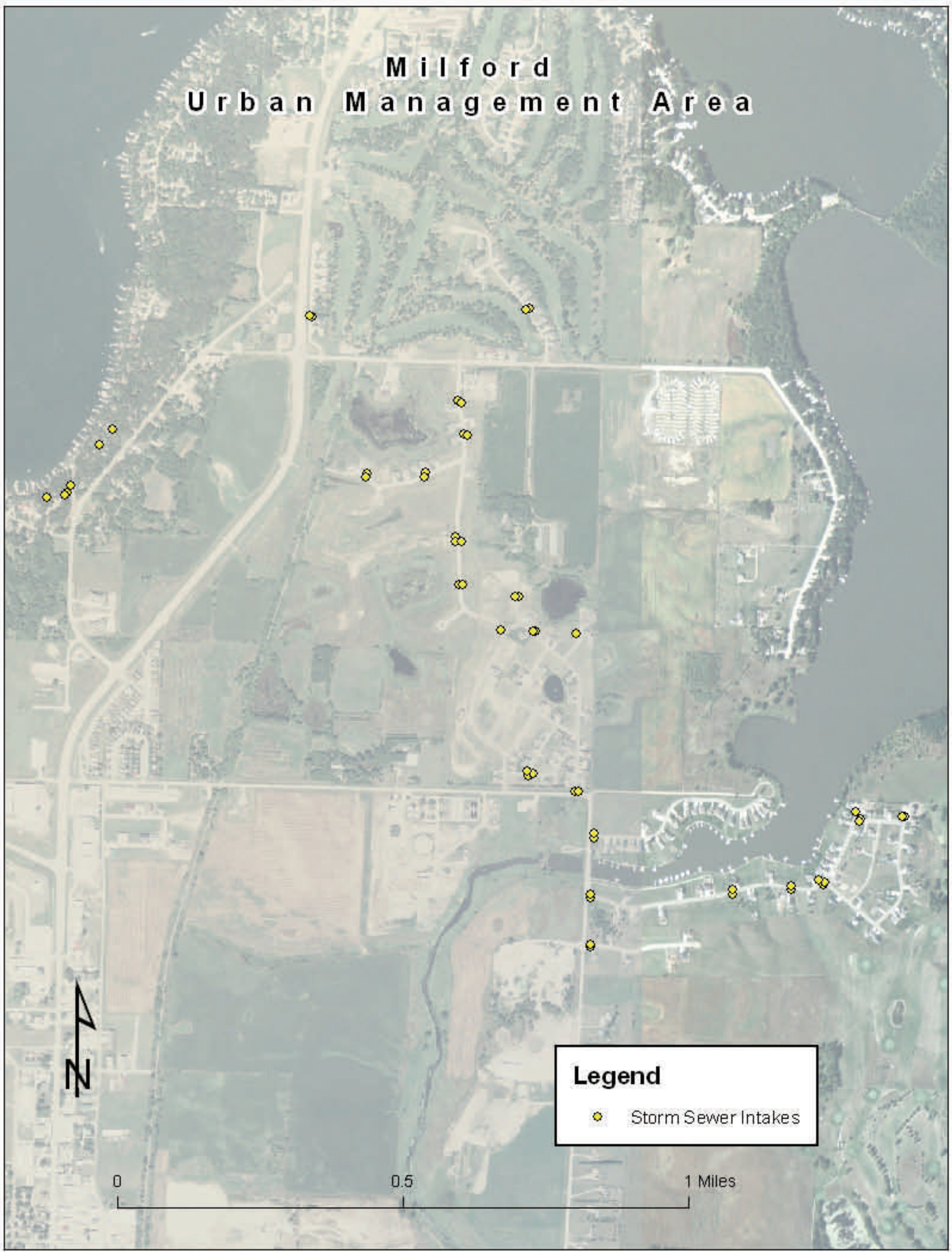


Figure 1.98 Milford Storm Sewer Intakes

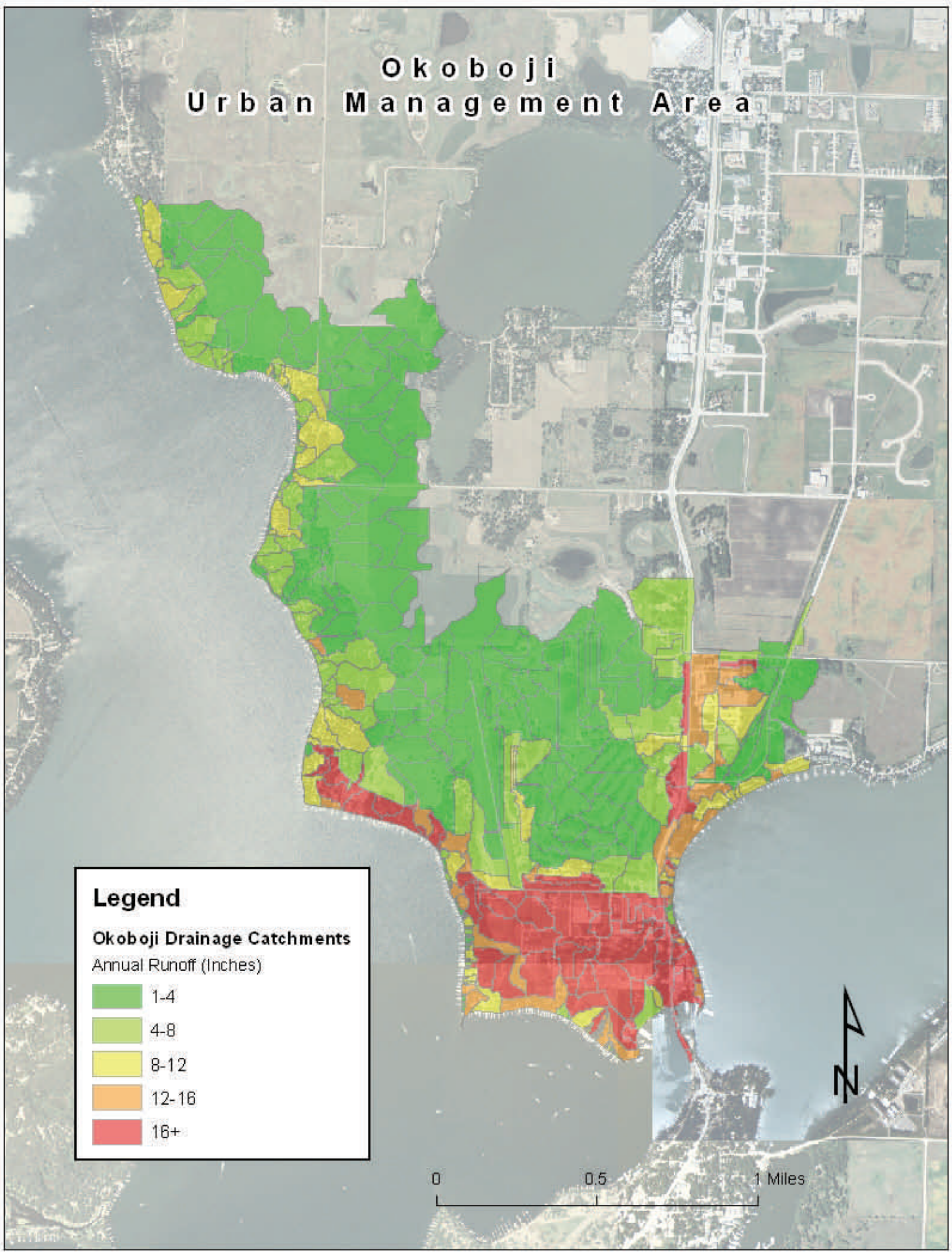


Figure 1.99 Okoboji Drainage Catchments

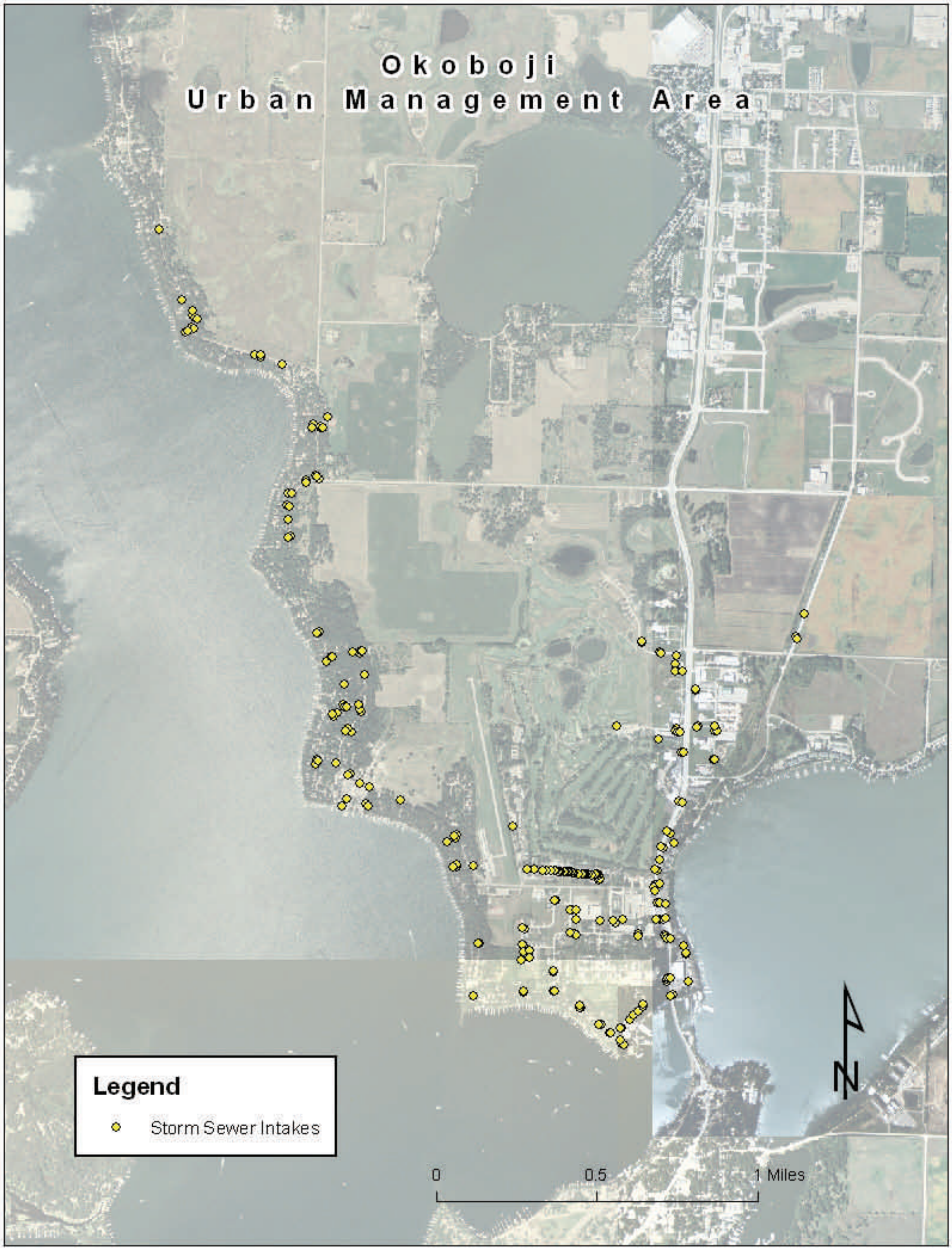


Figure 1.100 Okoboji Storm Sewer Locations

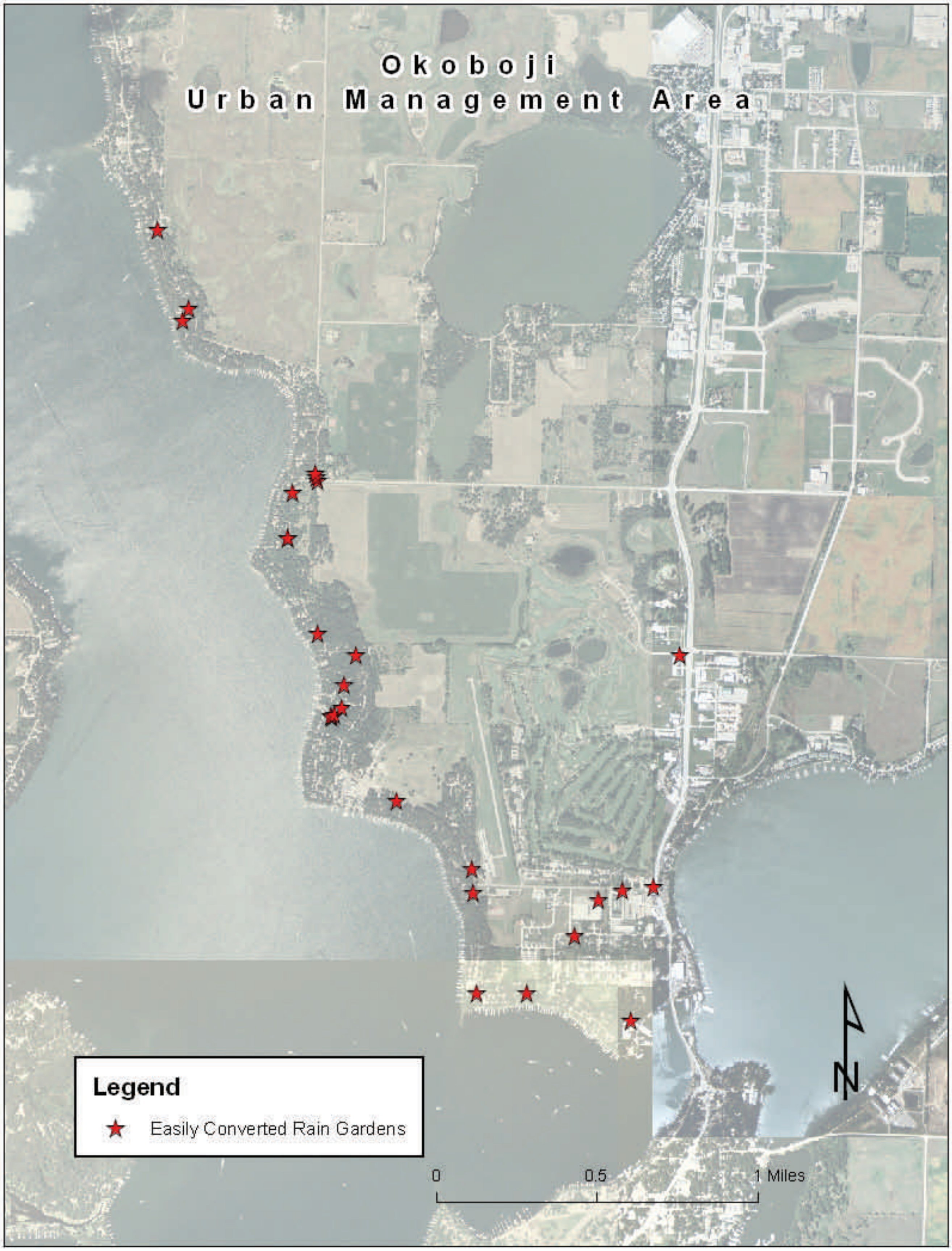


Figure 1.101 Okoboji Easily Retrofitted Storm Sewers

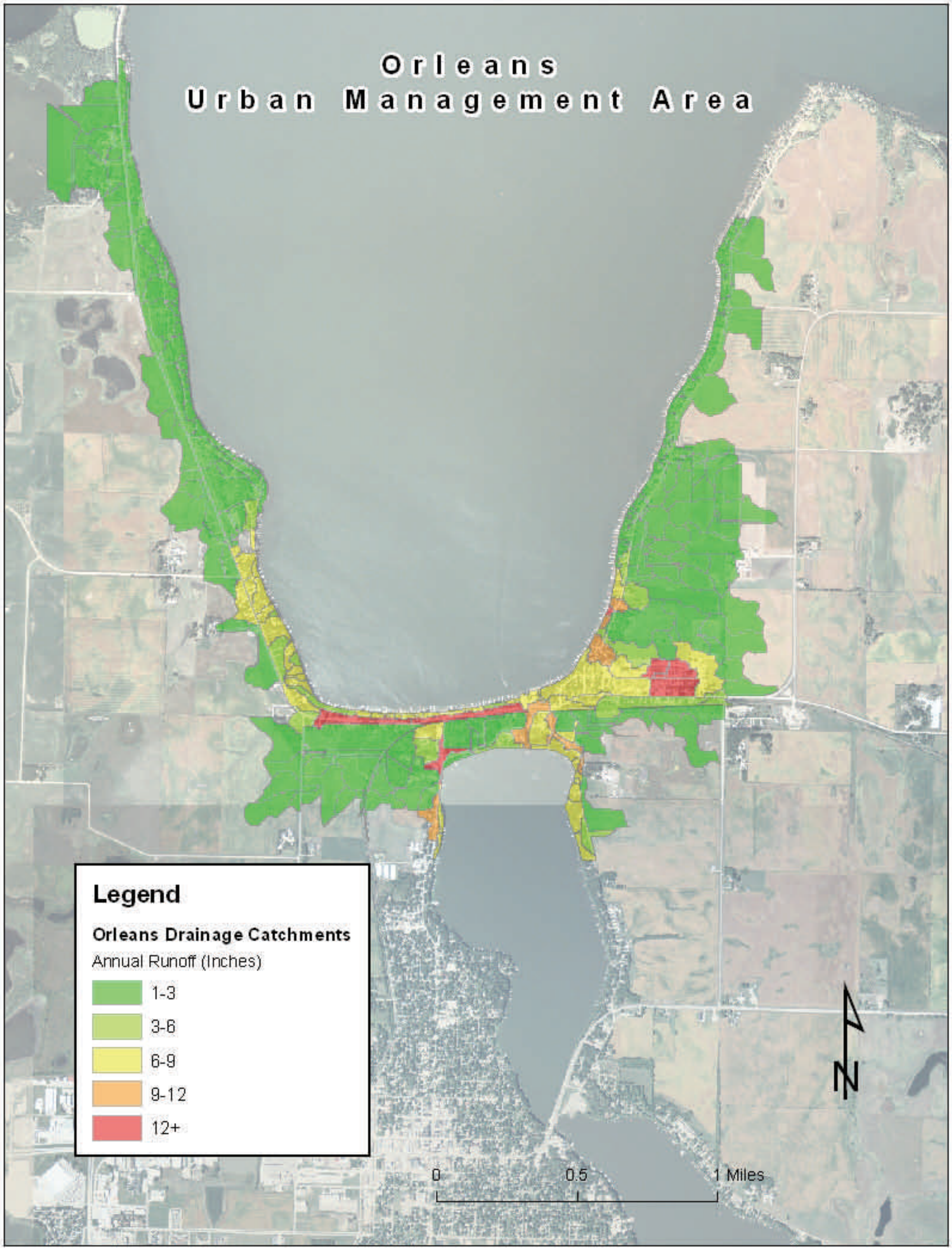


Figure 1.102 Orleans Drainage Catchments

Figure 1.103 Orleans Storm Sewer Locations

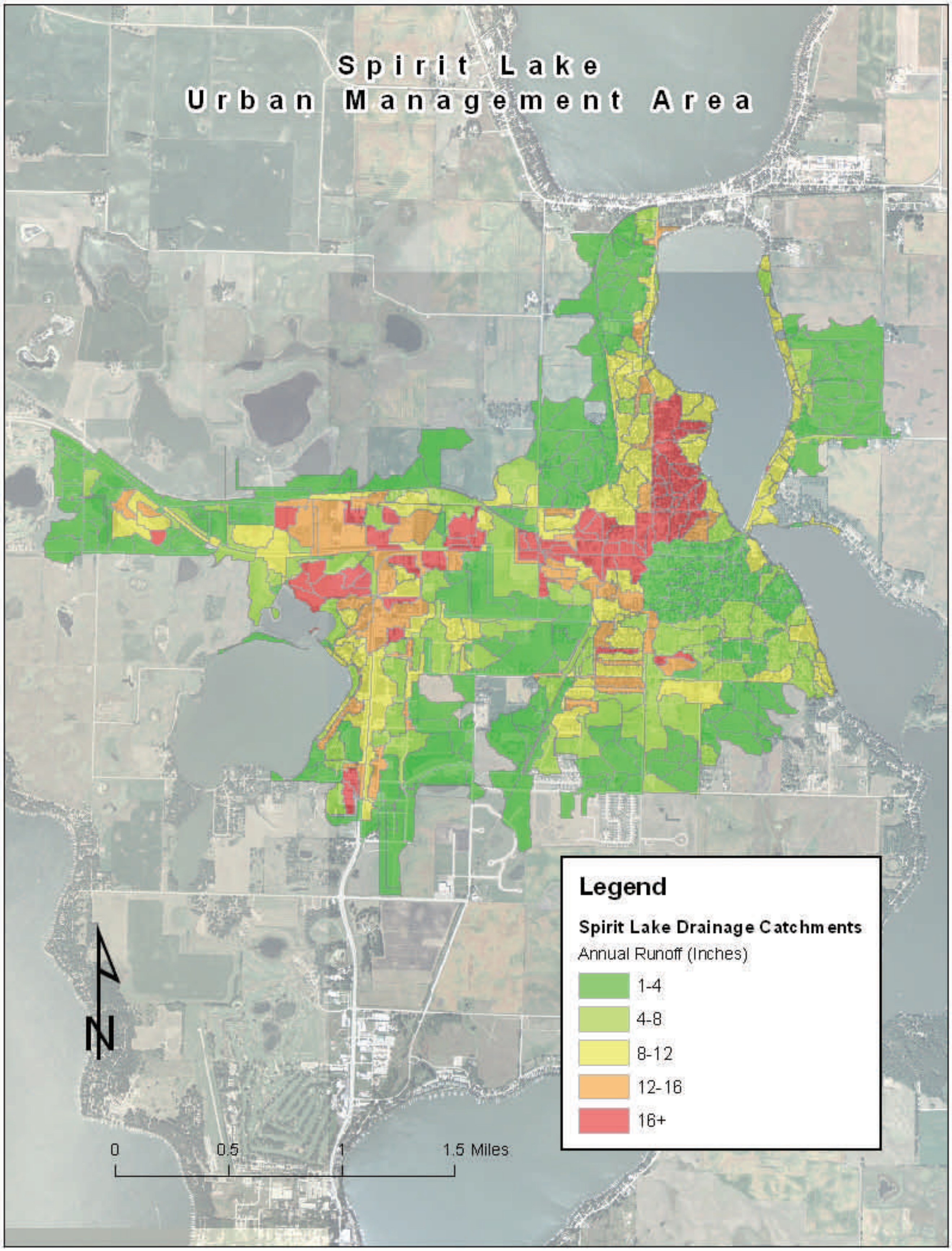


Figure 1.104 Spirit Lake Drainage Catchments

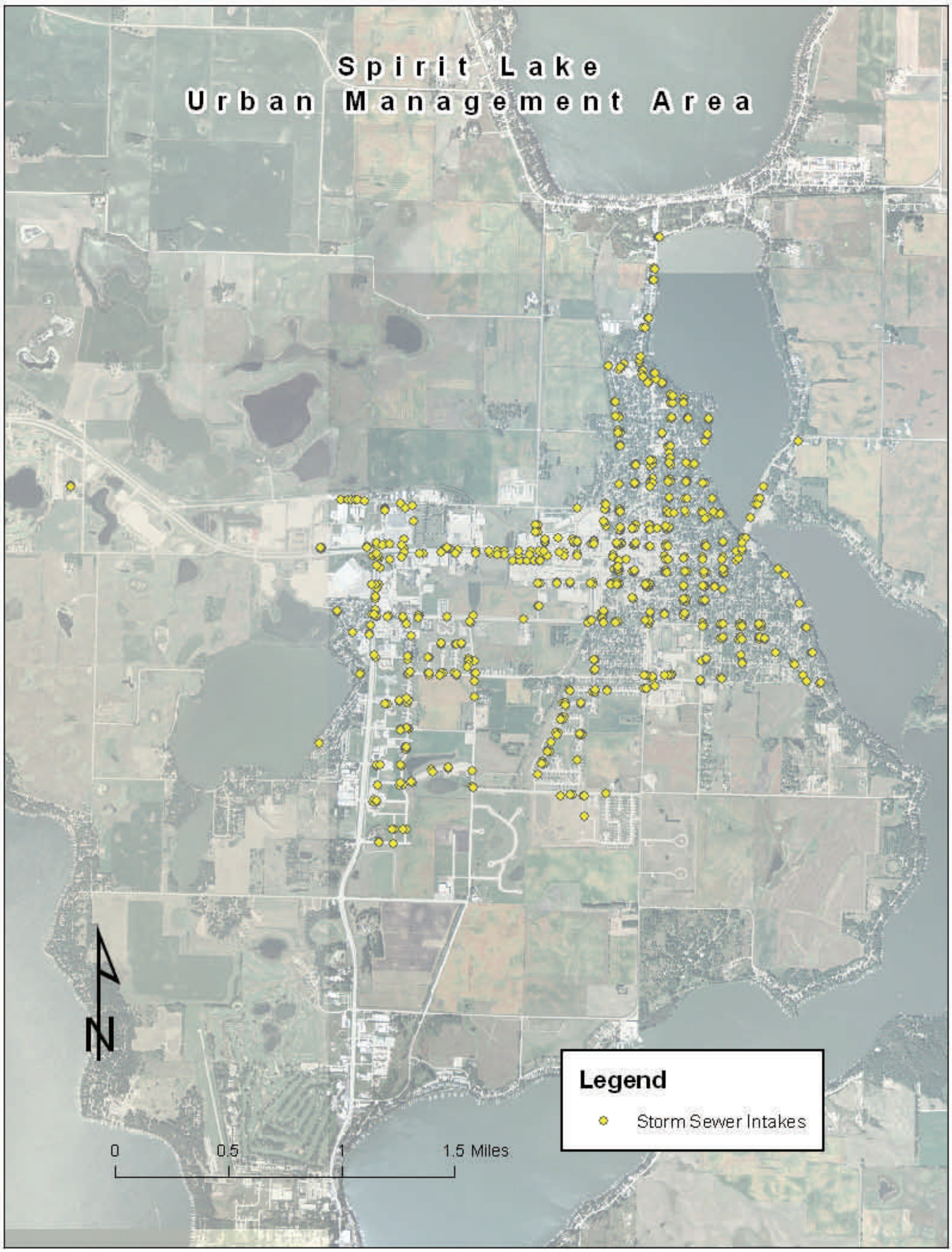


Figure 1.105 Spirit Lake Storm Sewer Locations

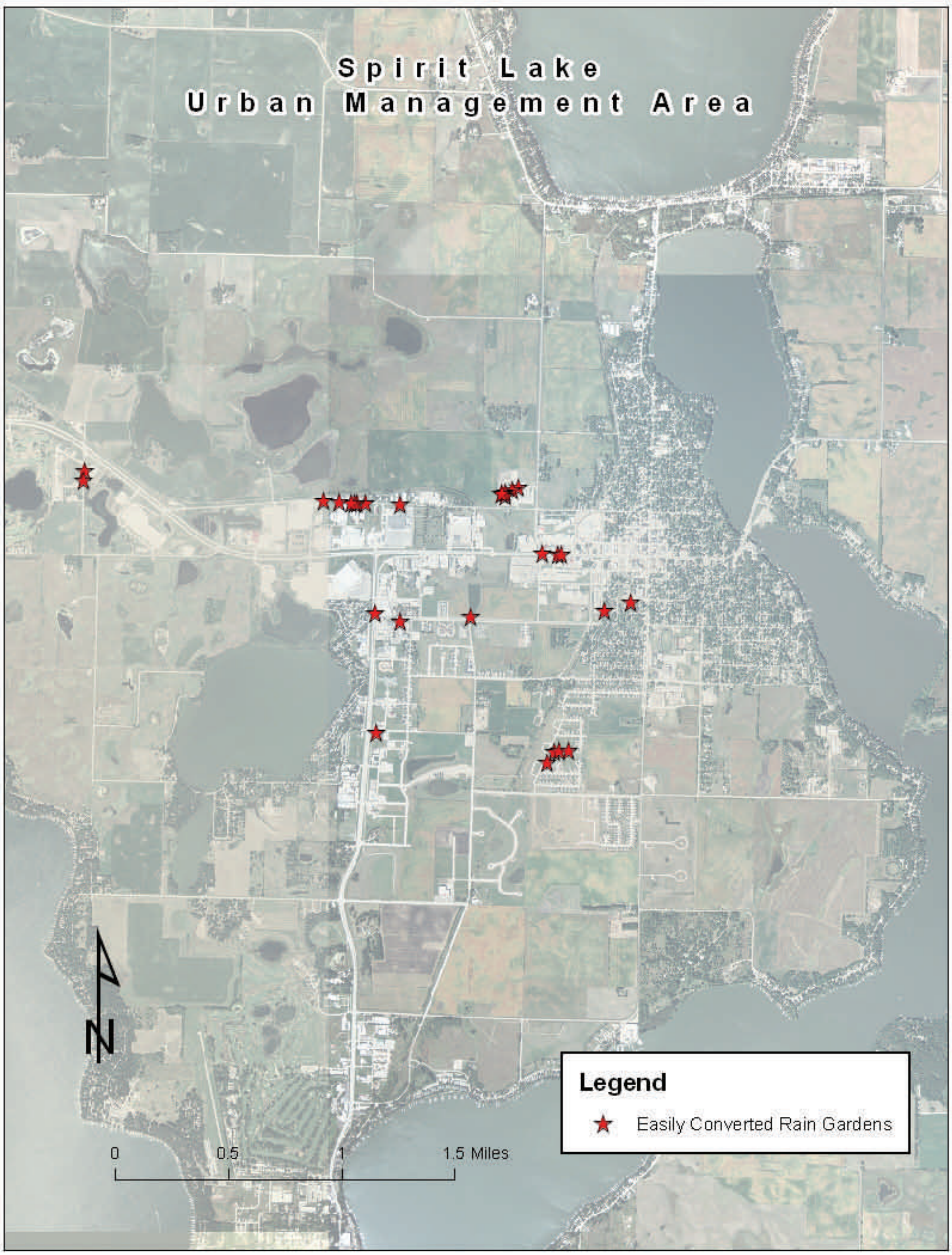


Figure 1.106 Spirit Lake Easily Retrofitted Storm Sewers

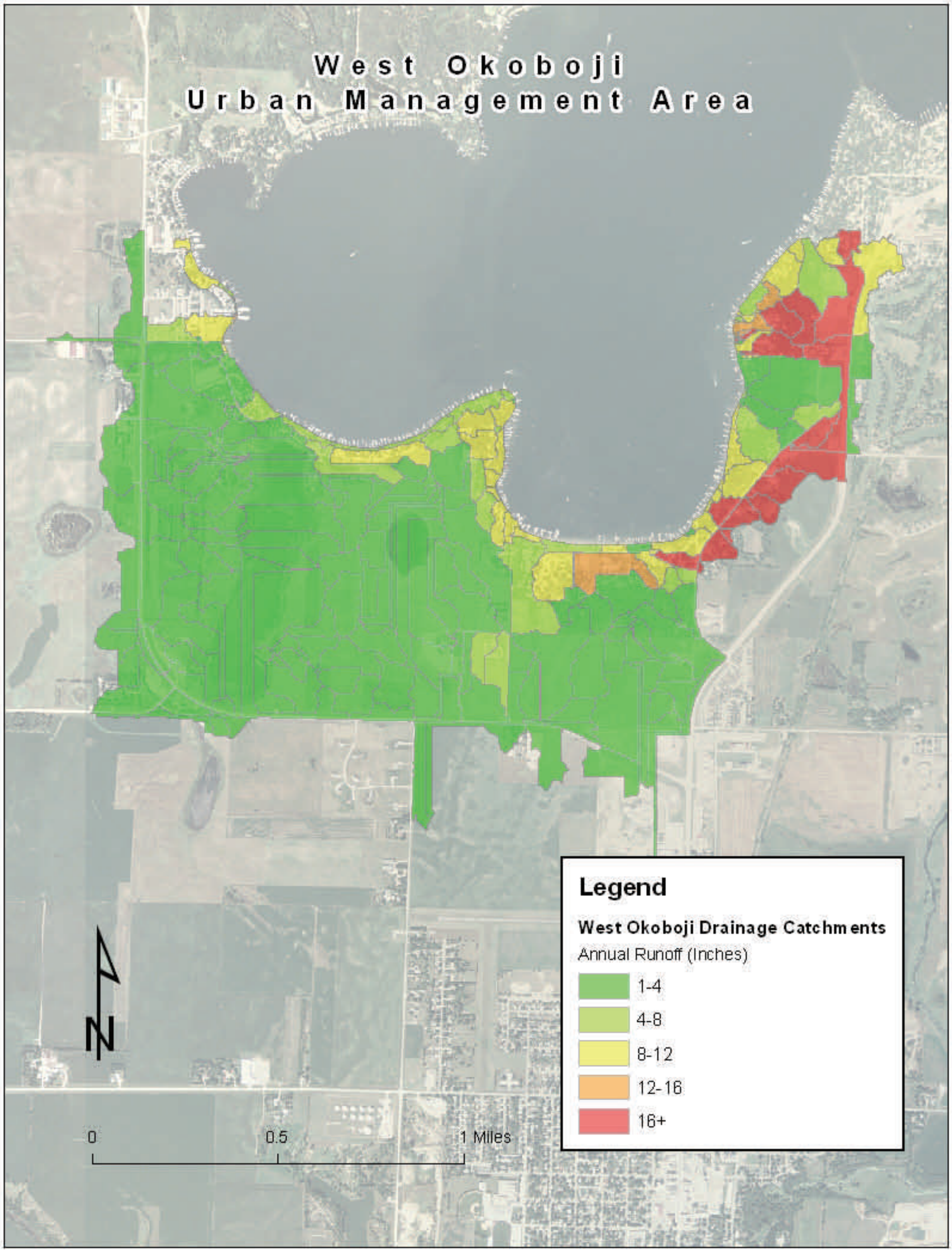


Figure 1.107 West Okoboji Drainage Catchments

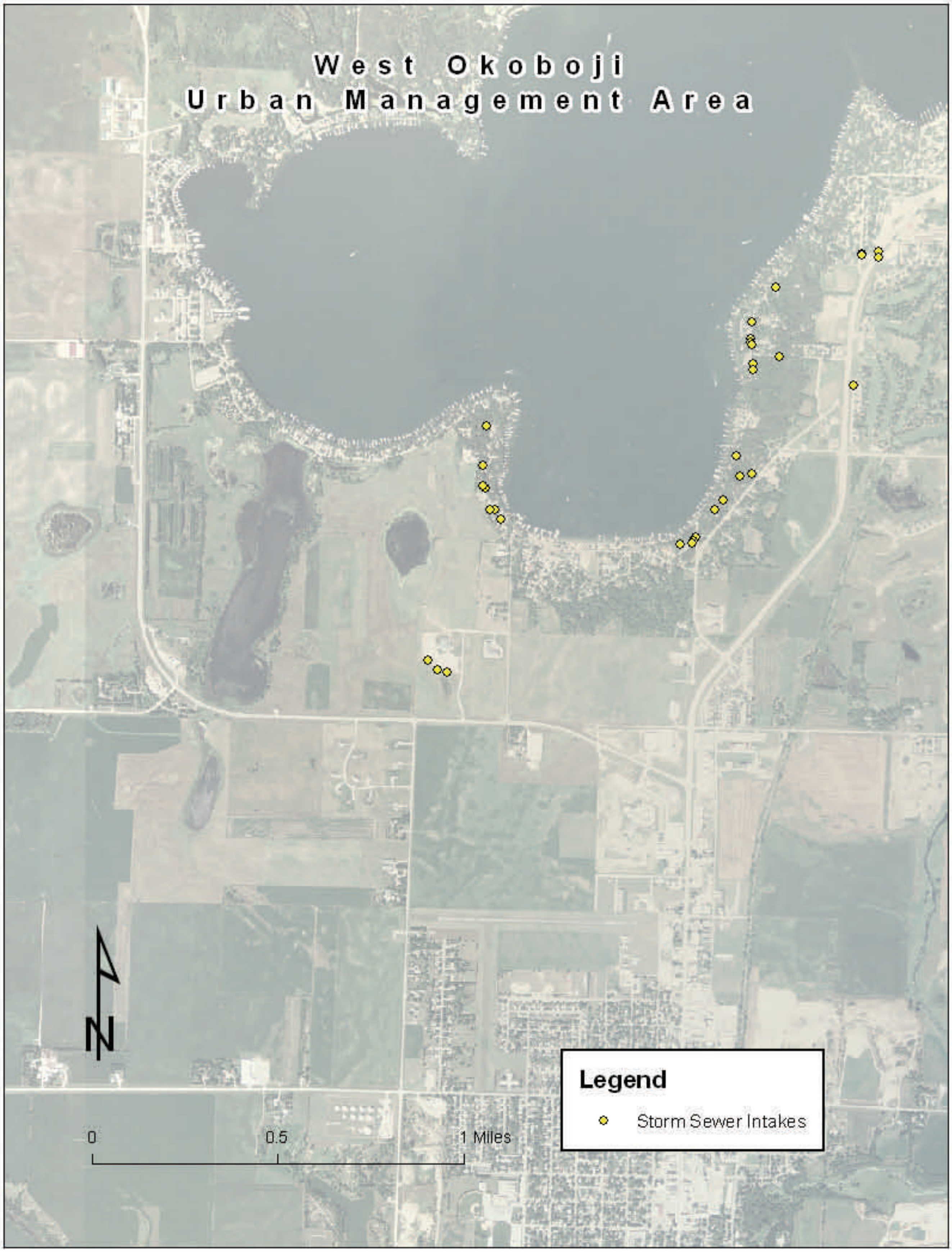


Figure 1.108 West Okoboji Storm Sewer Locations

Figure 1.109 West Okoboji Easily Retrofitted Storm Sewers

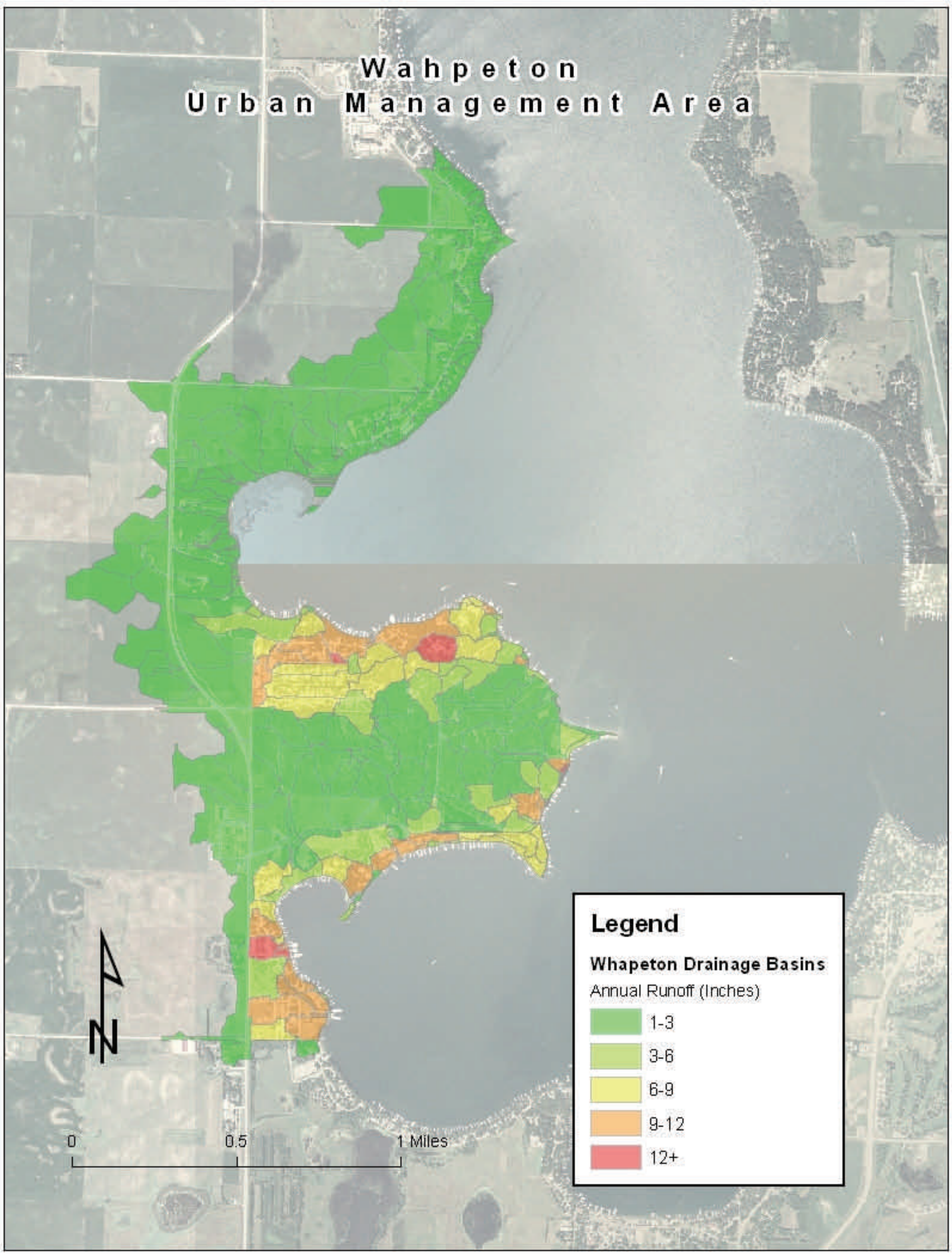


Figure 1.110 Wahpeton Drainage Catchments

Figure 1.111 Wahpeton Storm Sewer Locations

Figure 1.112 Wahpeton Storm Easily Retrofitted Storm Sewers

1000-FOOT LAKESHORE BUFFER ZONE

Objective **–** Reduce the amount of pollutant and runoff coming from the area closest and most detrimental to the lakeshore.

Description **–** Within 1000 feet of lakeshore of the Iowa Great Lakes, there are areas of urban development, rural farmland, golf courses, recreation areas and timber land. In these areas, there are practices that can be put in place to reduce runoff, sediment delivery and contaminants that are flowing into the IGL. Once implemented, we are hopeful that the quality of the water flowing into the lakes from this buffer will be greatly improved. This zone is critical to the ecosystem as the water from this area has almost instant access to the lakes in a storm and will have the least amount of time to filter out contaminants.

<u>Urban Development</u>: Currently, the residents of this area are accepting of Low Impact Development (LID) practices, but more can be done to implement them on a wider scale. There are projects currently in the planning and early development phase utilizing LID in whole residential developments that will be used as models for years to come for the entire State of Iowa. Practices that will be commonplace in the IGL include:

- Rain Gardens: Naturally filter runoff through the soil as opposed to running off the surface directly into the lake or storm drain
- Pervious Pavers: Paving systems that allow the runoff to naturally filtrate into the soil
- Shoreline Restoration: re-introduce naturally occurring vegetation to the shoreline ecosystem to reduce shoreline erosion due to wind, waves, and humans
- Bioretention Cells: slows the flow of water to reduce erosion on a larger scale than a rain garden (for commercial scale projects)

<u>Recreation Areas &Timberlands</u>: There are many acres of timber in the Iowa Great Lakes region. Most is located on public land and some is in private residential areas. The public may use the land for hunting, camping, hiking and nature walking. The main problem caused by these areas is soil erosion. Since the trees are so dense, the sunlight does not reach the ground to promote new vegetation growth. Without the root system of the small plants on the floor of the forest, the soil is at risk for washing away in a small storm. The larger storms are capable of degrading the forest to such an extent of washing away soil around tree roots making them vulnerable to falling over in strong winds. Some of the following practices would help reduce the soil erosion making the areas safer and more desirable for recreational uses.

- Rock lined gulley: reduce soil erosion due to flowing water
- Shade loving grasses & ground covers: reduce soil erosion in areas where vegetation is sparse due to low sunlight
- Controlled burns: reduce debris and get rid of dead trees, branches, leaves and any other natural hindrance for new, young growth
- Reduce the number of trees so a savannah type landscape is achieved.

<u>Rural Farmland</u>: There are a few farm fields that exist within the 1000 foot zone of the Lakes. Most of the operators of the farms are concerned with the runoff factors associated with normal maintenance of the land. Incentives could make some conservation practices a more attractive option for farmers who might be interested in improving their operation above what is required.

- CRP: reduce the amount of surface soil area that could end up as flowing sediment (erosion) into the water system

- Conservation tillage & Nutrient and Pest Management: reduce erosion & the amount of natural & synthetic chemicals that could become suspended in the water system
- Grassed waterways: reduce soil erosion, slows the flow of storm water to reduce the chance of gulley formation

<u>Golf Courses</u>: Currently there are 4 golf courses that have land within the buffer area. A golf course has to improve the quality of the course in order to draw in golfers. Because of this courses may use a large amount of fertilizers and pesticides to enhance the vegetation. In addition irrigation is used a great deal on golf courses which causes greater runoff during rain events.

- Fertilizers: more stringent requirements on types and amounts of chemicals put on fairways, greens & roughs within 1000' of the lakeshore
- Buffers around water features: give an additional safeguard against runoff contaminants flowing into the water features
- Additional water features (wetland areas) or any other urban conservation practice: helps to slow and clean the water eventually flowing in to the lakes system

IMPLEMENTATION SCHEDULE

"You can always amend a big plan, but you can never expand a little plan. I don't believe in little plans. I believe in plans big enough to meet a situation which we can't possibly foresee now."

Harry S. Truman

It is not likely that the water quality of the Iowa Great Lakes will ever equal or exceed that of pre-settlement. However, as in the picture below, from 1910, the water quality of our lakes has great potential to become sustainable and desirable for its highest and best use, which in many instances is contact.

Swimmers near Arnolds Park in the 1930's

The difficulty in assigning an implementation schedule for a watershed the size of the Iowa Great Lakes is trying to foresee any delays, human caused or weather related, and how to understand the relationship of how fast a water body can react to treatment conditions. In some instances a 10% reduction of sediment may boost the water quality to a sustainable and desirable level but in another it may actually create a different problem than was being experienced prior to the treatment. In the second example, a new treatment schedule would need to be planned.

What can be done is create an implementation schedule that does not have firm dates but rather create an "order of importance" to it. For instance, Figure 1.113 shows the agricultural areas in the IGL which produce 30% of the sediment that reaches a water body or basin. Those are the areas that need to be treated adequately, first, prior to moving onto new management areas. In addition to agricultural areas, urban areas are a significant source of pollutants to the Iowa Great Lakes. The areas that produce at least 60% runoff from those urban areas are shown in Figure 1.114.

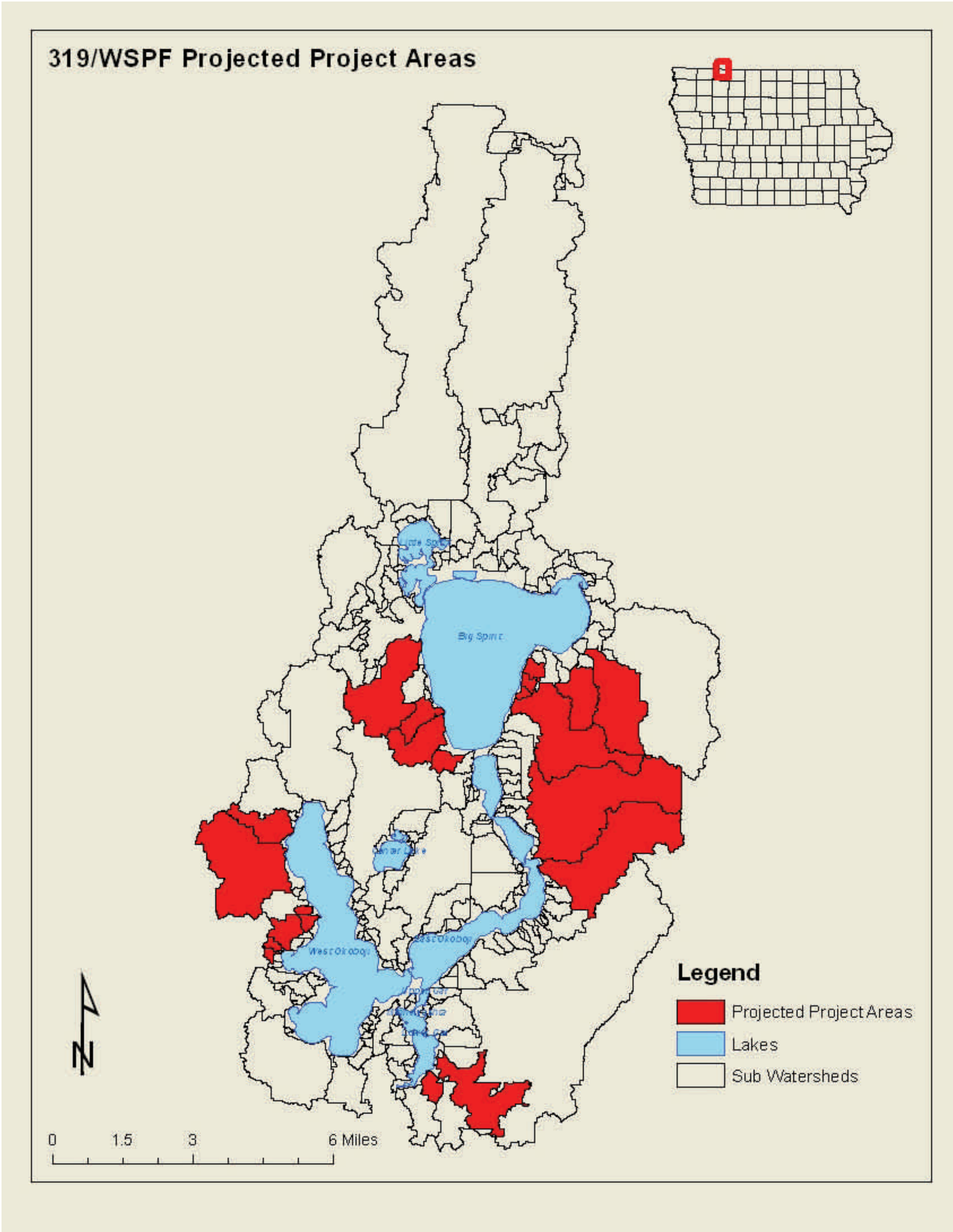


Figure 1.113 Sub-watersheds that produce 30% of sediment delivered to the Iowa Great Lakes each year.

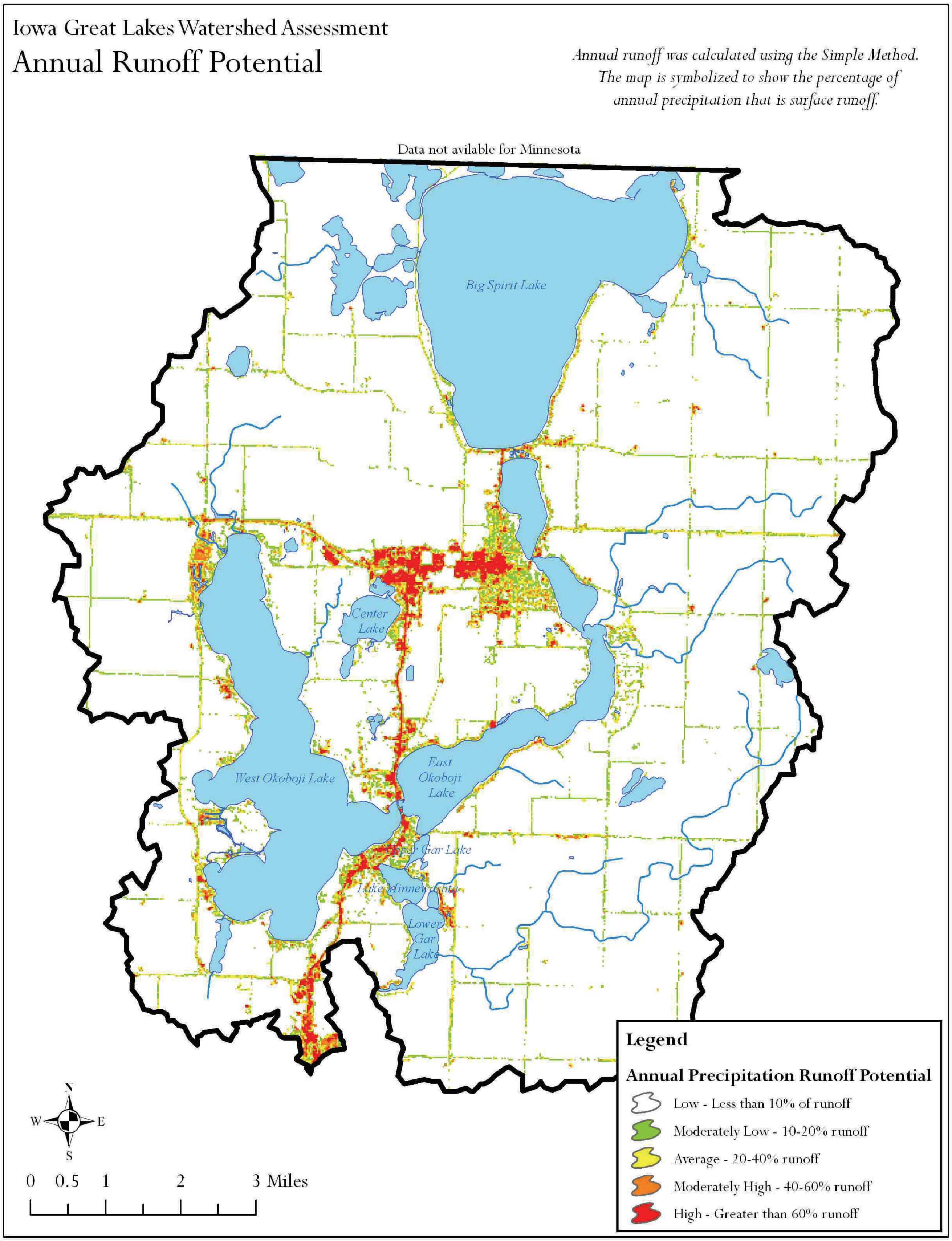


Figure 1.114 Annual Urban Runoff Potential

The Iowa Great Lakes Watershed plan breaks into three phases. The first phase will take place from 2010 to 2020. Based on prioritization of BMP's, the end of the first phase will see a reduction of phosphorous and sediment to the lakes from the watersheds affected. The second phase will take place from 2020 to 2030. The second phase will not only concentrate on new priority areas, but will also include a revision of plans based on successes and challenges from phase one. Finally, phase three will include new priority areas and a revision of plans based on data collected and successes and challenges from phases one and two.

The phases will include an aggressive pursuit of the implementation plans previously described in the Resources Management Areas. It must be emphasized that in a watershed the size of the Iowa Great Lakes, many situations can slow progress or even speed that progress in water quality improvement.

Table 1.17 shows an implementation schedule that should be followed as a guide for the Iowa Great Lakes. It should include an aggressive approach to treating the greatest pollution, producing sub-watersheds in the Iowa Great Lakes. Some areas that should receive constant attention are the 1,000 foot buffer surrounding the Iowa Great Lakes and the Urban areas. These areas could prove to produce the greatest "bang for the buck" in protecting the Iowa Great Lakes.

Implementation Schedule for the Iowa Great Lakes Watershed						
	Phase I		Phase II		Phase III	
Resource Management Area	2010 -- 2015	2015 -- 2020	2020 -- 2025	2025 -- 2030	2030 -- 2040	2040 -- 2050
Little Spirit Lake RMA						
Loon Lake RMA						
Sandbar Slough RMA						
Hales Slough RMA						
Reeds Run RMA						
Templar Lagoon RMA						
Hottes/Marble Lake RMA						
Elinor Bedell RMA						
East Okoboji Beach RMA						
Lower Gar Lake RMA						
Center Lake RMA						
Welch Lake RMA						
Lazy Lagoon RMA						
Okoboji View RMA						
Lakeside Lab RMA						
Garlock Slough RMA						
1,000 Foot Buffer						
Urban RMA's						

Table 1.17 Implementation Schedule for Watershed Treatment in the Iowa Great Lakes

IOWA GREAT LAKES WATERSHED PRACTICES NEEDED								
Resource Management Area	PRIORITY WETLAND RESTORA-TION (NUMBER)	SEDIMENT RETEN-TION BA-SINS (NUMBER)	GRASSED WATERWAY (FEET)	TILLAGE INCEN-TIVE (ACRES)	CONSER-VATION COVER (ACRES)	NUTRIENT AND PEST MANAGE-MENT (ACRES)	ROCK TILE INTAKE	LAKE MANAGE-MENT
Little Spirit Lake RMA	3	1	25000	400	106	971	40	YES
Loon Lake RMA	5	2	295000	7313	778	15036	40	YES
Sandbar Slough RMA	5	2	135000	2084	262	4018	40	YES
Hales Slough RMA	2	1	20000	263	27	445	20	YES
Reeds Run RMA	3	1	20000	687	79	1300	27	NO
Templar La-goon RMA	3	2	10000	193	2	266	10	NO
Hottes/Marble Lake RMA	5	2	31250	496	142	688	40	YES
Elinor Bedell	3	2	55000	675	110	1707	35	NO
East Okoboji Beach RMA	4	3	60000	750	55	1525	45	NO
Lower Gar Lake RMA	5	3	90000	494	293	3900	65	NO
Center Lake RMA	2	1	11000	320	131	695	10	YES
Welch Lake RMA	3	1	20000	222	230	894	45	NO
Lazy Lagoon RMA	3	2	25000	201	29	133	15	NO
Okoboji View RMA	3	3	31000	460	171	1357	45	NO
Lakeside Lab RMA	3	2	1500	80	22	199	15	NO
Garlock Slough RMA	4	2	8700	104	50	500	45	YES
1,000 Foot Buffer (100,000/yr)								
Urban RMA's (100,000/yr)								
Totals	56	30	813450	14342	2381	32663	497	

Table 1.18 Implementation Costs for Watershed Treatment in the Iowa Great Lakes

IOWA GREAT LAKES WATERSHED IMPLEMENTATION GOALS

Resource Management Area	Phosphorus Reduction	BMP's to be Implemented in Phase I
Lower Gar Lake RMA	4000 lbs/year—Phase I	4 Rock Inlets, 750' Grassed Waterways, 11 acres converted to CRP, 200 acres for reduced tillage incentives
East Okoboji Beach RMA	1300 lbs/year—Phase I & II	6 Rock Inlets, 1750' Grassed Waterways, 18 acres converted to CRP, 300 acres for reduced tillage incentives
Elinor Bedell RMA	1300 lbs/year—Phase I & II	6 Rock Inlets, 1625' Grassed Waterways, 37 acres converted to CRP, 300 acres for reduced tillage incentives
Garlock Slough RMA	300 lbs/year—Phase II	
Lakeside Lab RMA	300 lbs/year—Phase I	75' Grassed Waterways, 11 acres converted to CRP, 100 acres for reduced tillage incentives
Okoboji View RMA	300 lbs/year—Phase I & III	1000' Grassed Waterways, 55 acres converted to CRP, 200 acres for reduced tillage incentives
Lazy Lagoon RMA	300 lbs/year—Phase I & I	750' Grassed Waterways, 9 acres converted to CRP, 150 acres for reduced tillage incentives
Welch Lake RMA	300 lbs/year—Phase III	
Center Lake RMA	273 lbs/year—Phase II & III	
Sandbar Slough RMA	600 lbs/year—Phase I & II	7 Rock Inlets, 3000' Grassed Waterways, 66 acres converted to CRP, 600 acres for reduced tillage incentives
Hales Slough RMA	300 lbs/year—Phase I & II	450' Grassed Waterways, 7 acres converted to CRP, 130 acres for reduced tillage incentives
Reeds Run RMA	300 lbs/year—Phase I & II	5 Rock Inlets, 550' Grassed Waterways, 20 acres converted to CRP, 300 acres for reduced tillage incentives
Templar Lagoon RMA	200 lbs/year—Phase III	
Hottes/Marble Lake RMA	300 lbs/year—Phase I & II	5 Rock Inlets, 100' Grassed Waterways, 47 acres converted to CRP, 230 acres for reduced tillage incentives
Little Spirit Lake RMA	1400 lbs/year—Phase II	
Loon Lake RMA	Phase II & III	
1,000 Foot Buffer	Phase I, II & III	5000' Shoreline Restoration
Urban RMA's	Phase I, II & III	80 Rain Gardens, 8 Bioretention Cells, 24 Grass Swales, 16 Enhanced Swales
Additional Practices to be Implemented in the Watershed	Phase I	8 Sediment Basins, 4 Wetland Restorations/Constructions

Table 1.19 Goals for Phosphorus Reduction and BMP's

RESOURCE NEEDS

"If you want to know how rich you really are, find out what would be left of you tomorrow if you should lose every dollar you own tonight".
William J. H. Boetcker

The Iowa Great Lakes has been degrading for over 100 years. The Iowa Great Lakes is a complicated system of lakes, wetlands, streams, and urban development. The Watershed is separated by state boundaries, two counties, and city governments. These challenges make restoring the Iowa Great Lakes water quality to acceptable levels a problem.

The costs associated with implantation of the protection measures in the Iowa Great Lakes Watershed are illustrated in Table 10.1, based on current estimates and the amount of BMP's necessary as cited in Table 1.18. Likely funding sources are predicted and are assured to come from multiple sources in a variety of denominations.

Possible Funding Sources for IGL Improvements

Priority Wetland Restoration
- Watershed Improvement Fund (WIRB)
- Wetlands Reserve Program (WRP)
- Section 319 Clean Water Act (319)
- North American Wetland Conservation Act (NAWCA)
- Conservation Reserve Enhancement Program (CREP)

Sediment Retention Basins
- Iowa Watershed Protection Program (WSPF)
- Section 319 Clean Water Act (319)
- Iowa Financial Incentives Program (IFIP)
- Watershed Improvement Fund (WIRB)

Grassed Waterways
- Continuous Conservation Reserve Program (CCRP)
- Iowa Watershed Protection Program (WSPF)

Tillage Incentive
- Environmental Quality Incentives Program (EQIP)
- Iowa Financial Incentives Program (IFIP)
- Conservation Security Program (CSP)

Conservation Cover
- General Signup Conservation Reserve Program (CRP)

Nutrient and Pest Management
- Environmental Quality Incentives Program (EQIP)
- Conservation Security Program (CSP)

Rock Tile Intake
- Section 319 Clean Water Act (319)
- Iowa Great Lakes Water Quality Commission

Lake Management
- Section 319 Clean Water Act (319)
- Iowa Great Lakes Water Quality Commission
- Lake Restoration Fund

Urban Practices
- Lake Restoration Fund
- Section 319 Clean Water Act (319)
- Watershed Improvement Fund (WIRB)
- Resource Enhancement and Protection Program (REAP)
- Iowa Watershed Protection Program (WSPF)
- Iowa Great Lakes Water Quality Commission
- Water Protection Fund (WPF)

IOWA GREAT LAKES WATERSHED FINANCIAL RESOURCES NEEDED						
Resource Management Area	**Phase I A**	**Phase I B**	**Phase II A**	**Phase II B**	**Phase III**	Totals
Little Spirit Lake RMA			$ 303,857	$ 306,745		$ 610,602
Loon Lake RMA			$ 1,613,667	$ 1,645,000	$ 1,707,667	$ 4,966,334
Sandbar Slough RMA	$ 600,000	$ 618,000	$ 630,900		$ 414,200	$ 2,263,100
Hales Slough RMA	$ 100,000	$ 110,000	$ 115,000		$ 170,000	$ 495,000
Reeds Run RMA	$ 100,000	$ 110,000	$ 190,000			$ 400,000
Templar Lagoon RMA		$ 110,000		$ 49,000	$ 50,000	$ 209,000
Hottes/Marble Lake RMA	$ 230,000		$ 250,000		$ 260,000	$ 740,000
Elinor Bedell RMA	$ 200,000	$ 310,000	$ 345,000			$ 855,000
East Okoboji Beach RMA	$ 230,000		$ 345,000	$ 350,000		$ 925,000
Lower Gar Lake RMA	$ 450,000	$ 495,000		$ 500,000		$ 1,445,000
Center Lake RMA		$ 135,000	$ 145,000		$ 160,000	$ 440,000
Welch Lake RMA				$ 215,000	$ 220,000	$ 435,000
Lazy Lagoon RMA	$ 125,000	$ 130,000		$ 135,000		$ 390,000
Okoboji View RMA	$ 125,000			$ 235,000	$ 220,000	$ 580,000
Lakeside Lab RMA	$ 43,000	$ 45,000				$ 88,000
Garlock Slough RMA			$ 195,000	$ 200,000		$ 395,000
1,000 Foot Buffer	$ 1,500,000	$ 1,550,000	$ 1,560,000	$ 1,570,000	$ 2,200,000	$ 8,380,000
Urban RMA's	$ 1,500,000	$ 1,510,000	$ 1,520,000	$ 1,530,000	$ 2,300,000	$ 8,360,000
Salary for Employees	$ 800,000	$ 650,000	$ 1,007,000	$ 725,000	$ 2,250,000	$ 5,432,000
Grand Totals	$ 5,203,000	$ 5,773,000	$ 7,213,424	$ 6,735,745	$ 7,701,867	$ 37,409,036

* Salary includes 2 full-time technical persons and one full time GIS person in Phase 1A, Phase IIA and Phase III.

Table 1.20 Financial Resources Needed for Iowa Great Lakes Watershed Protection

REFERENCES CITED

Bachman, Roger, Jones, John. (1974) Water Quality in the Iowa Great Lakes. Iowa State University, Ames, IA

Carlson, Roy. Copper Compounds and Algae. (2008). http://www.bassresource.com/fish_biology/algae_copper.html. Accessed July 16, 2008.

Dankert, Wayne (Ed.). (1980). *Soil Survey of Dickinson County, Iowa*. National Cooperative Soil Survey.

Dickinson County Comprehensive Planning and Development Plan. (2006) http://www.co.dickinson.ia.us/Department/Zoning/pdf/2006%20Dickinson%20Co%20Comp%20Plan.pdf accessed August 15, 2008.

Dickinson Soil and Water Conservation District,. (2008). *Iowa Great Lakes Watershed Assessment.* Spirit Lake, IA

Downing, John A. (2008). Iowa Lakes Survey. Retrieved July 2, 2008, from Iowa Lakes Information System Web site: http://limnology.eeob.iastate.edu/lakereport/chemical_report.aspx

DNR, Iowa (2003). *Total Maximum Daily Load For Turbidity Lower Gar Lake, Dickinson County, Iowa.* Des Moines, Iowa

DNR, Iowa. (2004). *Nitrogen and Phosphorous Budgets* (Adobe), Retrieved from http://www.iowadnr.gov/water/nutrients/files/nbfull.pdf

DNR, Iowa (2004)., *Total Maximum Daily Load For Noxious Aquatic Plants Upper Gar Lake, Dickinson County, Iowa.* Des Moines, IA

DNR, Iowa (2004). *Total Maximum Daily Load For Turbidity and Algae Little Spirit Lake Dickinson County, Iowa.* Des Moines, IA

DNR, Iowa and EPA, U.S. (2006)., *Comprehensive Report of Ambient Water Quality Monitoring Programs in Iowa.,* Retrieve December 4, 2009 from: http://www.igsb.uiowa.edu/wqm/Reports/Strategy2006.pdf.

Extension, ISU (2003,November). *Center for Agricultural and Rural Development*. Retrieved from http://www.card.iastate.edu/environment/items/Iowa LakesSurvey_02.pdf

Natural Resource Conservation Service (NRCS). Electronic Field Office Technical Guide. (2009) Web site: http://efotg.nrcs.usda.gov/treemenuFS.aspx. Accessed January 8, 2009.

Graham, Jennifer (2005). USGS Science for a Changing World. Retrieved June 2, 2008, from Preliminary Assessment of Cyanobacteria Occurrence in Lakes and Reservoirs in the United States Web site: http://ks.water.usgs.gov/studies/qw/cyanobacteria/prilasscyano2008.ppt#257,1,Slide 1

Henderson, Carrol L., Dindorf, Carolyn J., Rozumalski, Fred J. 2008. Lakescaping for Wildlife and Water Quality. Saint Paul, Minnesota, State of Minnesota, Department of Natural Resources.

Hickok, Eugene A.. *Management Plan for Water Quality Iowa Great Lakes.* 1 ed. Wayzata, Minnesota: Hickok and Associates, 1974.

Iowa Department of Natural Resources

IA DNR, (2005). Plan for the Management of Aquatic Nuisance Species in Iowa. Retrieved August 2, 2008, from Plan for the Management of Aquatic Nuisance Species in Iowa Web site: http://www.anstaskforce.gov/Iowa-ANS-Mangement-Plan.pdf

Iowa Great Lakes and Dickinson Clean Water Alliance.

Iowa Statewide Urban Design Standards Manual, (2008), SUDAS, Retrieved January 13, 2009, from http://www.iowasudas.org/design.cfm.

Jackson County Planning and Environmental Services. November 28, 2007

Lakes Information System, Iowa DNR (2005) http://limnology.eeob.iastate.edu/lakereport/class_trends_in_water_quality.aspx?Lake_ID=001&bk=1#1 Accessed (July 15, 2008)

Limnology Laboratory, (2007). Cooperative Lakes Area Monitoring Project (CLAMP). Retrieved December 2,

2008, from Iowa Lakes Information System Web site: http://limnology.eeob.iastate.edu/clamp/default.aspx
Ractliffe, Robert. "www.bioremediate.com." October 15, 2002. http://www.bioremediate.com/algae.htm (accessed July 16, 2008).
Phillips, Gary S., 2008. Aquatic Vegetation Inventory of Anglers Bay, Spirit Lake, Dickinson County, IA, 2006 – 2007. Estherville, IA. Iowa DNR.
Protect Your Waters, http://www.protectyourwaters.net/news/ and http://www.newwest.net/index.php/citjo/article/10009/C38/L38. accessed April 12, 2007.
Septic Tank Failures (2004). Kent County Public Works. Accessed January 13, 2009. http://co.kent.de.us/Departments/PublicWorks/SepticTankFailures.htm
Starinchak, Joe (2006, July 18). Protect Your Waters. Retrieved April 12, 2007, from Protect Your Waters Web site: http://www.protectyourwaters.net/news/
Securing a Future for Wildlife, (2005). *Iowa Wildlife Action Plan*, Retrieved June 15, 2008, from http://www.iowadnr.com/wildlife/diversity/files/iwap_part1.pdf
Sperling's Best Places, (2008). Dickinson County, Iowa climate. Retrieved December 12, 2008. from http://www.bestplaces.net/County/Dickinson_IA-CLIMATE-41905900060.aspx
Stenback, (2005). Quantification of Nutrient Inputs into the Iowa Great Lakes. U.S. EPA.
University of Missouri The, sampled the Iowa Great Lakes for algal toxins from 1999-2004 (J. Graham).
USDA, (2007). National Invasive Species Management Plan. Retrieved July 2, 2008, from Invasive Species Web site: http://www.csrees.usda.gov/nea/pest/in_focus/invasive_if_plan.html
U.S. Census Bureau, (2000). U.S. Census Bureau. Retrieved July 8, 2008, from Iowa -- County Web site: http://factfinder.census.gov/servlet/GCTTable?_bm=y&-geo_id=04000US19&-_box_head_nbr=GCT-PH1&-ds_name=DEC_2000_SF1_U&-format=ST-2
Vacation Okoboji, http://www.vacationokoboji.com/2002/09_living/09_01area.html, accessed May 4, 2007.

APPENDIX A: SOCIAL DYNAMICS ASSESSMENT

Excerpt from SOCIAL DYNAMICS ASSESSMENT: UPPER GAR, MINNEWASHTA, LOWER GAR RESTORATION, December 2009.

Research Design and Methods

This social dynamics assessment was conducted in 2009 and structured to compare assumptions and understanding about the Lower Chain of Lakes and related issues among watershed residents. The diagnostics and feasibility study team considered this comparison critical in order to formulate implementation plans and communicate restoration alternatives to the public. A questionnaire survey was designed and conducted using adaptations of the Dillman Tailored Design Method with 24 questions including closed-ended, multiple response, and scaled response options. All research protocols and techniques complied with Iowa State University Institutional Review Board requirements. Residents were invited to participate in several ways. Internet links to the questionnaire were provided to four lake protective associations (Three Lakes, West, East and Spirit Lakes), six non-profit organizations (Okoboji Foundation, Cooperative Lakes Area Monitoring Project, Friends of Lakeside Lab, Iowa Great Lakes Chamber of Commerce, Iowa Lakes Corridor Development Corporation, Iowa Great Lakes Water Safety Council). Invitations to participate were also conveyed through two local list serves and through a Dickinson County newspaper and its blog.

The survey sample size is statistically representative of the study area population. Population for the study area was a total of 2814. This included the communities of Arnolds Park, Okoboji, West Okoboji, and the portion of Milford incorporated limits associated with Lower Gar Lake (U.S. Census Bureau 2000). The total sample included 332 participants.

Results and Discussion

Who Participated in the Research

Men represented 69.5% of the sample. Reported respondent age response rates were similar to county rates, with 58% of the sample between the ages of 50 and 69. Twenty-eight percent of research participants were less than fifty years old and 13.6% were older than 69. Seventy-five percent of research participants indicated having no children under the age of 18 residing with them. Lastly, a significant number of respondents have been associated with the Iowa Great Lakes Area for more than twenty years (Figure 1).

Slightly less than 25% of respondents reported participation in one or more local non-profit organization association with the Iowa Great Lakes region (Figure 2).

Most respondents (97%) reported owning or renting residential property. Fifteen percent own or rent commercial property, nine percent own or rent agricultural property, and one percent own “other” types of property such as storage.

Seventy-nine percent of respondents indicated they were property owners on or near a lake. Respondents reporting ownership of property on or near the Lower Chain of Lakes represented 45% of the sample.

The top five water-based recreational activities respondents indicated participating in include pleasure boating (77%), fishing (58%), using adjacent parks and water skiing (both 43%), and swimming (23%).

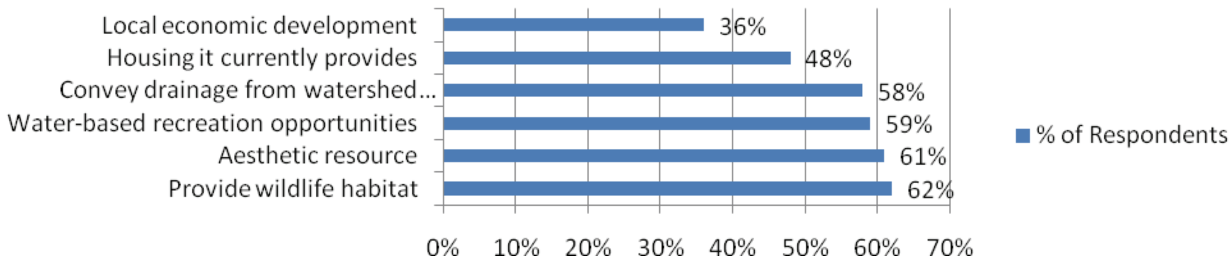
Lawn Fertilization Rates

More than half of respondents, 56%, indicated they fertilize their lawns. An additional 12% are unsure if their lawn is fertilized. Sixty-eight percent of those fertilizing reported using a P-Free fertilizer product.

Why Lakes Are Valuable

The most frequently reported values for the Lower Chain Lakes include providing wildlife habitat, aesthetics, water-based recreation opportunities, and conveying water downstream. Each was reported by a majority of respondents. Additionally, 62% of respondents indicated both water-based recreation and providing wildlife habitat was very important (Figure 3).

Figure 3. Most Important Values for the Lower Chain Lakes (n=280)



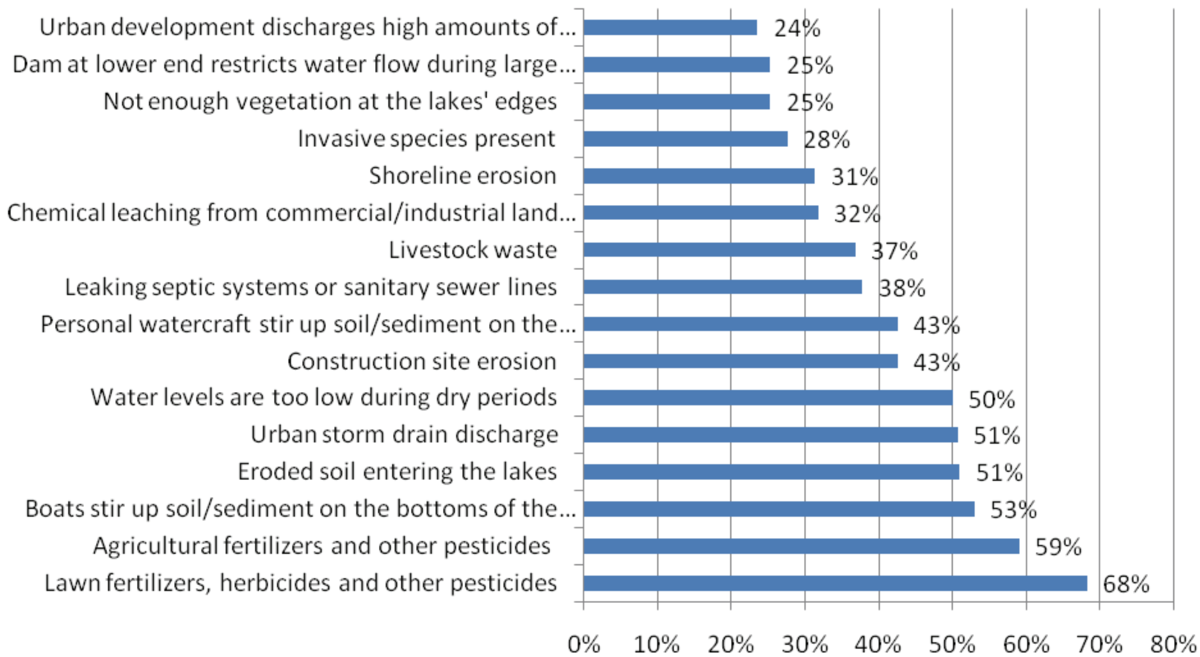
Water Quality and Pollution in the Lower Chain of Lakes

Survey respondents reported they defined water quality primarily by human senses and quality of use. More than 80% of the total sample indicated they use water appearance and smell to judge water quality. The quality of swimming, nutrient, and chemical quality were identified by more than 60% of the sample. The ability to use docks and ramps, enjoyment of boating and skiing, quality of fishing, quality of habitat the lake provides, and lake depth were criteria reported by between 50-60% of respondents.

Beliefs about Problems in Lower Chain Lakes

Fertilizers and pesticides were the most frequently identified pollution problem warranting attention in the Lower Chain (Figure 4). Urban sources were identified at a slightly higher rate than agricultural sources. Two problems associated specifically with soil were also indicated by more than half the sample: eroded soil entering the lakes and boats stirring up sediment on the bottom of the lakes. Urban storm drain discharge, as a concept, was also indicated as a potential impact to lake water quality by a majority of respondents.

Figure 4. Problems Identified in Lower Chain Lakes (n=296)



Expectations for Future Lake Condition

The need for enhancement of Lower Chain lakes as a broad concept was well supported by respondents. Only 3% of respondents indicated they believed it was appropriate for Lower Chain lakes to remain as is among options for future outcomes.

Less turbidity and less frequent algae blooms were supported by the highest number of respondents (73%) (Table 1). Of those supporting dredging, nearly twice as many support dredging in specific places to enhance habitat than support lake deepening to allow larger boat access and recreation. Deeper dredging to allow larger boat access and recreation on the Lower Chain was supported by only 35% of respondents.

Table 1. More Than 50% of Participants Support These Five Potential Restoration Outcomes for the Lower Chain of Lakes (n=297).

Potential Outcomes	% of Respondents
Water is less cloudy with sediment (less turbid)	73%
Lake bottom is more solid	51%
Lake(s) are deepened in places that enhance	61%
Water leaving Lower Gar Lake is less polluted	54%
Algae blooms are less frequent	73%

Beliefs About Improving Lake Condition

Water quality enhancement practices such as wetland restoration in agricultural areas and bioretention in urban areas are considered effective in the region. A majority of survey participants indicated their belief that construction of additional agricultural practices (75%) and urban practices (75%) may improve water quality. The majority (57%) also indicated they believe limiting development would improve lake conditions.

APPENDIX B: POTENTIAL FUNDING SOURCES

clean water starts with you
IOWA DNR WATERSHED IMPROVEMENT

Watershed Improvement Funding Sources

Iowa Department of Agriculture and Land Stewardship - Division of Soil Conservation

Programs	Web address (some may break on to two lines)	Program Description	App
Iowa Financial Incentives Program (IFIP)	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	50 percent cost-share available to landowners through 100 SWCDs for permanent soil conservation practices	cont
No-Interest Loans	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	State administered loans to landowners for permanent soil conservation practices	Feb.
District Buffer Initiatives	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	Funds for SWCDs to initiate, stimulate and incentivise signup of USDA programs, specifically buffers	cont
Mining Reclamation	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	$2 million state and federal program (16:1 match) to reclaim abandoned surface coal mines at no cost to landowner	varie
Agricultural Drainage Well Closure Assistance Fund	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	Provides 75 percent cost-share to landowners for alternative drainage in order to close ag drainage wells and protect groundwater quality	varie
Iowa Watershed Protection Program (WSPF)	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	Funds for SWCDs to provide water quality protection, flood control, and soil erosion protection in priority watersheds; 50-75 percent cost-share; Used as state match for EPA 319 funding	April
Conservation Reserve Enhancement Program (CREP)	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	Levering USDA funds (4:1) to establish nitrate removal wetlands in north central Iowa with no cost to landowner	cont
Soil and Water Enhancement Account – REAP Water Quality Improvement Projects	www.iowaagriculture.gov/FieldServices/waterQualityProtectionProjects.asp	REAP funds for water quality improvement projects (sediment, nutrient and livestock waste) and wildlife habitat and forestry practices; 50-75 percent cost-share; Used as state match for EPA 319 funding	April 15
Soil and Water Enhancement Account – REAP Water Quality Improvement Practices	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	Tree planting, native grasses, forestry, buffers, streambank stabilization, traditional erosion control practices, livestock waste management, ag drainage well closure, urban stormwater	continuo
Integrated Farm and Livestock Management Demonstration Program (IFLM)	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	Statewide farm demonstrations of BMPs for nutrient and pesticide management, air quality, and soil and water conservation	
State Revolving Loans (SRF)	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	Low interest loans provided by SWCDs to landowners for permanent water quality improvement practices; subset of DNR program	continuous

* Dates are approximate. Check with funding agency to determine exact due date.

1