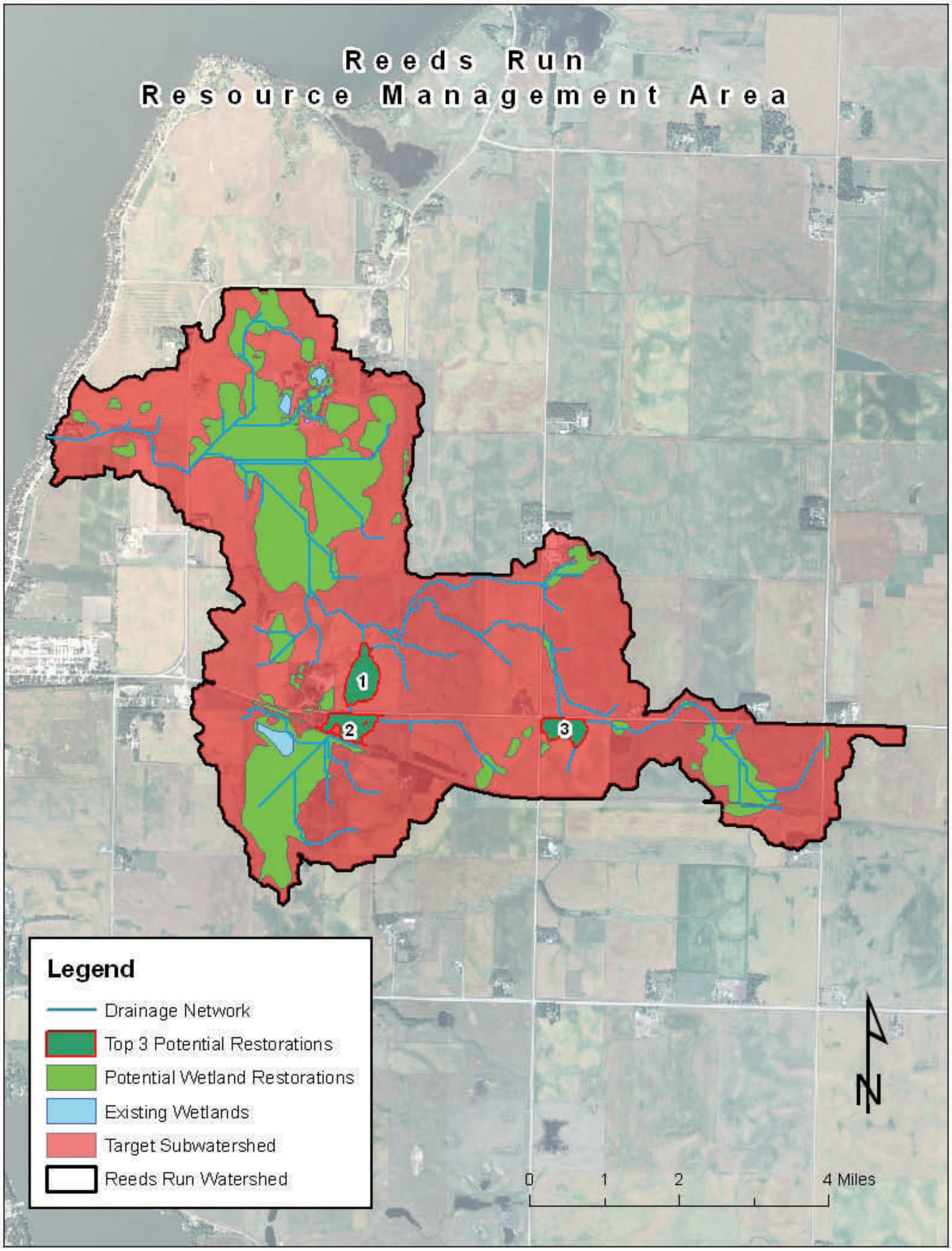

Figure 1.64 Reeds Run Priority Wetland Restorations

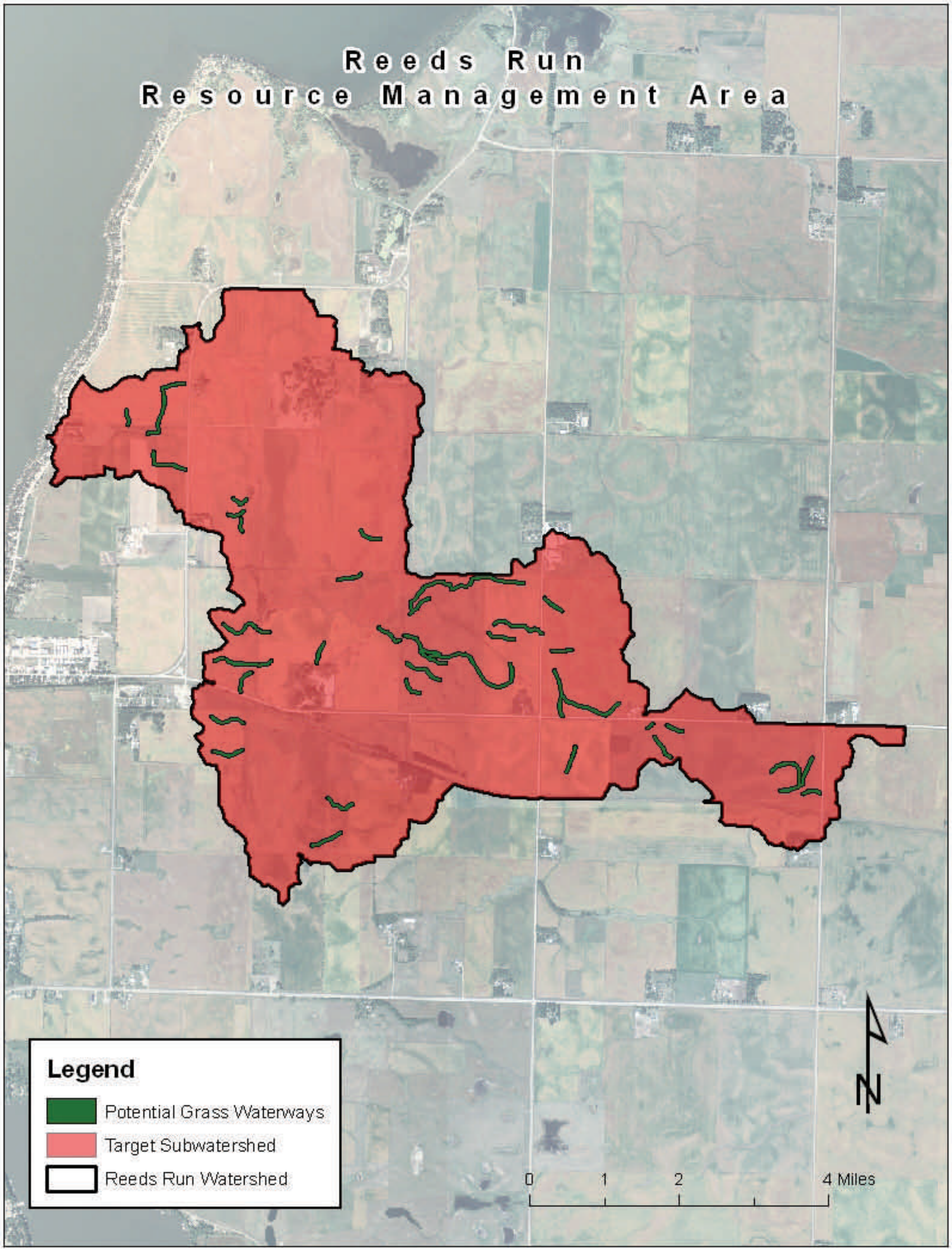

Figure 1.65 Reeds Run Ephemeral Gullies

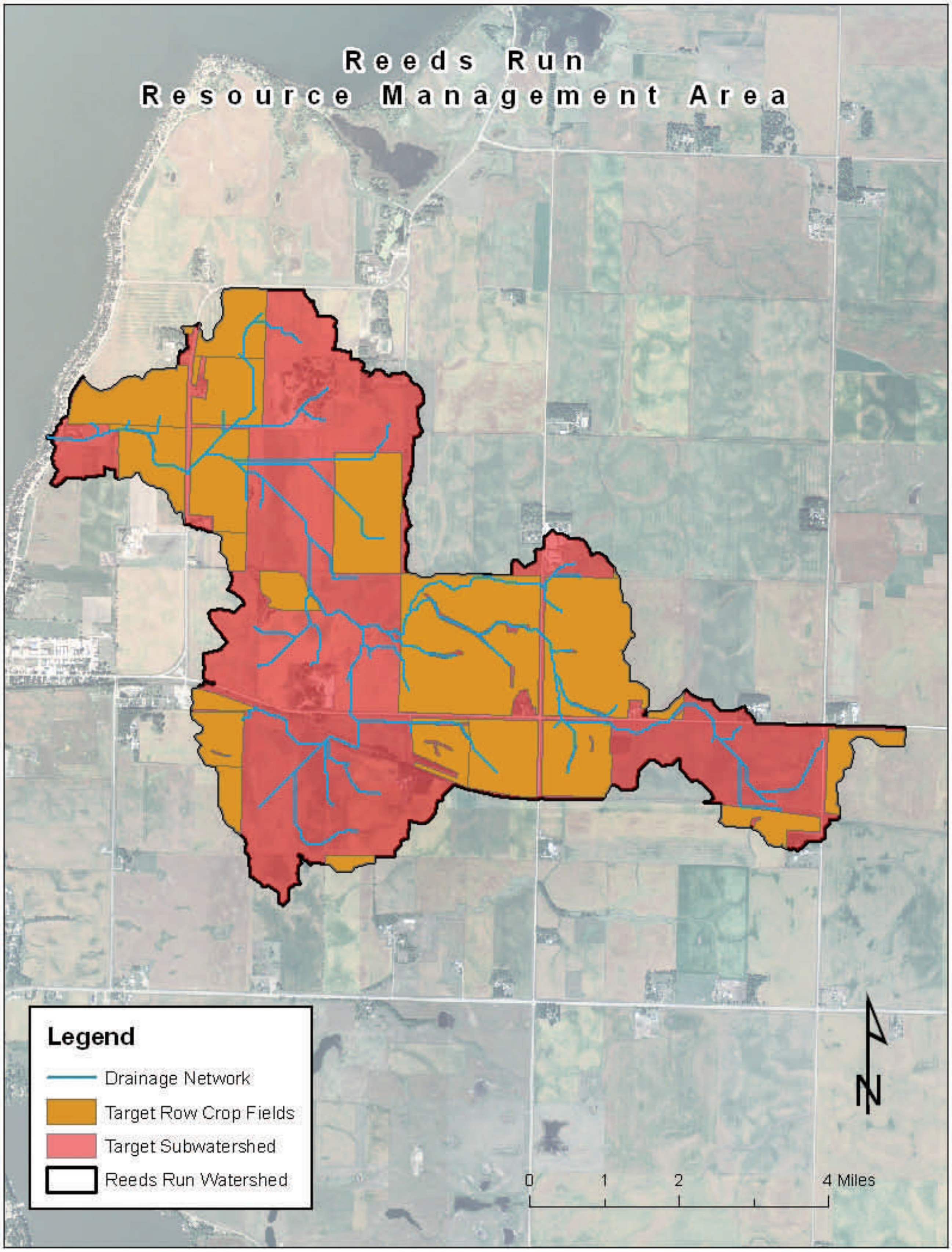

Figure 1.66 Reeds Run Target Row Crop Fields

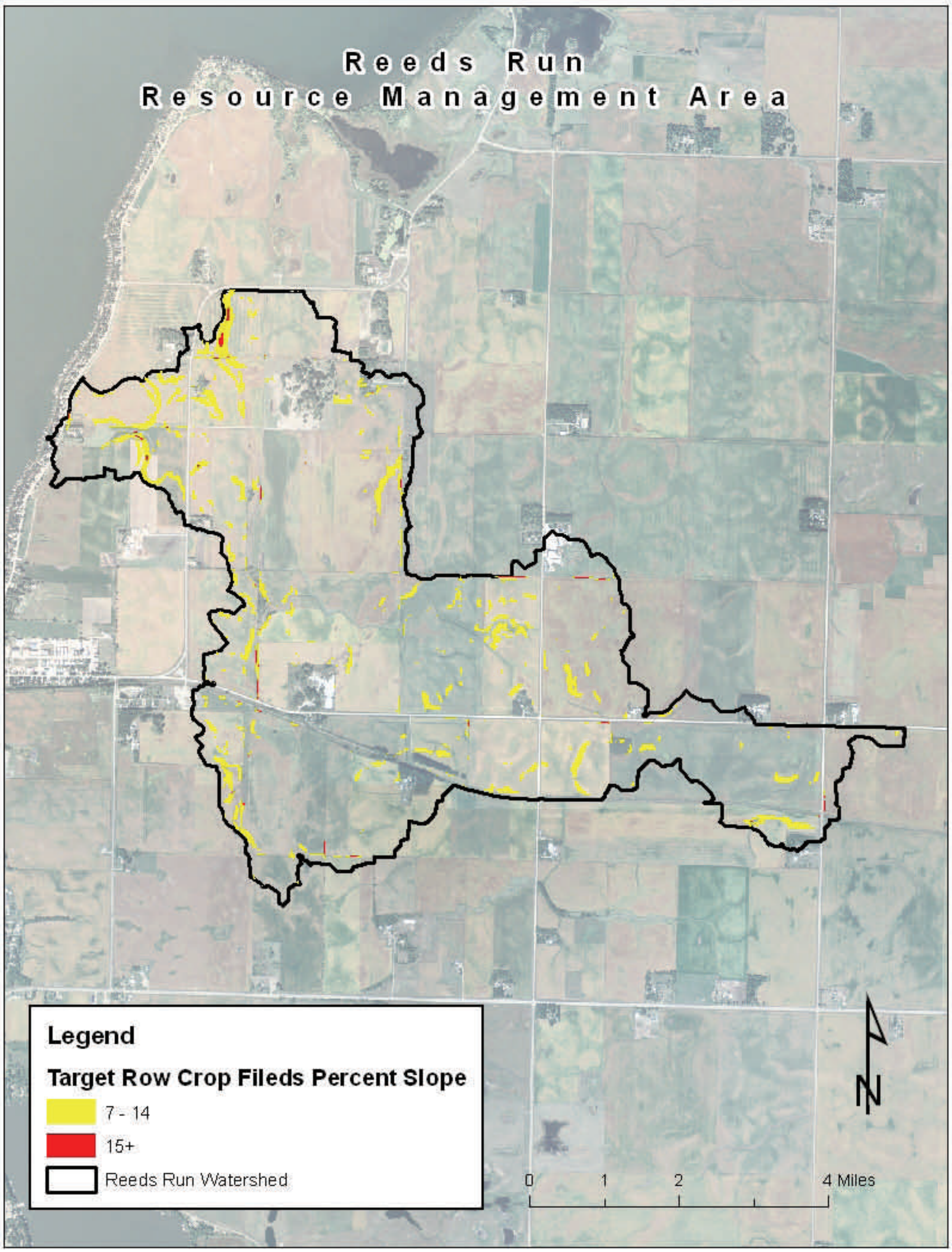

Figure 1.67 Reeds Run Target Row Crop Slopes

Templar Park Resource Management Area (RMA)

Objective – Prevent heavy sediment loaded water reaching Big Spirit Lake via Templar Park Lagoon. The sediment reductions in this RMA will assist with the target reduction of phosphorus in Upper Gar Lake (3,300 pounds per year) and Lower Gar Lake (6,100 per year) in accordance with their specific approved TMDL's.

Description – The watershed draining towards Templar Park has undergone many hydrological changes in the past 100 years. The reduction of wetlands and the switch from prairies to farmland has left this watershed very degraded. This watershed represents approximately 2% of the watershed of Big Spirit Lake. Originally a long series of pothole wetlands provided important watershed protection to Big Spirit Lake and provided critical wildlife habitat. A holistic approach is needed to restore ecological health and water quality to this area. A combination of both watershed and wetland restoration practices is needed to reach the project objective. Sediment, nutrients, and water volume loadings from the watershed should be reduced utilizing a prioritized plan through augmentation of existing landowner conservation programs, easements, and public acquisitions.

Restoration Planning Components

<u>Watershed Practices</u>

Prioritized Sub-watershed (Figure 1.68)

Structural Sediment Trapping

- Analysis has identified three priority wetland restorations in this sub-watershed (Figure 1.69).
- These wetland restorations have the potential to effectively intercept 450 acres (86% of the priority sub-watershed) of primarily agricultural runoff (Table 1.13).
- In lieu of restoration of these priority wetland areas, analysis has identified several locations for sediment retention basins or constructed wetlands.
- Restoration of wetlands on these acres will prevent 1,350 tons of sediment from reaching the lake.

Gully Management

- Two miles of ephemeral gully erosion has been identified within agricultural fields (Figure 1.70).
- installing grassed waterways within each of these ephemeral gullies, 16 acres of upland habitat can be created and sediment loss from these areas significantly reduced.
- Construction of grassed waterways in these gullies can prevent 176 tons of sediment per year.

Highly Erodible Fields—Conservation Tillage

- Four agricultural fields devoted to row crop production exceed sediment loss thresholds (Figure 1.71).
- These fields, totaling 193 acres, account for 50% of the sediment loss within the targeted watershed.

Highly Erodible Fields—Permanent Vegetation

- Sediment loss can be reduced on 42 acres of row cropped fields by implementing alternative practices (i.e. permanent vegetation, sediment basins, and reduced tillage) where field slope is greater than seven percent.
- One and a half acres have been identified and should have alternate land practices implemented because their slope is greater than 15% (Figure 1.72).
- tillage on these acres can prevent 386 tons of sediment per year from reaching the lake.

Nutrient Management

- A total of 266 acres are currently being utilized for the production of corn and soybeans within the targeted watershed of Templar Lagoon.
- A nutrient and pesticide management plan should be set up with each individual landowner to ensure that over application and runoff of nutrients and pesticides is minimized.
- A plan should also be put into place to protect field tile intakes from excessive nutrients and sediment.
- Rock tile intakes with an additional 50 foot vegetative buffer should be discussed and implemented at all tile intake locations within the sub-watershed.

Pollution Reduction

Big Spirit Lake does not have a TMDL assigned to it, but in order to ensure the Lake and its watershed are sustainable for future years this plan requires a 1,500 pound reduction of phosphorous per year to be removed. This Management Plan will help meet that 1,500 pound goal with a reduction in Phosphorous coming from the restored priority wetlands, stopping the ephemeral gullies using grassed waterways and sediment basins, conservation tillage, vegetative cover, and nutrient and pest management. In addition, rock tile intakes and vegetation around the intakes will ensure an adequate reduction of phosphorous and associated sediment. The total reduction in phosphorous from the Templar Park RMA is 200 pounds of phosphorous.

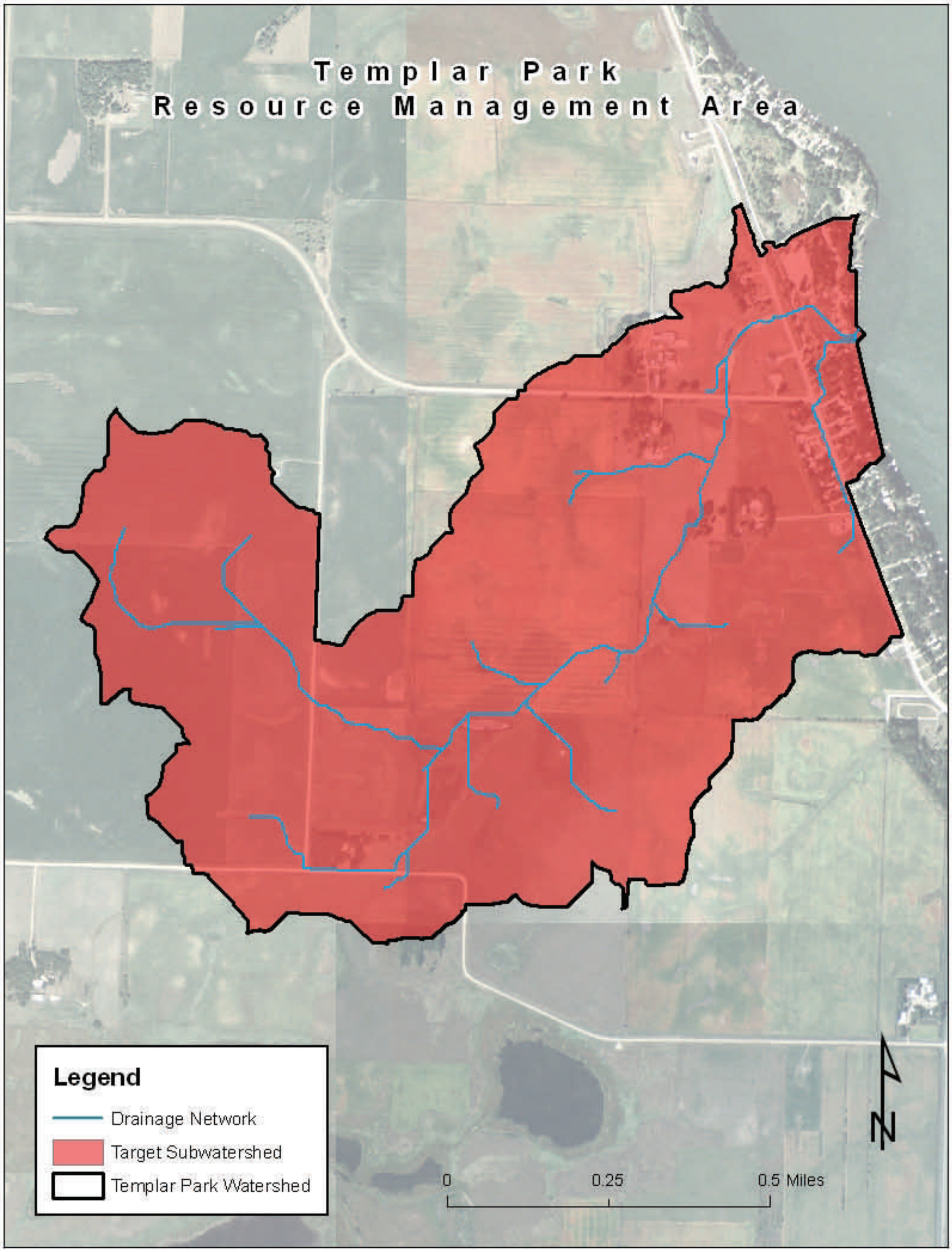

Figure 1.68 Templar Park Resource Management Area

Templar Lagoon Watershed Wetland Prioritization

Wetland ID	Flows into	Flows into	Flows into	Flows into	Flows into	Wetland Size (acres)	Watershed Size (acres)	Watershed to Wetland Ratio	GIS/RUSLE Priority
776	720	714	Lake			5.0	285.0	57.2	1
780	776	720	714	Lake		11.8	90.3	7.6	2
817	776	720	714	Lake		2.5	54.2	21.9	3
741	780	776	720	714	Lake	1.4	18.7	13.4	4
736	780	776	720	714	Lake	3.6	12.7	3.6	5
747	Lake					3.3	21.5	6.5	6
743	747	Lake				0.4	7.2	17.6	7
746	780	776	720	714	Lake	0.3	2.7	9.9	8
714	Lake					1.1	6.9	6.5	9
820	817	776	720	714	Lake	0.5	19.8	43.0	10

Table 1.13 Wetland restoration priorities for the Templar Park 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).

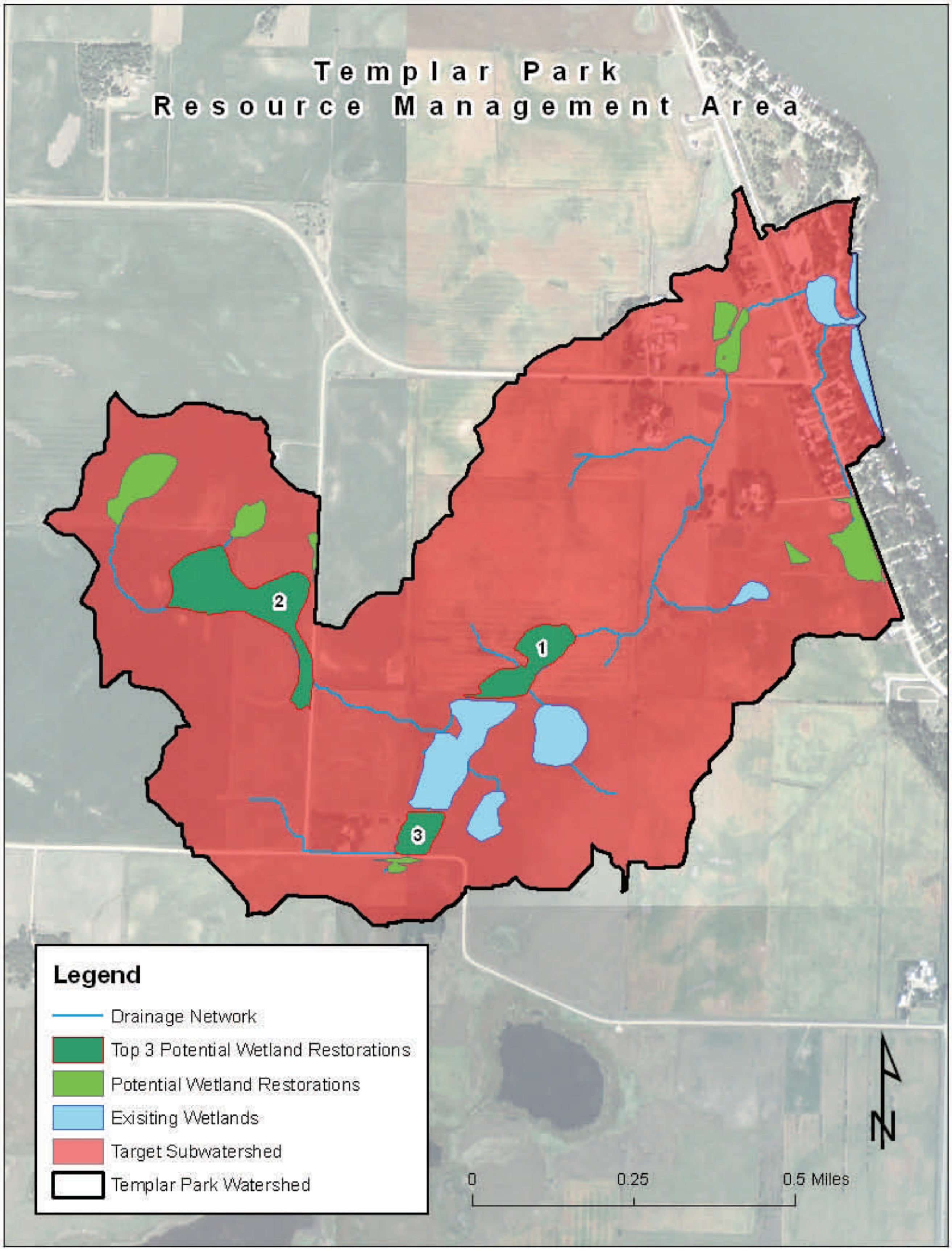

Figure 1.69 Templar Park Priority Wetland Restorations

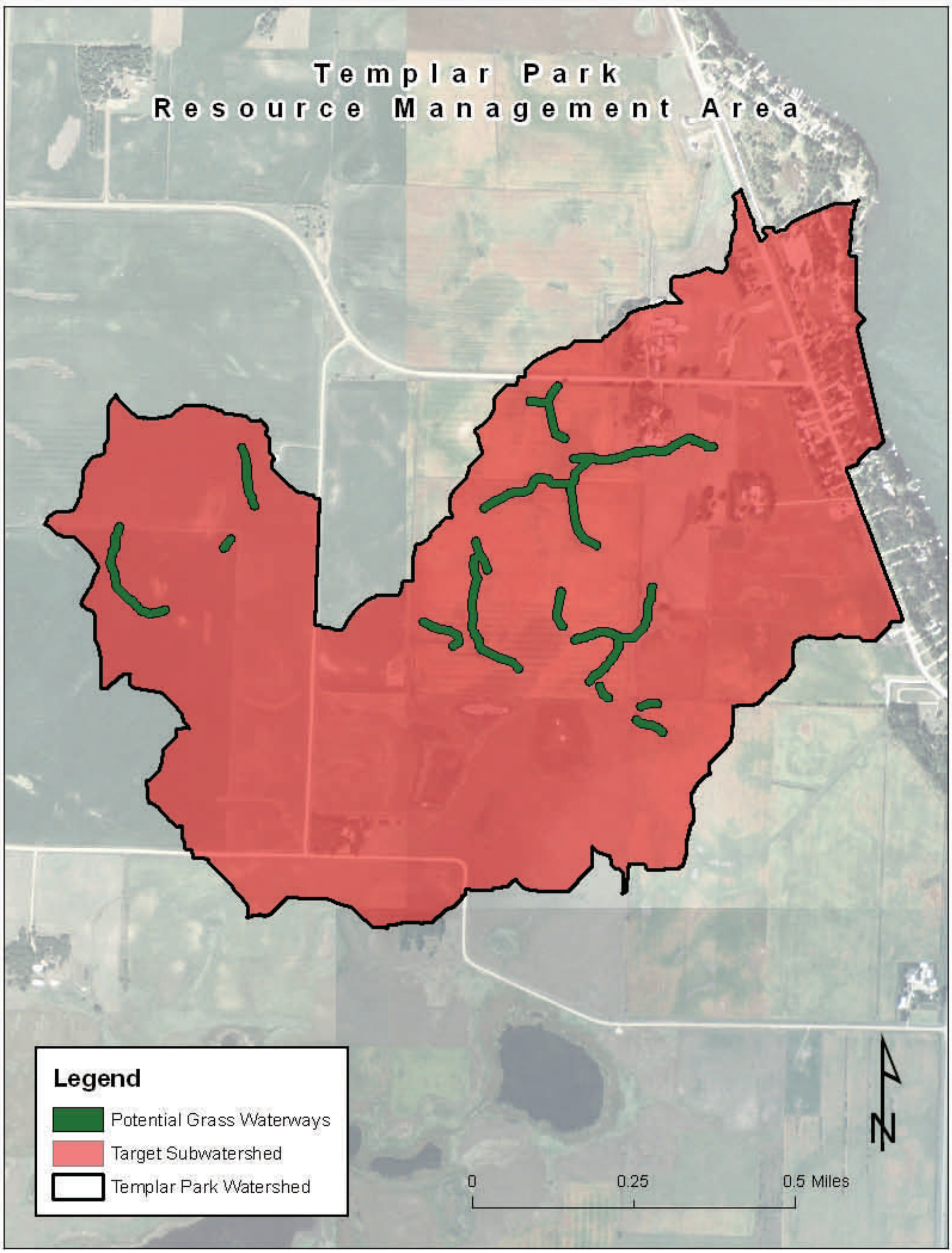

Figure 1.70 Templar Park Ephemeral Gullies

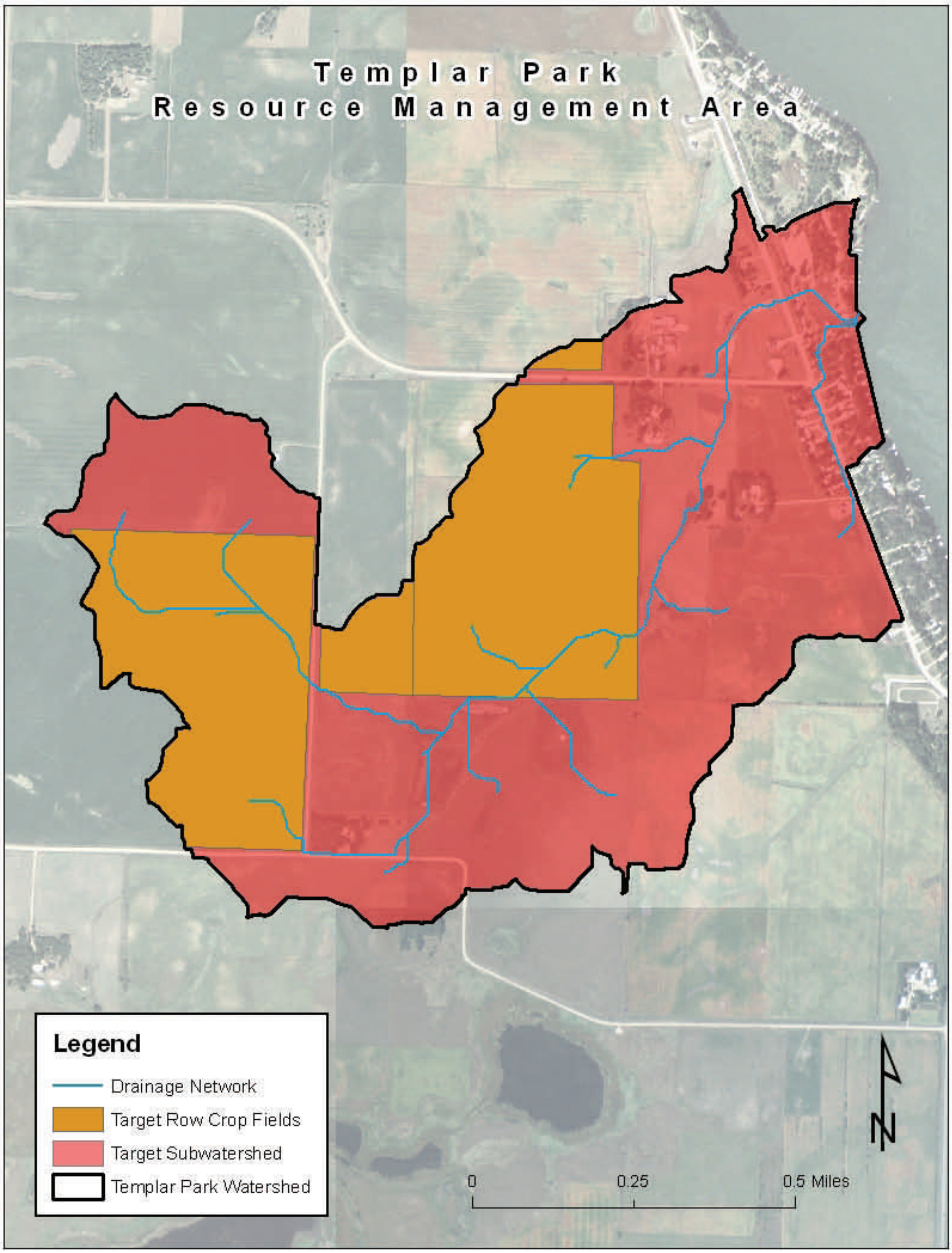

Figure 1.71 Templar Park Target Row Crop Fields

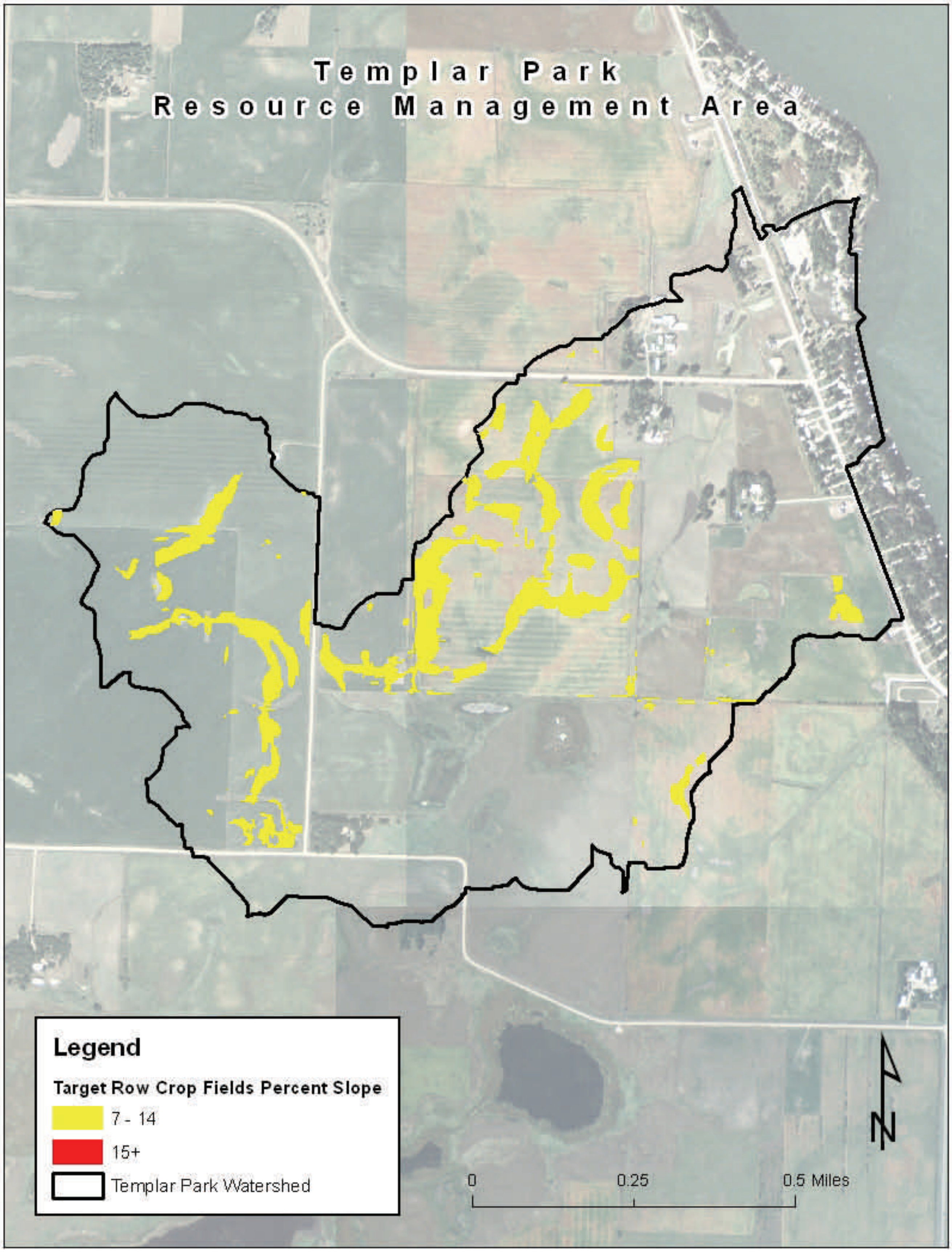

Figure 1.72 Templar Park Row Crop Target Slopes

MARBLE/ HOTTES LAKES WATERSHED

Watershed Information:

Lake Size	Total Watershed	Watershed Direct	Watershed Indirect	Watershed Lakes	Direct RMA	Indirect RMA	Impaired
67 ac	4292 ac	4225 ac	n/a	5	1	n/a	No

Lakes in the watershed of East Hottes Lake:

Direct
Marble Lake
West Hottes
North Hottes

Indirect
Grovers Lake

RMA's that drain to East Hottes Lake:

Direct
Hottes & Marble Lake RMA

Impairment for East Hottes Lake: East Hottes lake is not impaired.

Objective **–** East Hottes Lake is currently staying in a clear water state that is protecting Big Spirit Lake from large sediment deposits and nutrients. The goal is to restore and maintain the other lakes with in the Marble/ Hottes Lake watershed to a clear water state further protecting Big Spirit Lake and indirectly reducing sediment and phosphorus loads to Lower Gar and Upper Gar Lakes.

Hottes and Marble Lakes Resource Management Area (RMA)

Objective – Restore and maintain the Hottes Lakes and Marble Lake to clear water systems. The sediment reductions in this RMA will assist with the target reduction of phosphorus in Upper Gar Lake (3,300 pounds per year) and Lower Gar Lake (6,100 per year) in accordance with their specific approved TMDL's.

Description – Major changes in hydrology in the watersheds of this complex, along with the introduction of common carp have led to slow degradation of water quality in these shallow lakes. Aquatic vegetation has nearly disappeared in Marble Lake and has receded dramatically in West Hottes Lake. As the 1939 and 2002 aerial photos show a considerable amount of vegetation has disappeared on the Hottes/Marble Lake Complex (Figure 1.73 and 1.74) The Hottes/Marble Lake Resource Management Area is shown in Figure 1.37.

The Hottes/Marble Lake Complex and associated watershed represents nearly 19% of the watershed of Big Spirit Lake. When healthy, the shallow lakes making up the Hottes/Marble Lake Complex provide important watershed protection to Big Spirit Lake. These areas also provide critical fishery and wildlife habitats.
A holistic approach is needed to restore ecological health and water quality to this complex. A combination of both watershed and lake management practices is needed to reach the project objective.

Sediment, nutrients, and water volume loadings from the watershed should be reduced utilizing a prioritized plan through augmentation of existing landowner conservation programs, easements, and public acquisitions. Restoration of the lake to a clear water system can be accomplished through processes designed to mitigate watershed alterations and the introduction of common carp. To simulate natural drought conditions, managed water level draw downs are needed to stimulate growth of emergent aquatic vegetation and reduce or eliminate common carp populations.

Restoration Planning Components

<u>Watershed Practices</u>

Prioritized Sub-watershed (Figure 1.75)

Structural Sediment Trapping

- Analysis has identified three priority wetland restorations in this sub-watershed (Figure 1.76).
- These wetland restorations have the potential to effectively intercept 793 acres (65% of the priority sub-watershed) of primarily agricultural runoff (Table 1.14).
- In lieu of restoration of these priority wetland areas, analysis has identified several locations for sediment retention basins or constructed wetlands.
- Restoration of wetlands can reduce 1,427.4 tons of sediment per year.

Gully Management

- 6.25 miles of ephemeral gully erosion has been identified within agricultural fields (Figure 1.77).
- By installing grassed waterways within each of these ephemeral gullies, 57 acres of upland habitat can be created and sediment loss from these areas significantly reduced.
- Construction of grassed waterways can reduce 627 tons of sediment per year from reaching the lake.

Highly Erodible Fields—Conservation Tillage

- Ten agricultural fields devoted to row crop production that exceed sediment loss thresholds (Figure 1.78).
- These fields, totaling 496 acres, account for 50% of the sediment loss within the targeted watershed.

Highly Erodible Fields—Permanent Vegetation

- Sediment loss can be reduced on 142 acres of row cropped fields by implementing alternative practices (i.e. permanent vegetation, sediment basins, and reduced tillage) where field slope is greater than seven percent.
- Eight acres have been identified and should have alternate land practices implemented because their slope is greater than 15% (Figure 1.79).
- Conservation tillage can reduce 992 tons of sediment per year.

Nutrient Management

- A total of 688 acres are currently being utilized for the production of corn and soybeans within the targeted watershed of Marble Lake.
- A nutrient and pesticide management plan should be set up with each individual landowner to ensure that over application and runoff of nutrients and pesticides is minimized.
- A plan should also be put into place to protect field tile intakes from excessive nutrients and sediment.
- Rock tile intakes with an additional 50 foot vegetative buffer should be discussed and implemented at all tile intake locations within the sub-watershed.

Outside Prioritized Sub-watershed (Figure 1.75)

Structural Sediment Trapping

- Analysis has identified three priority wetland restorations in this portion of the sub-watershed (Figure 1.76).
- These wetland restorations have the potential to effectively intercept 380 acres (12% of the Hottes sub-watershed) of primarily agricultural runoff (Table 1.14).
- In lieu of restoration of these priority wetland areas, analysis has identified several locations for sediment retention basins or constructed wetlands.
- Restoration of these wetlands can reduce 684 tons of sediment per year.

Gully Management

- 4.15 miles of ephemeral gully erosion has been identified within agricultural fields (Figure 1.80).
- By installing grassed waterways within each of these ephemeral gullies, 39 acres of upland habitat could be created and sediment loss from these areas significantly reduced.
- Construction of these grassed waterways can reduce sediment by 429 tons per year.

Highly Erodible Fields—Conservation Tillage

- Four agricultural fields devoted to row crop production exceed sediment loss thresholds (Figure 1.81).
- These fields, totaling 52 acres, account for 25% of the sediment loss within this portion of the watershed.
- Conservation tillage can reduce sediment by 572 tons per year on these acres.

Highly Erodible Fields—Permanent Vegetation

- Sediment loss can be reduced on 73 acres of row cropped fields by implementing alternative practices (i.e permanent vegetation, sediment basins, reduced tillage) where field slope is greater than seven percent.
- Six acres have been identified and should have alternate land practices implemented because their slope is greater than 15% (Figure 1.82).

Nutrient Management

- A total of 440 acres are currently being utilized for the production of corn and soybeans within the second priority portion of the watershed for Hottes and Marble Lakes.
- A nutrient and pesticide management plan should be set up with each individual landowner to ensure that over application and runoff is minimized.
- A plan should also be put into place to protect field tile intakes from excessive nutrients and sediment.
- Rock tile intakes with an additional 50 foot vegetative buffer should be discussed and implemented at all tile intake locations within the sub-watershed.

<u>Lake Restoration</u>

Proper in lake management begins by controlling the movement of water and fish in/out of Marble Lake and the Hottes lakes. Electric water control devices including drain tiles should be placed at the outlets of Marble Lake and West Hottes Lake (Figure 1.83). These structures will allow for periodic draw downs that mimic historic drought conditions that are no longer occurring due to watershed changes. These water level fluctuations will allow managers to control fisheries populations and promote natural and diverse vegetation communities that benefit both fisheries and wildlife interests. At the same time and location the water control structures are placed; mechanical fish barriers should be installed to control the movement of fish in/out of these systems.

Once control structures are in place, an initial extended drawdown should occur in order to firm up near shore bottom sediments and promote extensive plant growth before water levels are allowed to return. This drawdown will also allow managers to apply chemical treatments to Marble Lake and West Hottes to completely eliminate any existing fishery. Once water levels are allowed to return, managers should introduce Northern Pike and Yellow Perch to the Marble Lake system to re-establish the historic fishery. A long term management plan should be developed between fish and wildlife professionals that outline the criteria and plan for dewatering these basins in order to maintain a balanced ecosystem.

Pollution Reduction

Big Spirit Lake does not have a TMDL assigned to it, but in order to ensure the Lake and its watershed are sustainable for future years this plan requires a 1,500 pound reduction of phosphorous per year to be removed. This Management Plan will help meet that 1,500 pound goal with a reduction in Phosphorous coming from the restored priority wetlands, stopping the ephemeral gullies using grassed waterways and sediment basins, conservation tillage, vegetative cover, and nutrient and pest management. In addition, rock tile intakes and vegetation around the intakes will ensure an adequate reduction of phosphorous and associated sediment. The total reduction in phosphorous from the Hales/Marble Lake RMA is 300 pounds of phosphorous.

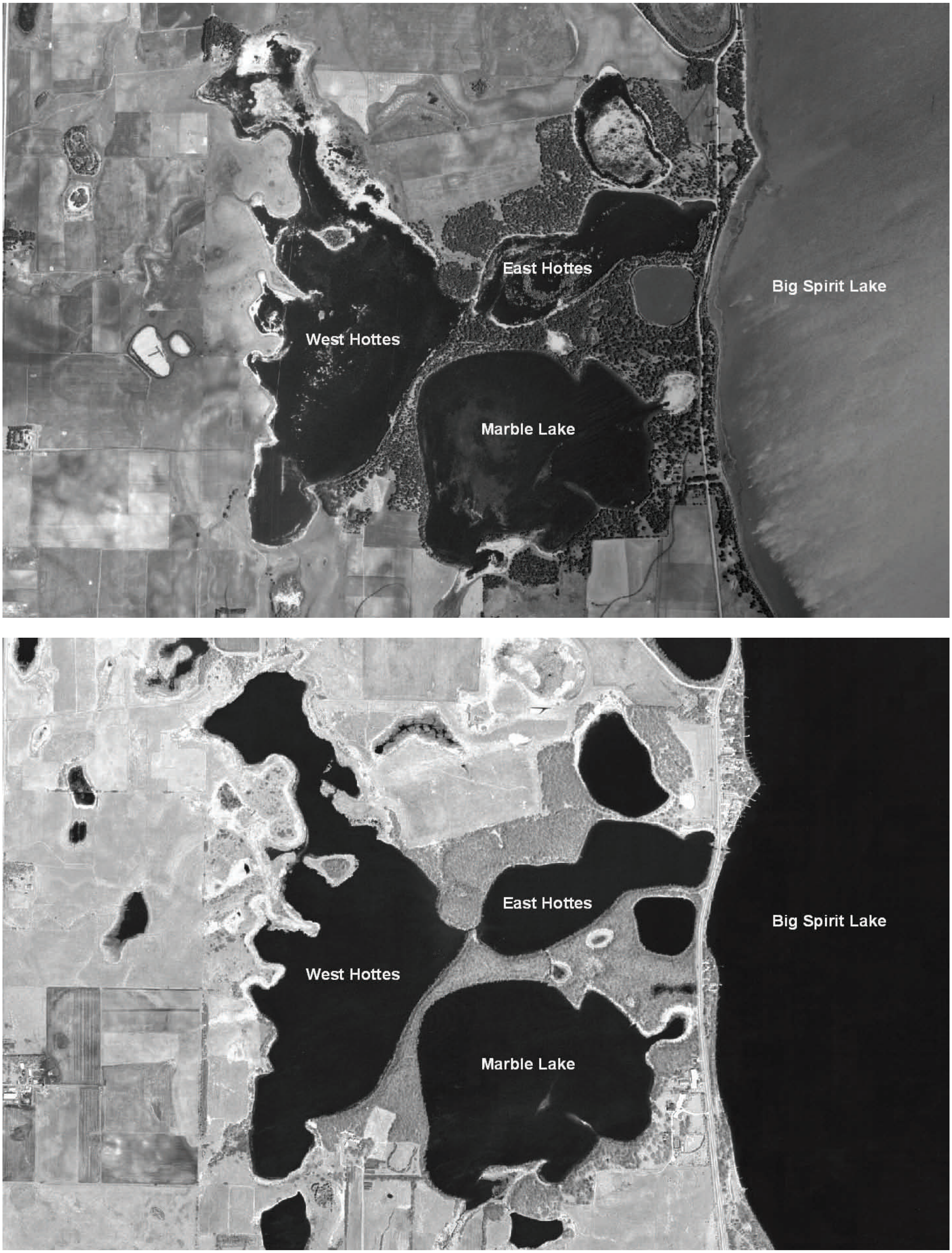

Figure 1.73 MARBLE AND HOTTES LAKE Aerial Photography from 1939 (top) and 2002 (bottom) demonstrating the change in extent of emergent vegetation

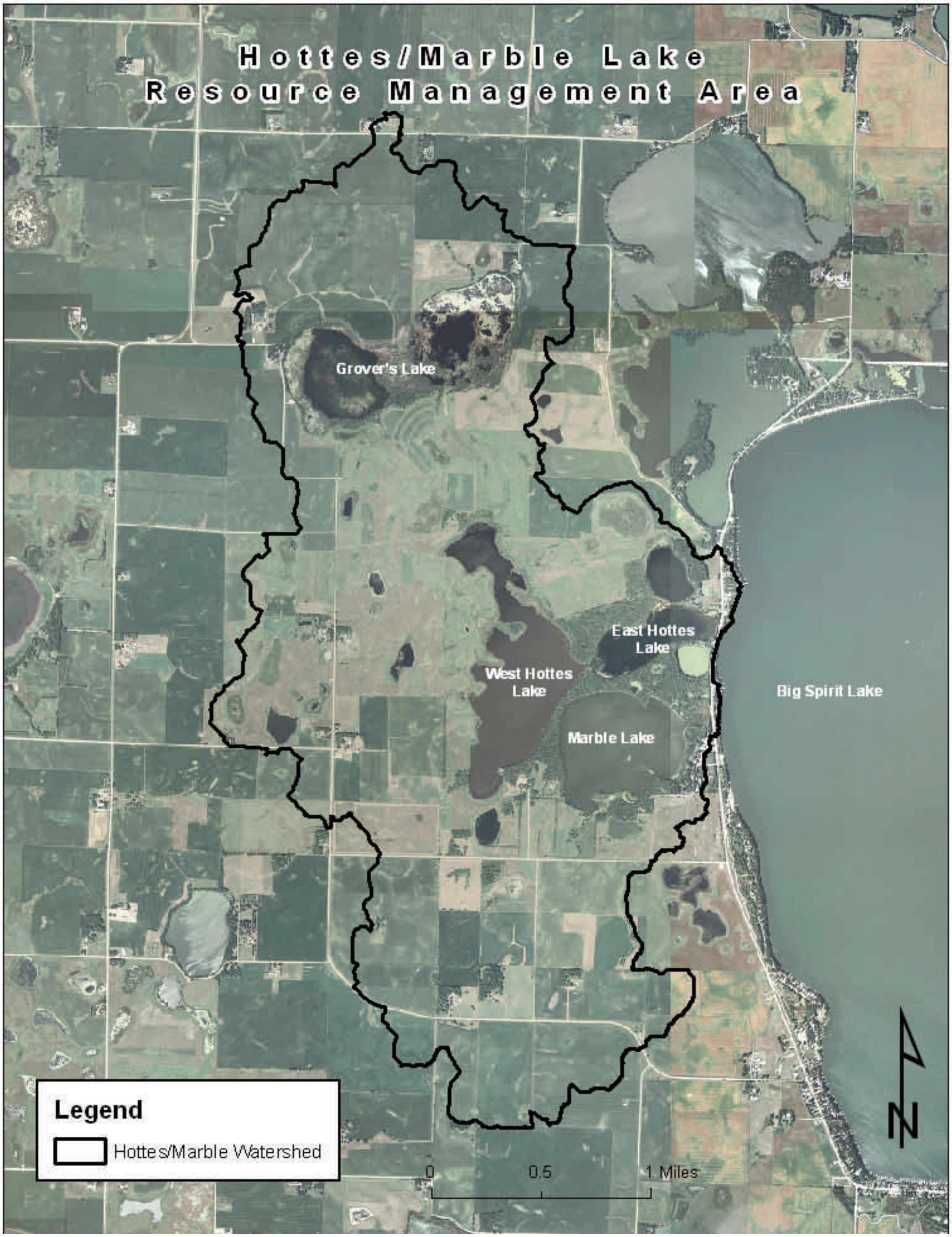

Figure 1.74 Hottes/Marble Lake Resource Management Area

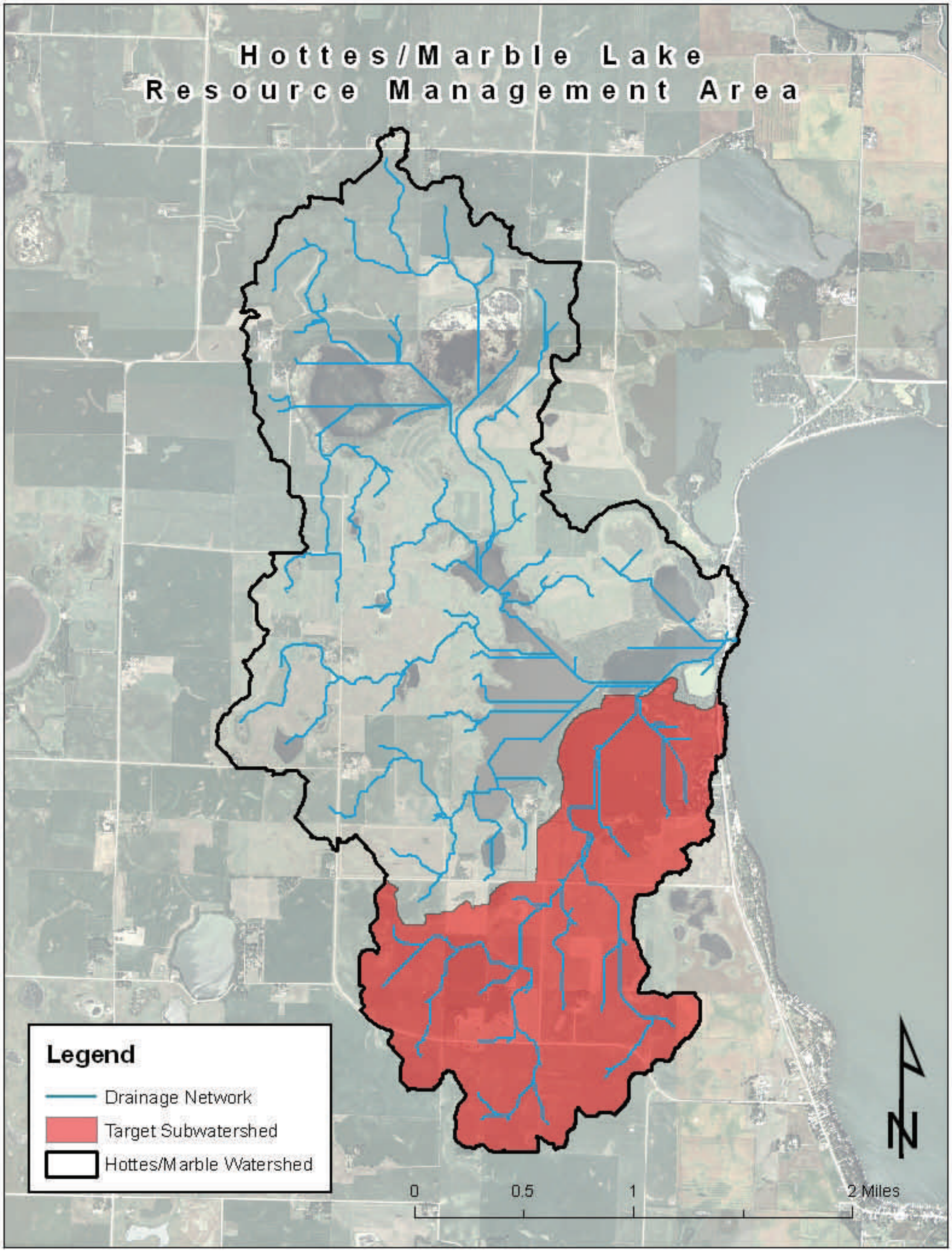

Figure 1.75 Priority sub-watershed (red) within the Hottes/Marble Lake watershed.

Hottes Lake Watershed Wetland Prioritization

Wetland ID	Flows into	Flows into	Flows into	Flows into	Flows into	Wetland Size (acres)	Watershed Size (acres)	Watershed to Wetland Ratio	GIS/RUSLE Priority
674	633	Lake				25.5	518.9	20.3	1
681	647	620	Lake			22.2	161.0	7.3	2
691	681	647	620	Lake		5.6	112.7	20.3	3
498	Lake					3.2	130.8	40.6	4
453	Lake					4.6	249.3	54.2	5
668	674	633	Lake			10.1	67.4	6.7	6
571	Lake					5.8	135.0	23.4	7
589	571	Lake				0.8	41.2	50.2	8
586	589	571	Lake			6.2	29.8	4.8	9
505	498	Lake				1.8	84.8	48.5	10
622	Lake					1.1	29.5	27.1	11
489	Lake					47.4	61.6	1.3	12
707	674	633	Lake			3.0	14.7	4.9	13
440	Lake					1.3	73.2	55.8	14
448	440	Lake				14.8	38.5	2.6	15
701	674	633	Lake			4.4	38.7	8.8	16
694	691	681	647	620	Lake	6.2	20.1	3.2	17
416	434	453	Lake			5.6	30.0	5.4	18
442	453	Lake				0.5	31.3	68.1	19
441	442	453	Lake			1.3	25.6	20.0	20
435	441	442	453	Lake		3.4	17.9	5.3	21
634	622	Lake				2.3	9.5	4.1	22
631	633	Lake				3.2	7.2	2.3	23
728	674	633	Lake			5.1	10.1	2.0	24
671	674	633	Lake			1.0	6.9	6.5	25
640	668	674	633	Lake		1.6	8.3	5.0	26
697	633	Lake				4.5	7.0	1.5	27
503	Lake					3.7	8.2	2.2	28
422	453	Lake				1.2	13.6	11.7	29
470	Lake					0.4	6.1	16.0	30

Table 1.14 Wetland restoration priorities for the Hottes/Marble 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).

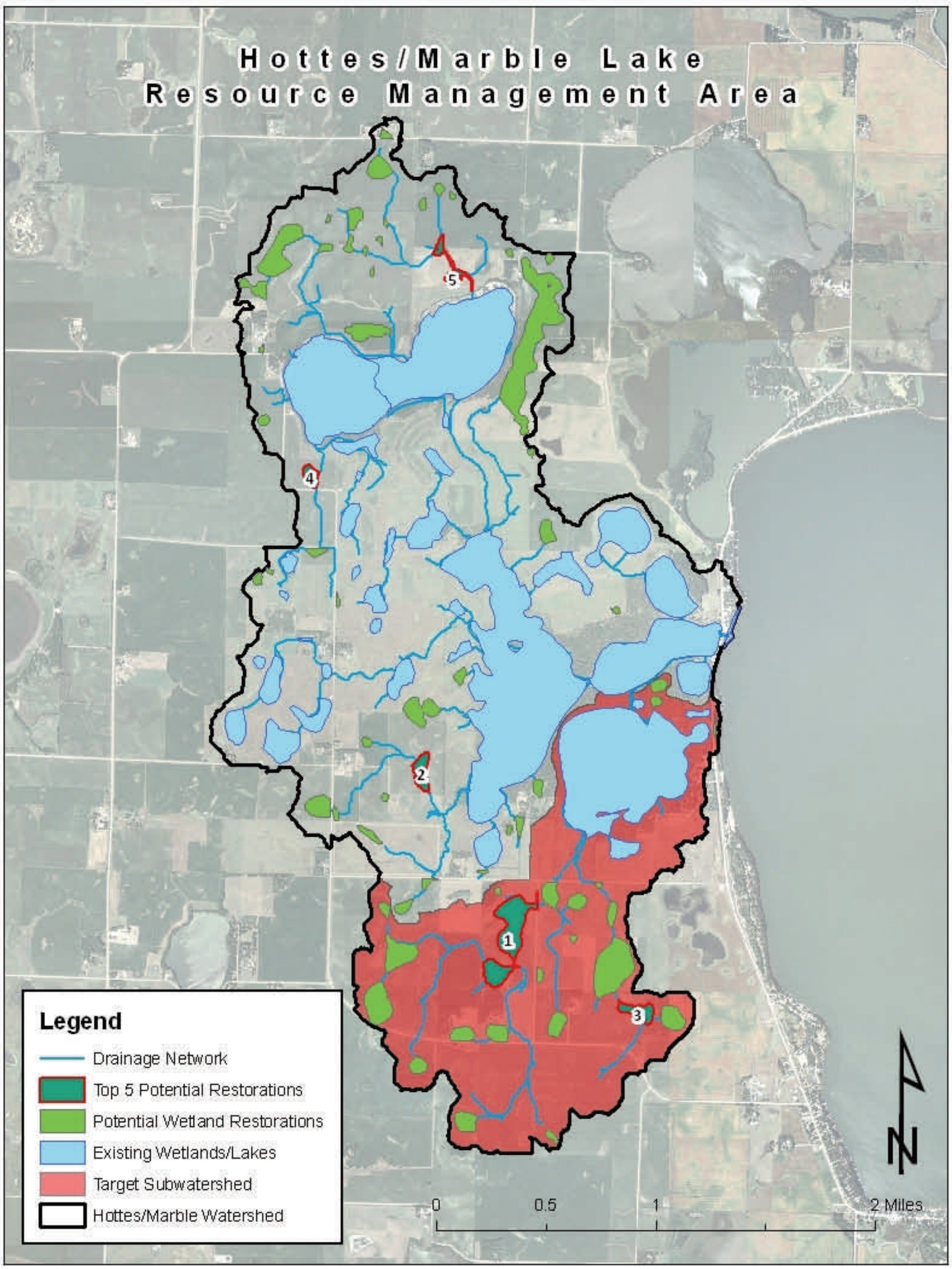

Figure 1.76 Wetland restoration priorities within the Hottes/Marble Lake watershed.

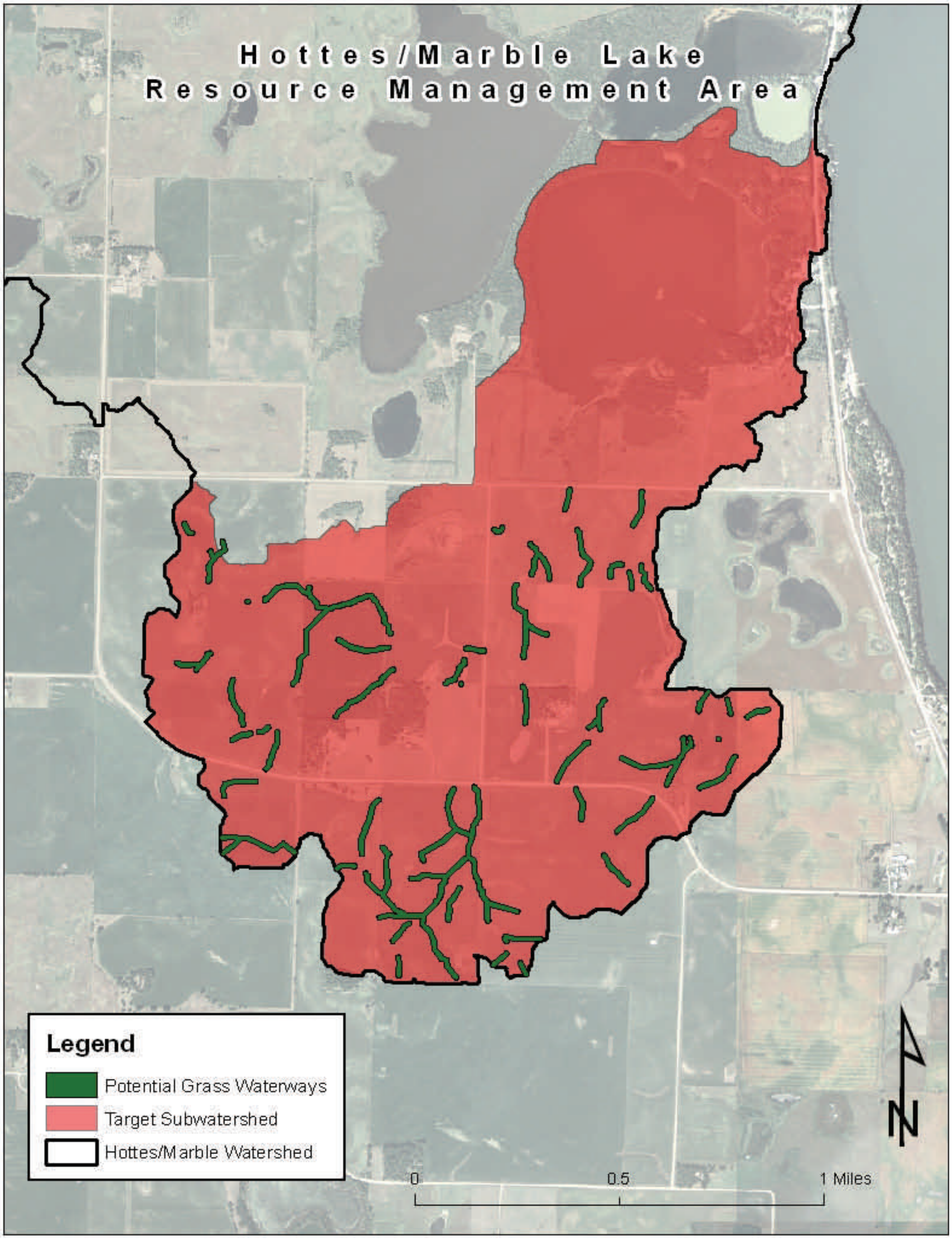

Figure 1.77 Hottes/Marble Lake Priority Area Ephemeral Gullies

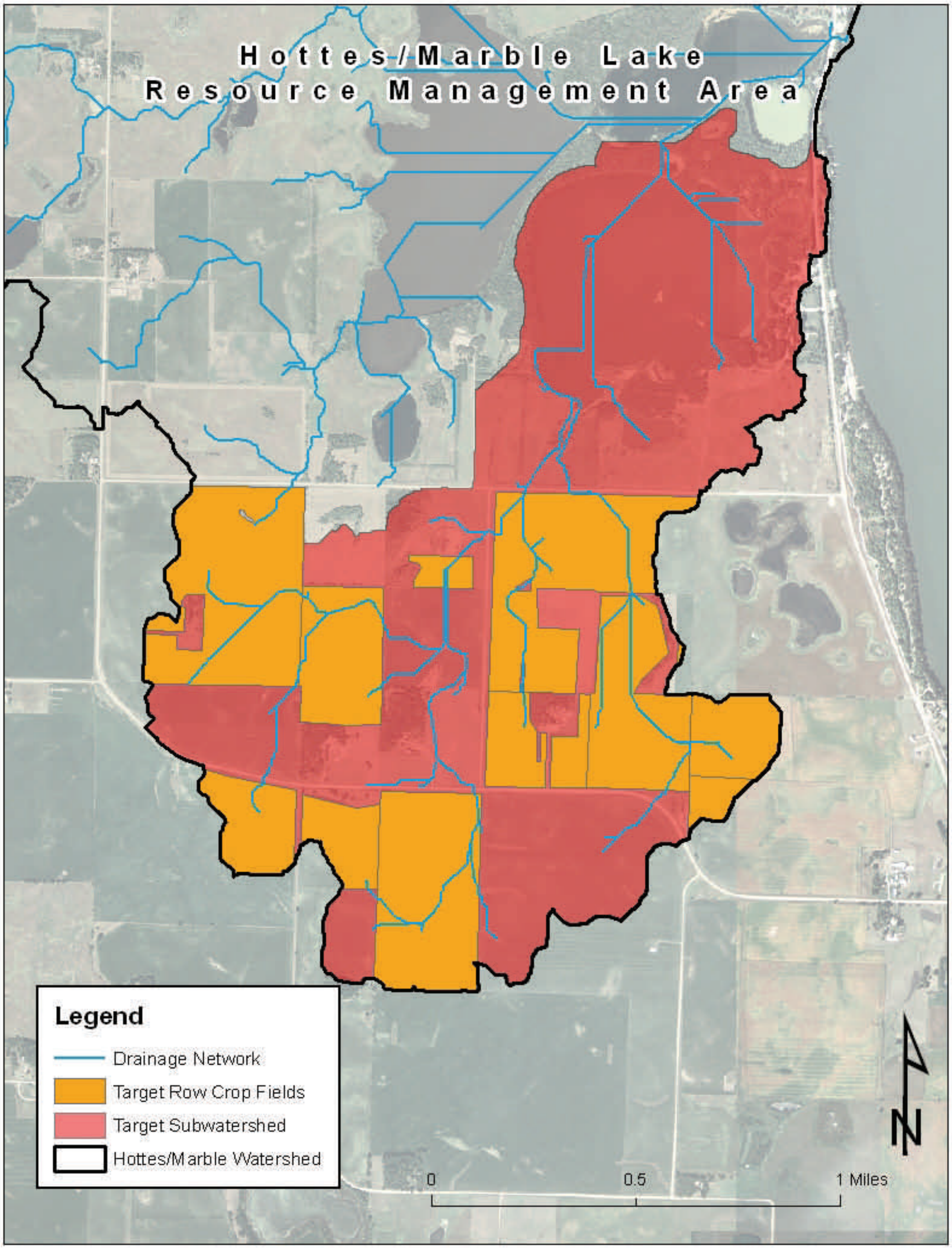

Figure 1.78 Marble/Hottes Lake Priority Area Targeted Row Cropped Fields

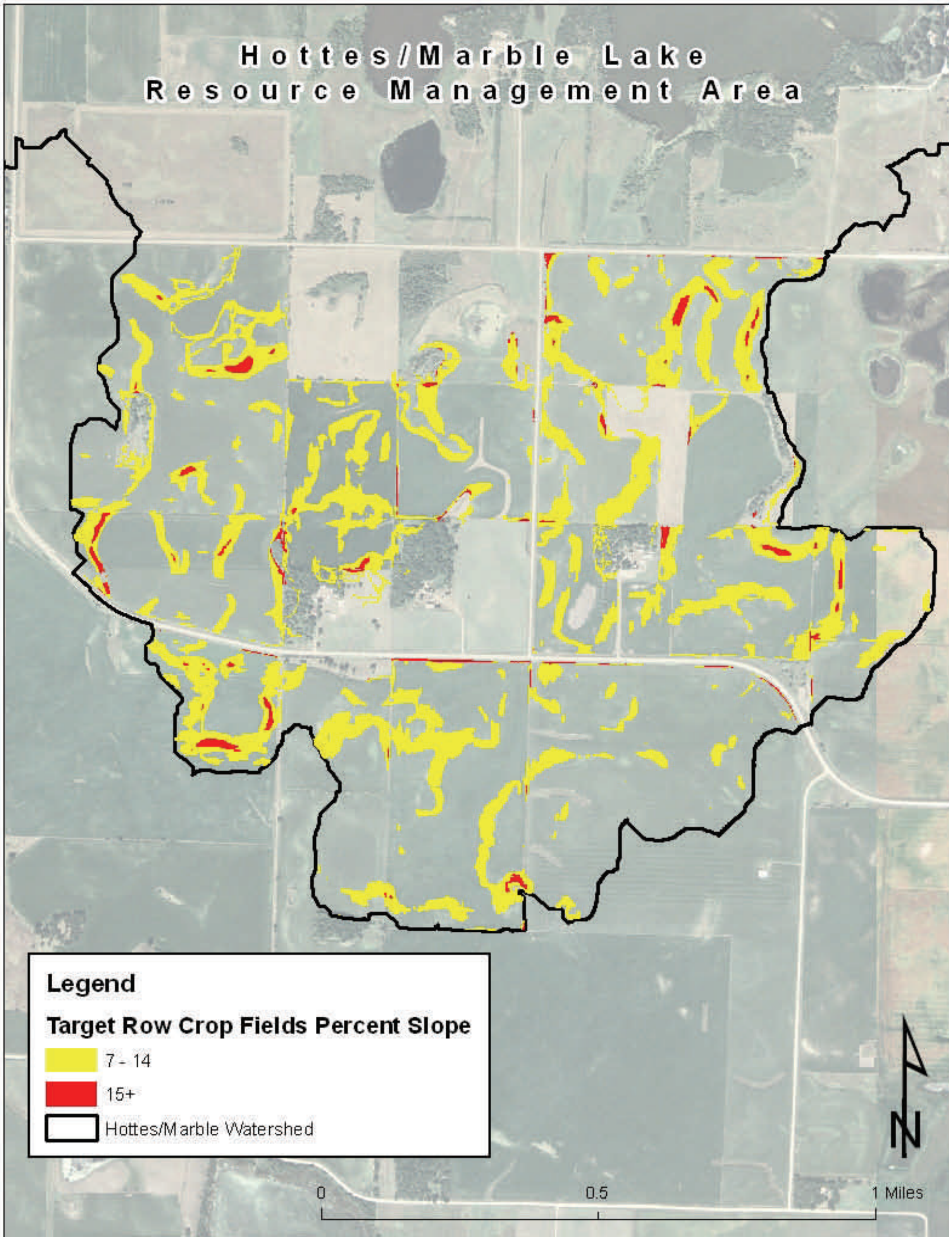

Figure 1.79 Hottes/Marble Lake Priority Sub-Watershed Row Crop Targeted Slopes

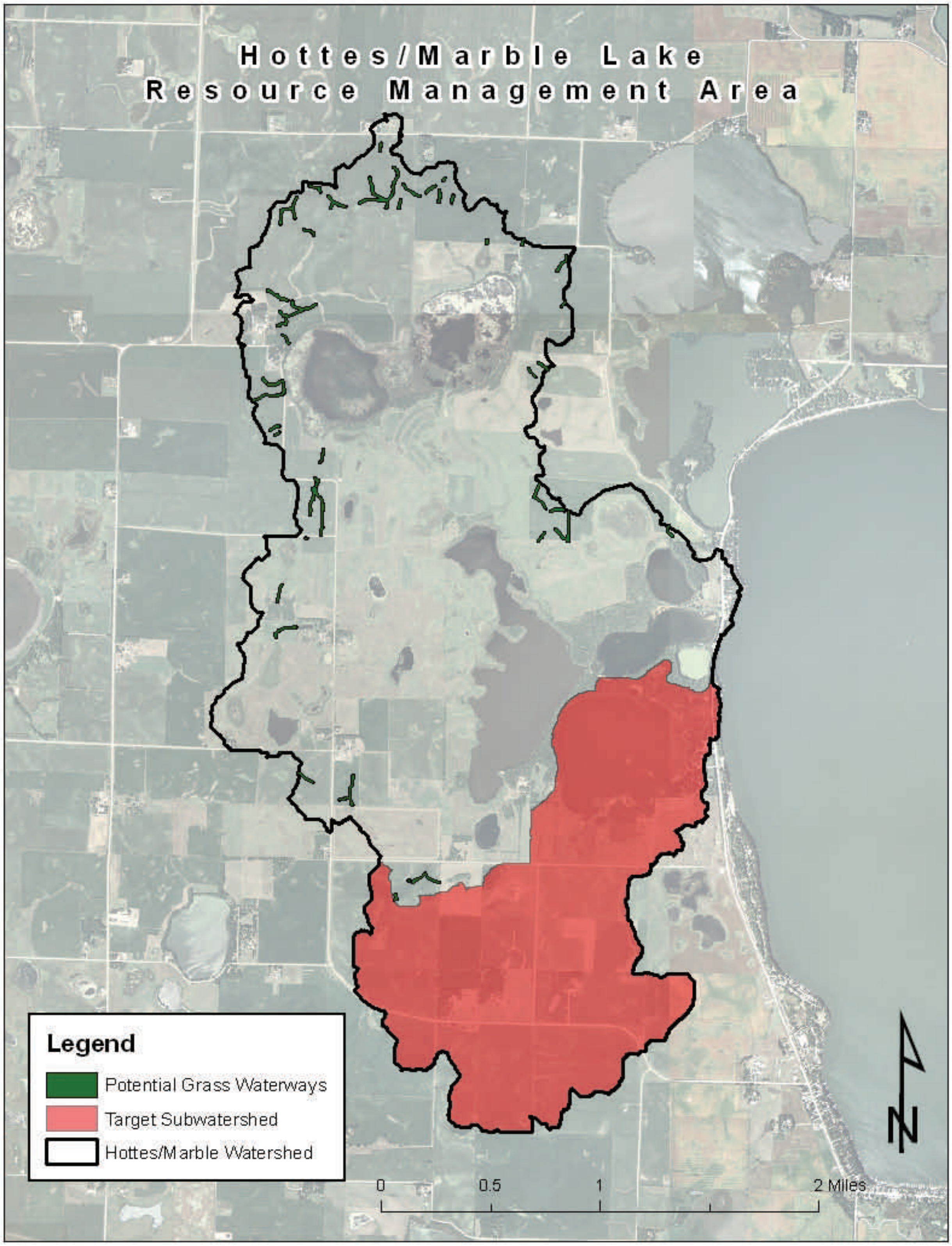

Figure 1.80 Hottes/Marble Lake Watershed Non-Priority Ephemeral Gullies

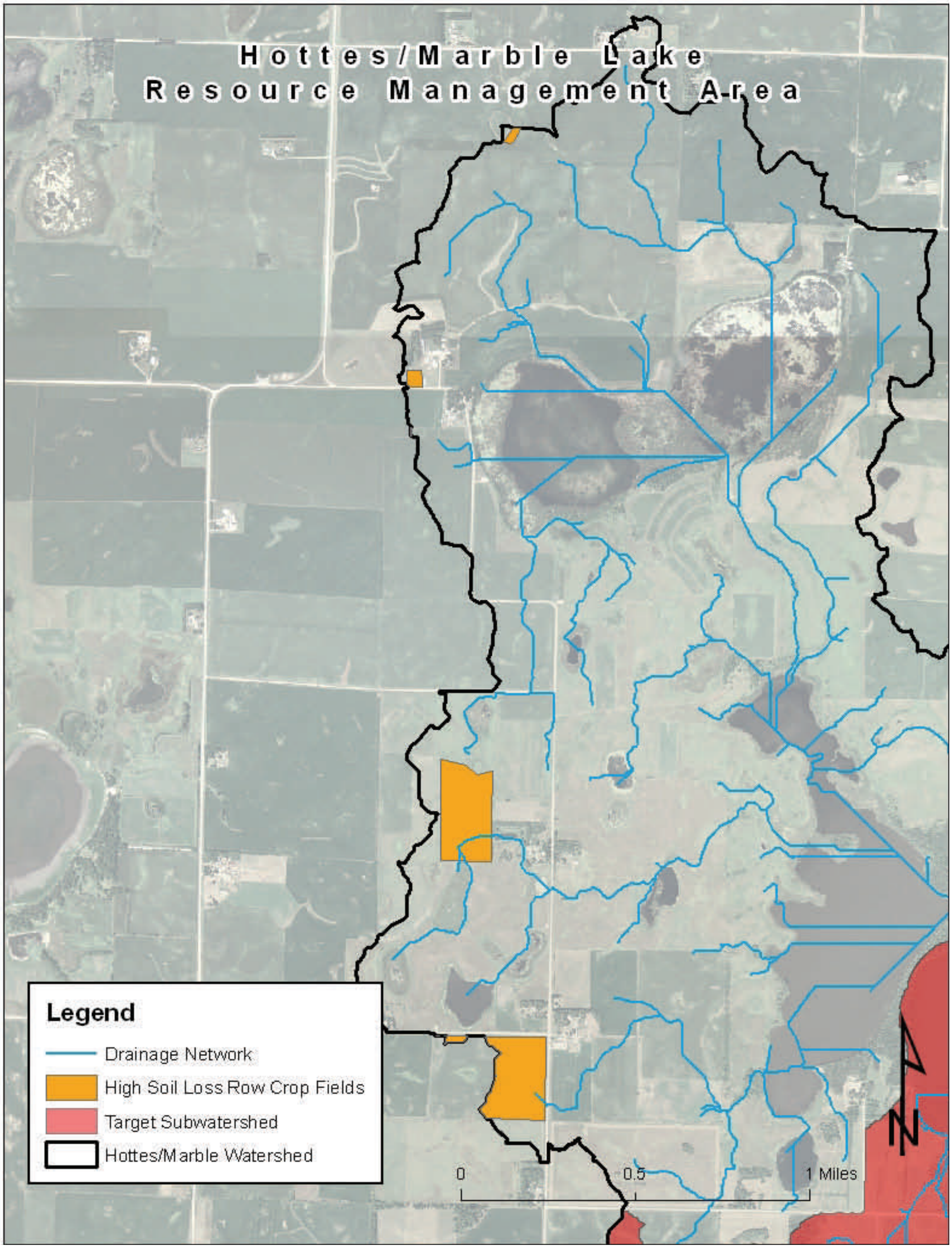

Figure 1.81 Hottes/Marble Lake Non-Priority Targeted Row Crop Fields

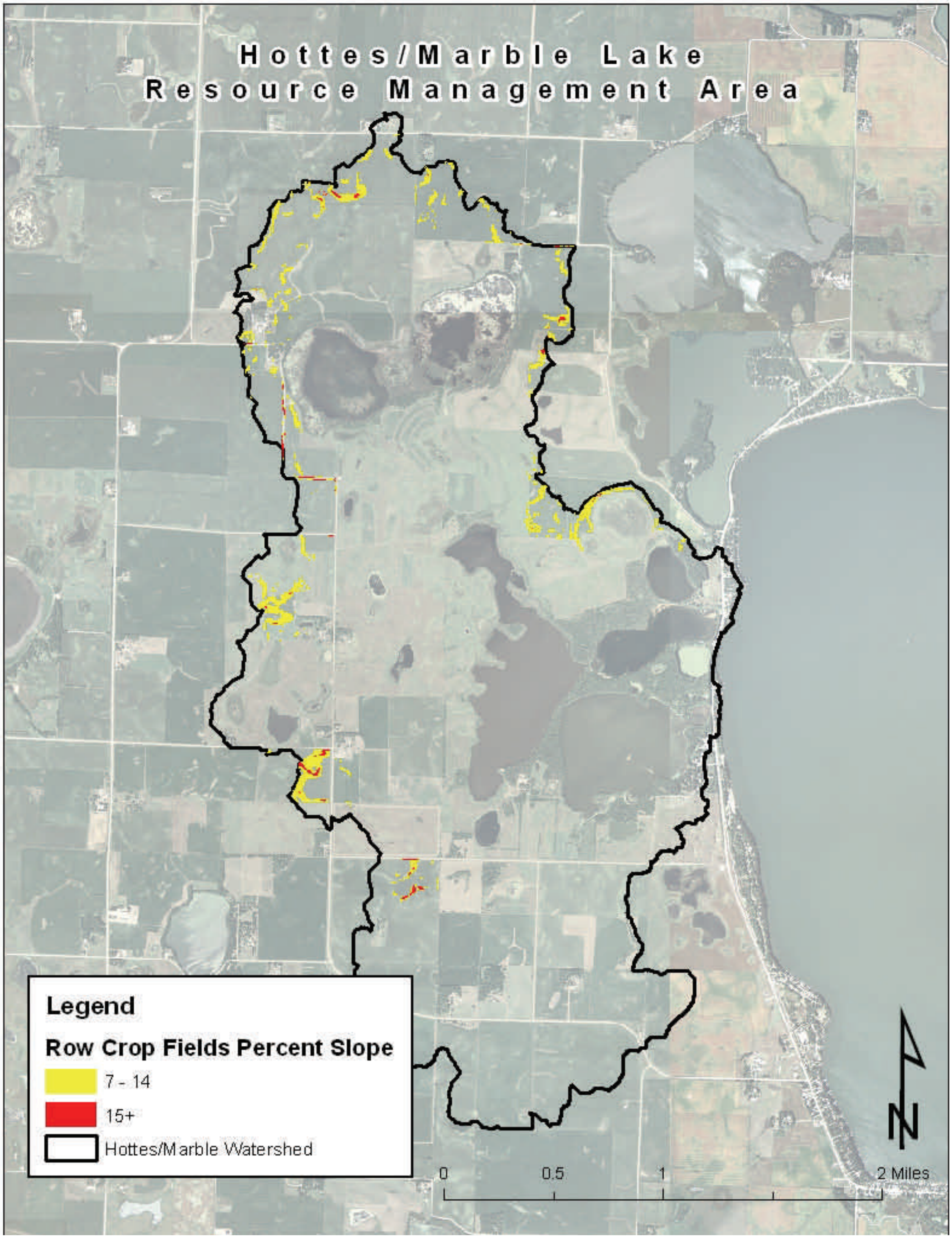

Figure 1.82 Hottes/Marble Lake Non-Priority Row Crop Targeted Slopes

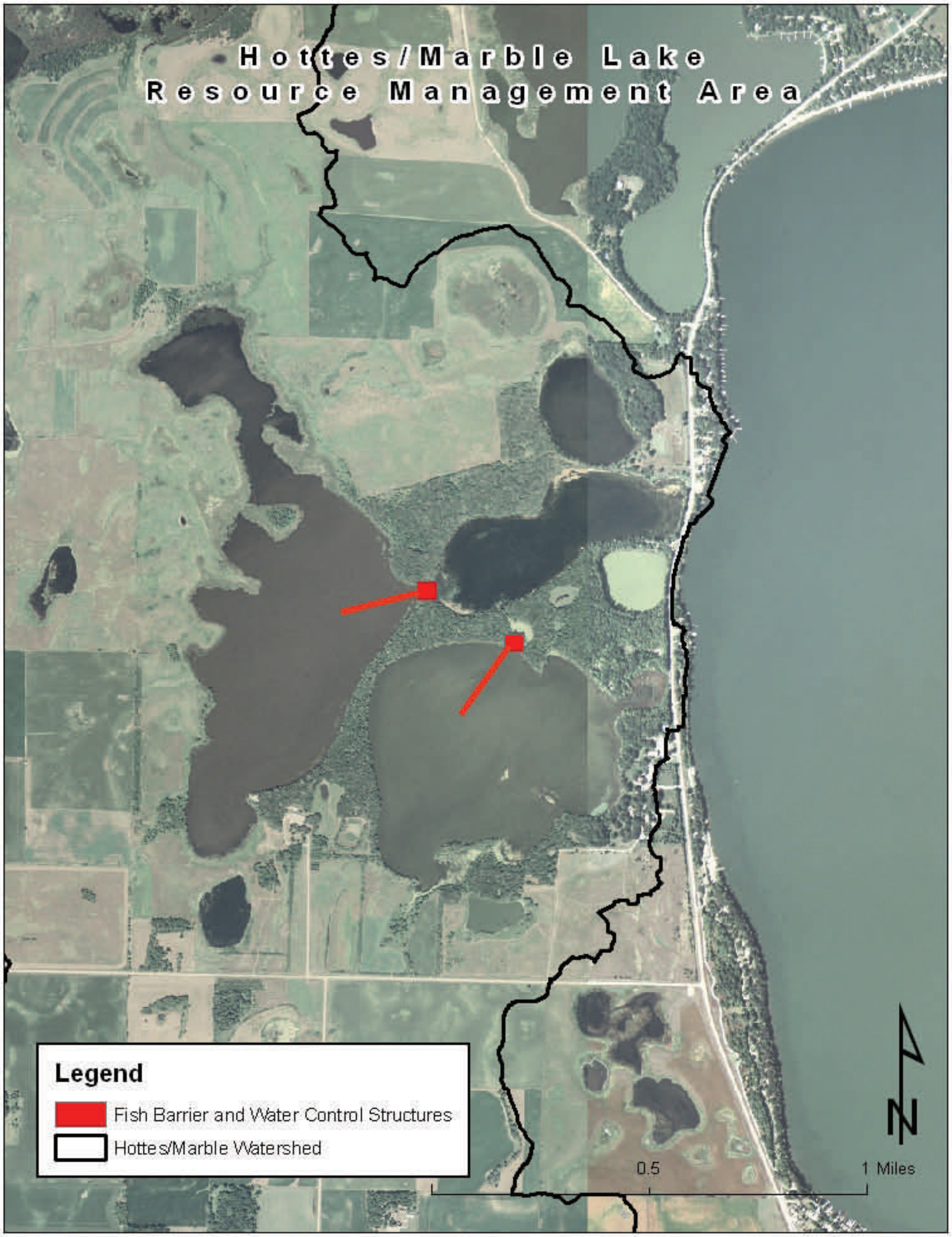

Figure 1.83 Hottes/Marble Lake RMA Fish Barrier and Water Control Structure Locations

LITTLE SPIRIT LAKE WATERSHED

Watershed Information:

Lake Size	Total Watershed	Watershed Direct	Watershed Indirect	Watershed Lakes	Direct RMA	Indirect RMA	Impaired
604 ac	2048 ac	1,444 ac	n/a	15	1	n/a	Yes

Lakes in the watershed of Little Spirit Lake: None

RMA's that drain to Little Spirit Lake:

Direct

Little Spirit Lake RMA

Impairment for Little Spirit Lake: The pollutants causing the water quality impairments are algae and turbidity associated with excessive nutrient (phosphorus) loading. Designated uses for Little Spirit Lake are Primary Contact Recreation and Aquatic Life. Excess nutrient loading has impaired aesthetic and aquatic life water quality narrative criteria and hindered the designated uses (2004 Little Spirit Lake TMDL).

Objective: To remove the impairment from Little Spirit Lake through watershed and internal reductions of phosphorus. The load allocation reduction is for a minimum of 500 pounds of phosphorus per year for the first five years, 1,000 pound reduction of phosphorus per year for following five years and a final reduction of 1,400 of phosphorus reduction in the last five years according to the 2004 TMDL for Little Spirit Lake. The final goal is to have a total loading of phosphorus down to 500 pounds per year. These objectives will be met through restoration planning components that follow

Little Spirit Resource Management Area (RMA)

Objective – Restore and maintain Little Spirit Lake to a clear water system. The sediment reductions in this RMA will assist with the target reduction of phosphorus in Upper Gar Lake (3,300 pounds per year) and Lower Gar Lake (6,100 per year) in accordance with their specific approved TMDL's.

Description – Major changes in hydrology in the watersheds of this complex along with the introduction of common carp have led to slow degradation of water quality in this shallow lake. Aquatic vegetation has nearly disappeared within Little Spirit Lake.

The Little Spirit Lake watershed represents nearly 9% of the watershed of Big Spirit Lake. When healthy, the shallow lake and wetland complex making up Little Spirit Lake watershed provide important watershed protection to Big Spirit Lake. These areas also provide critical fishery and wildlife habitats.

A holistic approach is needed to restore ecological health and water quality to this complex. A combination of both watershed and lake management practices is needed to reach the project objective.

Sediment, nutrients, and water volume loadings from the watershed should be reduced utilizing a prioritized plan through augmentation of existing landowner conservation programs, easements, and public acquisitions. Restoration of the lake to a clear water system can be accomplished through processes designed to mitigate watershed alterations and the introduction of common carp. To simulate natural drought conditions, managed water level draw downs are needed to stimulate growth of emergent aquatic vegetation and reduce or eliminate common carp populations.

Restoration Planning Components

<u>Watershed Practices</u>

Prioritized Sub-watershed (Figure 1.84)

Structural Sediment Trapping

- Analysis has identified three priority wetland restorations in this sub-watershed (Figure 1.85).
- These wetland restorations have the potential to effectively intercept 615 acres (30% of the priority sub-watershed) of primarily agricultural runoff (Table 1.15).
- In lieu of restoration of these priority wetland areas, analysis has identified several locations for sediment retention basins or constructed wetlands.
- Restoration of these wetlands will reduce sedimentation by 1,107 tons per year.

Gully Management

- Five miles of ephemeral gully erosion has been identified within agricultural fields (Figure 1.86).
- By installing grassed waterways within each of these ephemeral gullies, 47 acres of upland habitat can be created and sediment loss from these areas significantly reduced.
- Construction of these grassed waterways will reduce sediment movement by 394.8 tons per year.

Highly Erodible Fields—Conservation Tillage

- 12 agricultural fields devoted to row crop production exceed sediment loss thresholds (Figure 1.87).
- These fields, totaling 381 acres, account for 50% of the sediment loss within the targeted watershed.
- By using minimum tillage on these fields a reduction of 571.5 tons of sediment per year will be realized.

Highly Erodible Fields—Permanent Vegetation

- Sediment loss can be reduced on 106 acres of row cropped fields by implementing alternative practices (i.e. permanent vegetation, sediment basins, and reduced tillage) where field slope is greater than seven percent.
- Ten acres have been identified and should have alternate land practices implemented because their slope is greater than 15%.
- By establishing vegetation on these slopes, a reduction of 650 tons of sediment per year will be achieved.

Nutrient Management

- A total of 971 acres are currently being utilized for the production of corn and soybeans within the targeted watershed of Little Spirit Lake.
- A nutrient and pesticide management plan should be set up with each individual landowner to ensure that over application and runoff of nutrients and pesticides is minimized.
- A plan should also be put into place to protect field tile intakes from excessive nutrients and sediment.
- Rock tile intakes with an additional 50 foot vegetative buffer should be discussed and implemented at all tile intake locations within the sub-watershed.

Shoreline Restoration

Shoreline restoration is needed to reduce sediment re-suspension in Center Lake. There is an estimated 3,500 feet of linear shoreline that can be restored with upland prairie vegetation and in-lake native aquatic plants.

Lake Restoration

Proper in lake management begins by controlling the movement of water and fish in/out of Little Spirit Lake. A new fish barrier should be constructed between Big and Little Spirit Lakes to help control the movement of common carp into Little Spirit Lake. Controlled water level fluctuations may not be possible given the size and hydrological connectedness of Little Spirit to Big Spirit lakes. Heavy predator stocking within Little Spirit Lake could help offset the likelihood of strong common carp year classes. Once a new fish barrier is in place between Big and Little Spirit (Figure 1.88), northern pike and muskellunge stocking should begin.

Pollution Reduction

Little Spirit Lake has a TMDL which requires 1,400 pounds of phosphorous per year to be removed in order to remove the lake from the State's Impaired Waters List. This Management Plan will meet that goal with a reduction in Phosphorous coming from the restored priority wetlands, stopping the ephemeral gullies using grassed waterways and sediment basins, conservation tillage, vegetative cover, and nutrient and pest management. In addition, rock tile intakes and vegetation around the intakes will ensure an adequate reduction of phosphorous and associated sediment. By implementing the above components the 1,400 pounds of phosphorous will easily be achieved.

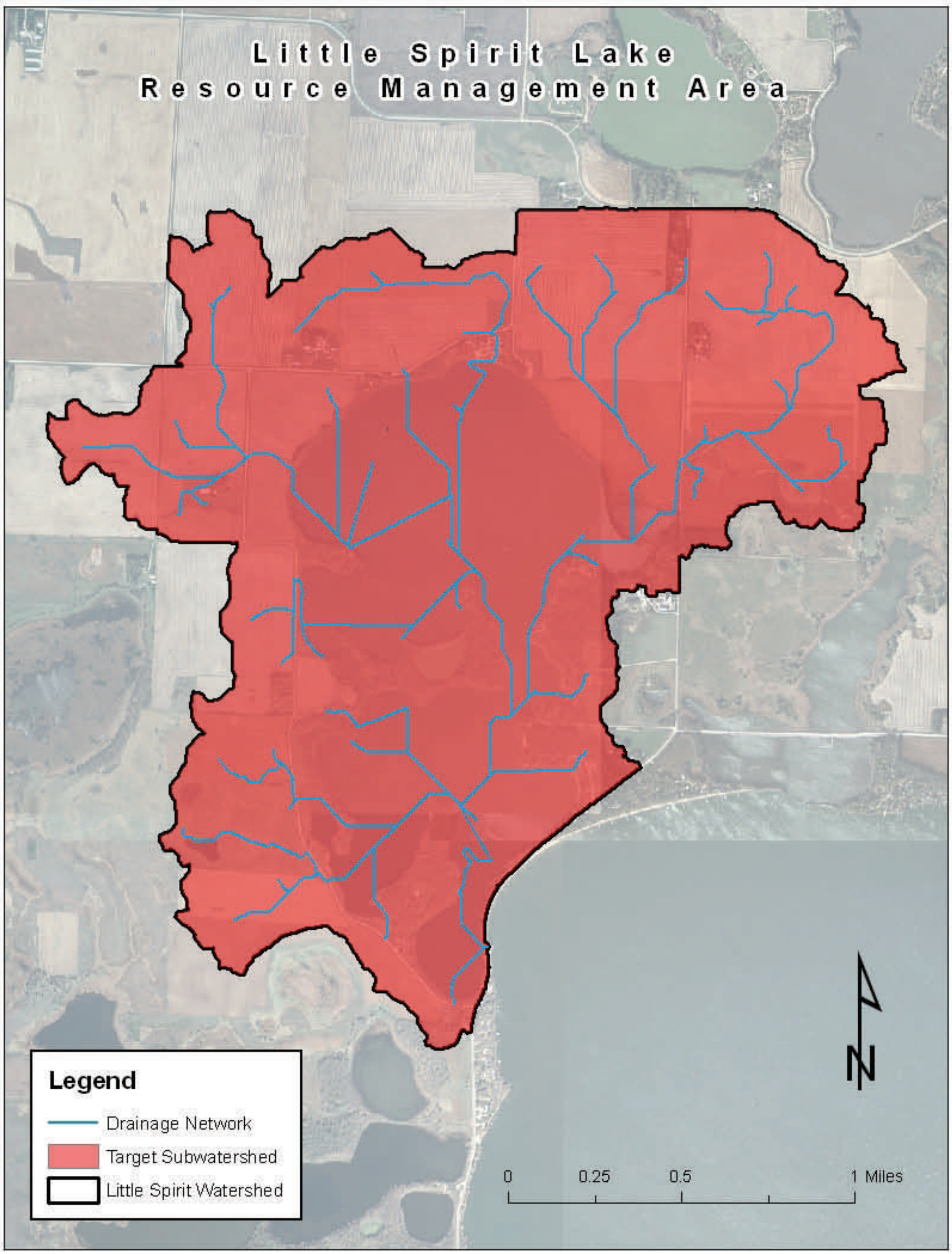

Figure 1.84 Little Spirit Lake Resource Management Area

Little Spirit 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
430	Lake						17.2	168.7	9.8	1
428	Lake						34.9	161.2	4.6	2
436	Lake						20.0	212.7	10.6	3
401	Lake						1.6	121.3	74.0	4
464	Lake						1.5	54.4	35.8	5
500	Lake						8.4	46.4	5.5	6
486	Lake						0.9	48.8	52.5	7
406	430	Lake					4.6	52.3	11.5	8
400	408	414	436	Lake			1.4	90.4	66.5	9
395	401	Lake					2.0	79.9	39.7	10
402	400	408	414	436	Lake		14.6	52.2	3.6	11
425	430	Lake					2.9	29.3	10.2	12
414	436	Lake					6.1	146.9	24.2	13
408	414	436	Lake				6.9	117.8	17.0	14
398	428	Lake					4.1	28.7	6.9	15
473	Lake						1.6	31.1	19.2	16
407	397	395	401	Lake			7.0	18.7	2.7	17
397	395	401	Lake				9.4	54.7	5.8	18
506	Lake						2.8	8.9	3.2	19
499	500	Lake					2.3	13.5	5.9	20
396	406	430	Lake				4.9	17.9	3.6	21
399	428	Lake					2.7	23.0	8.6	22
472	Lake						0.4	5.4	13.9	23
389	402	400	408	414	436	Lake	2.7	14.3	5.2	24
429	436	Lake					2.3	33.9	14.4	25
390	402	400	408	414	436	Lake	0.8	6.4	8.3	26
377	388	428	Lake				1.6	5.4	3.3	27
438	Lake						3.3	7.2	2.2	28
502	Lake						7.3	11.1	1.5	29
412	Lake						1.8	4.4	2.5	30
494	500	Lake					1.4	4.5	3.2	31
439	430	Lake					0.5	3.7	7.1	32
418	429	436	Lake				2.6	10.0	3.9	33
393	406	430	Lake				0.7	3.0	4.3	34
383	398	428	Lake				3.3	5.5	1.7	35

Table 1.15 Wetland restoration priorities for the Little Spirit 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).

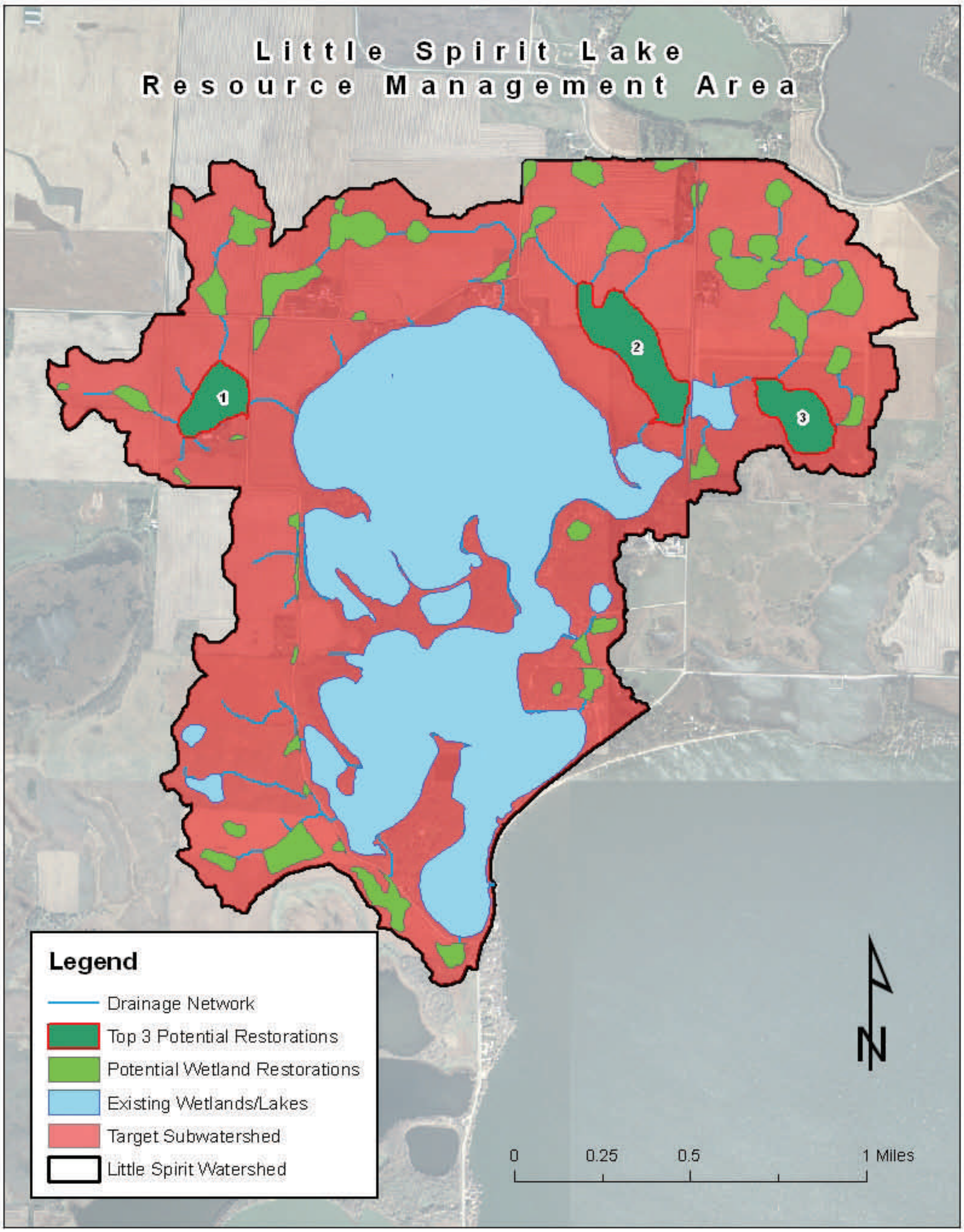

Figure 1.85 Little Spirit Lake Prioritized Wetland Restorations

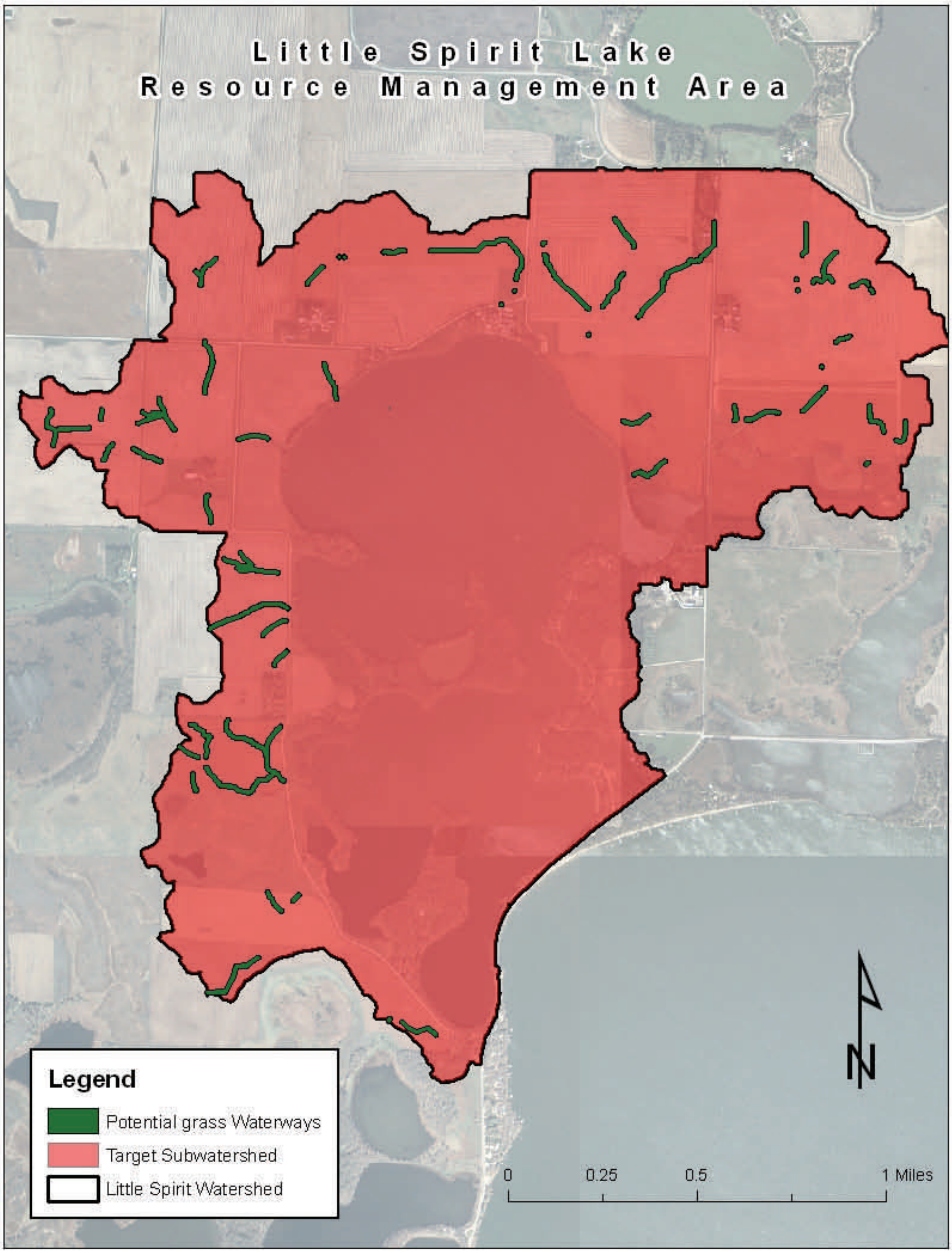

Figure 1.86 Little Spirit Lake Ephemeral Gullies

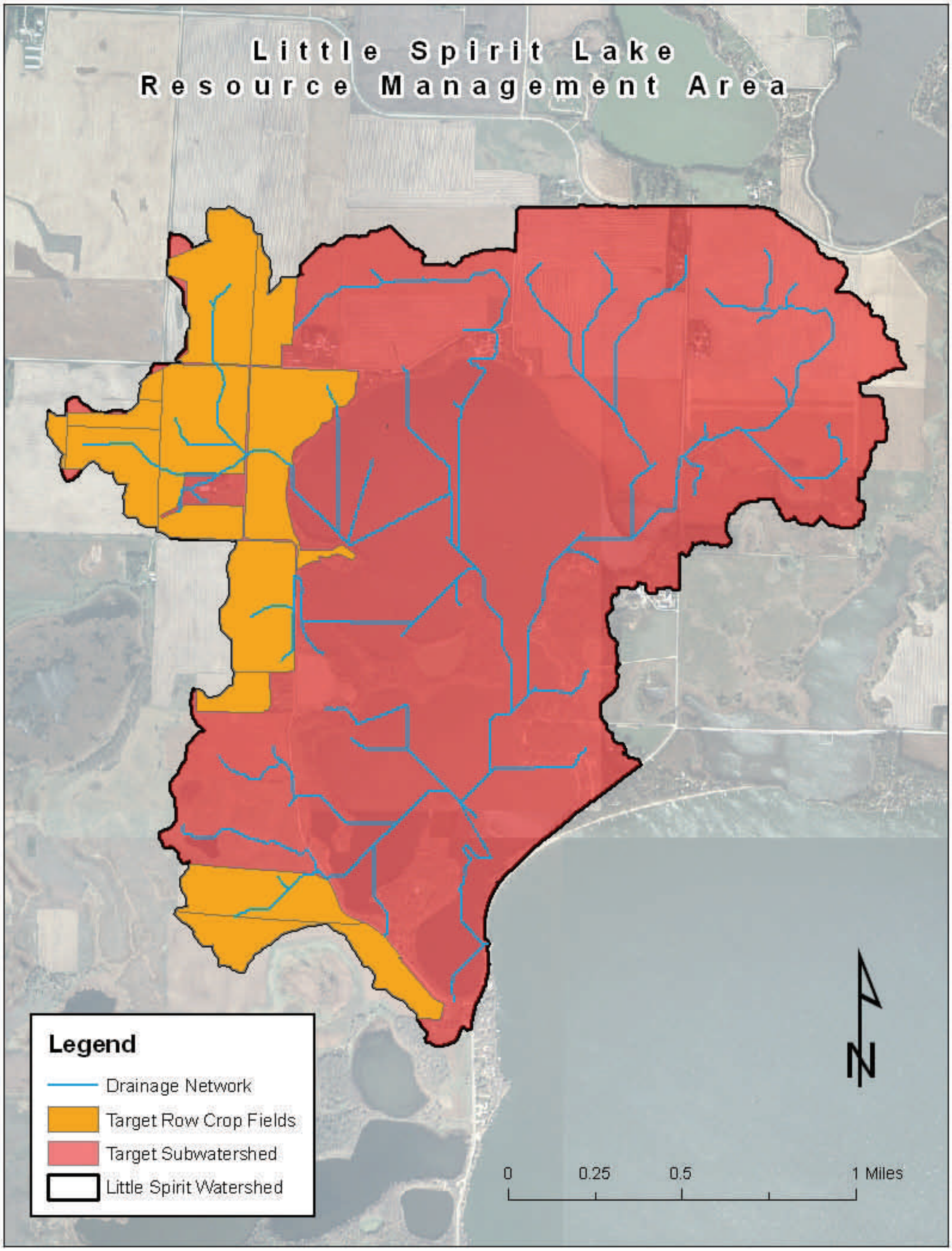

Figure 1.87 Little Spirit Lake Target Row Crop Fields

Figure 1.88 Little Spirit Lake Fish Barrier Location

LOON LAKE WATERSHED

Watershed Information:

Lake Size	Total Watershed	Watershed Direct	Watershed Indirect	Watershed Lakes	Direct RMA	Indirect RMA	Impaired
679 ac	19,238 ac	18,559 ac	n/a	3	1	0	Yes

Lakes in the watershed of Loon Lake:

Direct
Rush Lake
Clear Lake

Indirect
Pearl Lake

RMA's that drain to Loon Lake:

Direct
Loon Lake RMA

Impairment for Loon Lake: Loon Lake was impaired in 2008 for excessive nutrients. There is no approved TMDL for this Loon Lake as of 2010. The Minnesota Pollution Control Agency show that work on the TMDL will start in 2010. Within the Loon Lake watershed Clear Lake is also impaired for excessive nutrients and has a start time for a TMDL in 2010.

Objective – To remove excessive nutrient impairment from Clear and Loon Lake. This work will be done by reducing sediment loading into Clear and Loon Lake from agricultural landscape, minimal urban areas and improvement of septic systems. Improvements to Loon Lake are necessary to protect Big Spirit Lake from being impaired for excess nutrients and nuisance algae blooms. The work done within the Loon Lake watershed will also have an impact on the impairments on Upper Gar and Lower Gar Lakes.

Loon Lake Resource Management Area (RMA)

Objective – Restore and maintain Loon Lake to a clear water state. The sediment reductions in this RMA will assist with the target reduction of phosphorus in Upper Gar Lake (3,300 pounds per year) and Lower Gar Lake (6,100 per year) in accordance with their specific approved TMDL's.

Description – Major changes in hydrology in the watersheds of this complex along with the introduction of common carp have led to slow degradation of water quality in this shallow lake. Aquatic vegetation has nearly disappeared within Loon Lake Watershed.

Restoration Planning Components

<u>Watershed Practices</u>

Prioritized Sub-watershed (Figure 1.89)

Structural Sediment Trapping

- Analysis has identified five priority wetland restorations in this sub-watershed (Figure 1.90).
- These wetland restorations have the potential to effectively intercept 3,284 acres (17% of the priority sub-watershed) of primarily agricultural runoff (Table 1.16).
- In lieu of restoration of these priority wetland areas, analysis has identified several locations for sediment retention basins or constructed wetlands.
- Restoration of these wetlands will reduce 5,911.2 tons of sediment per year.

Gully Management

- 59 miles of ephemeral gully erosion has been identified within agricultural fields (Figure 1.91).
- By installing grassed waterways within each of these ephemeral gullies, 521 acres of upland habitat can be created and sediment loss from these areas significantly reduced.
- 5,731 tons of sediment will be removed from this RMA with the construction of these grassed waterways.

Highly Erodible Fields—Conservation Tillage

- 161 agricultural fields devoted to row crop production exceed sediment loss thresholds (Figure 1.92).
- These fields, totaling 7,313 acres, account for 50% of the sediment loss within the targeted watershed.
- By using minimum tillage on these acres, a reduction of 18,282.5 tons per year will be realized.

Highly Erodible Fields—Permanent Vegetation

- Sediment loss can be reduced on 778 acres of row cropped fields by implementing alternative practices (i.e. permanent vegetation, sediment basins, and reduced tillage) where field slope is greater than seven percent.
- Another 141 acres have been identified and should have alternate land practices implemented because their slope is greater than 15% (Figure 1.93).
- By establishing vegetation on these slopes, a reduction of 5,582 tons per year will be achieved.

Nutrient Management

- A total of 15,036 acres are currently being utilized for the production of corn and soybeans within the targeted watershed of Loon Lake Watershed.
- A nutrient and pesticide management plan should be set up with each individual landowner to ensure that over application and runoff of nutrients and pesticides is minimized.
- A plan should also be put into place to protect field tile intakes from excessive nutrients and sediment.
- Rock tile intakes with an additional 50 foot vegetative buffer should be discussed and implemented at all tile intake locations within the sub-watershed.

Lake Restoration

Proper in lake management begins by controlling the movement of water and fish in/out of Loon Lake. A new fish barrier should be constructed between Loon Lake and Big Spirit Lakes to help control the movement of common carp into Loon Lake. Controlled water level fluctuations may not be possible given the size and hydrological connectedness of Loon Lake to Big Spirit Lake. Heavy predator stocking within Loon Lake could help offset the likelihood of strong common carp year classes. Once a new fish barrier is in place between Loon Lake and Big Spirit Lake (Figure 1.6), northern pike and muskellunge stocking should begin.

Pollution Reduction

There is currently no reliable pollution figures for the Loon Lake RMA. When those numbers have been calculated, the RMA will be assigned an adequate figure.

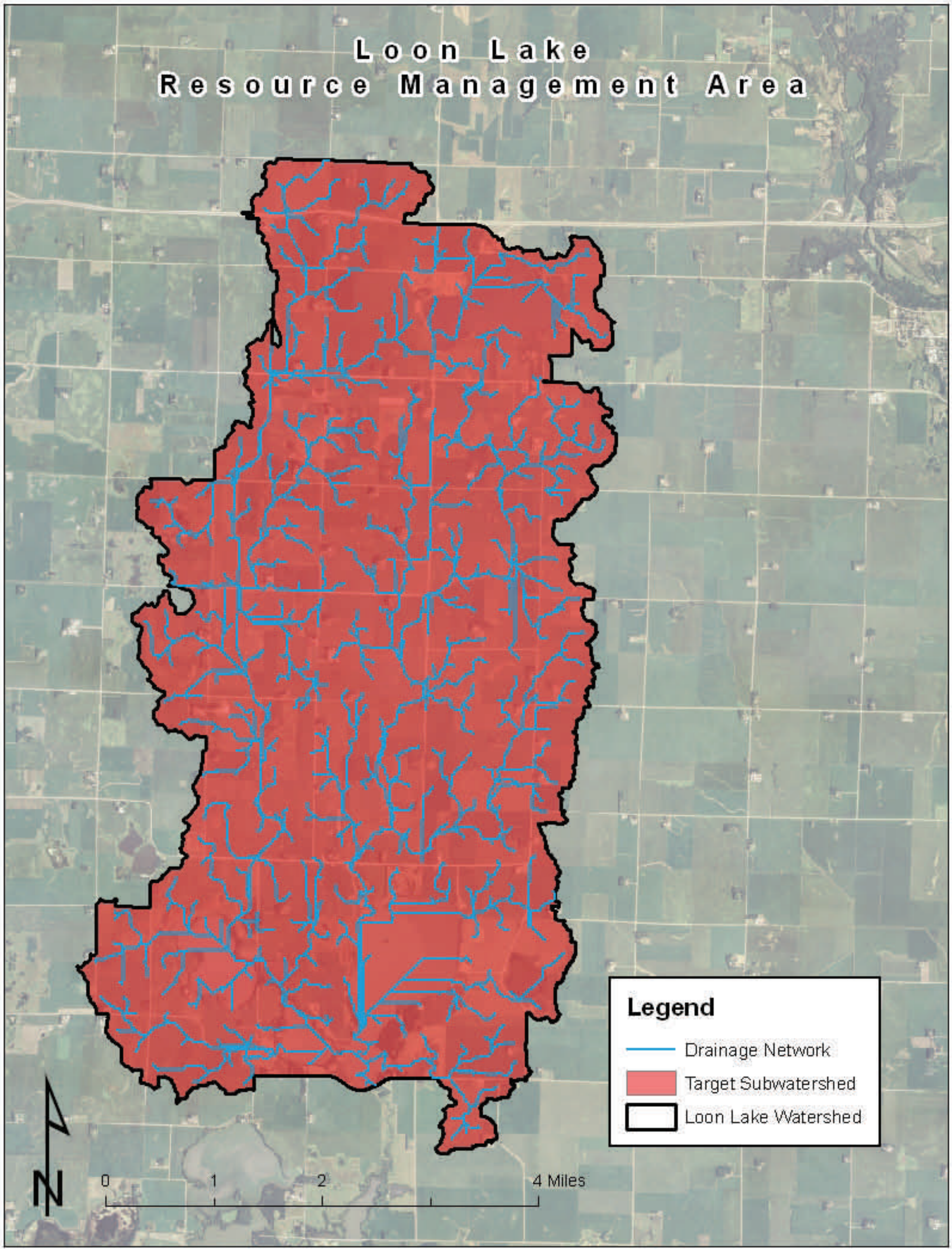

Figure 1.89 Loon Lake Resource Management Area