Topeka Shiner Monitoring in Minnesota: Year Three

submitted to:

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ABSTRACT

This work represents the continuation of a long-term surveying project (Ceas & Anderson, 2004; Ceas & Monstad, 2005) to conduct presence/absence surveys for Topeka shiners within the federally designated critical habitat in Minnesota. These data comprise the third year of an ongoing population-monitoring project designed to provide the DNR with a tool for detecting changes in the overall presence/absence of Topeka shiners within Minnesota.

Following the protocol established in 2004 and used again in 2005, twenty 1-mile stream segments within the Rock and Big Sioux watersheds of southwestern Minnesota (Missouri River system) were selected randomly using an ArcView extension program. Based on known habitat preferences, aerial photos of the twenty stream segments were reviewed to identify the 10 most likely sampling sites within each stream segment. If off-channel habitats were present then these were included as potential sample sites. A brief field reconnaissance of each stream segment allowed us to rank the ten sites within each segment according to which sites appeared most suitable for Topeka shiners, and sampling was conducted using a 10' x 5' eighth-inch mesh minnow seine.

Topeka shiners were found at eighteen of the twenty 1-mile stream segments, and in nine of these eighteen stream segments Topeka shiners were found at the first site sampled. Only three off-channel habitats existed within the twenty 1-mile stream corridors, and the shiners were generally found in well-developed in-channel pools or backwaters that appear to stay connected to the stream year-round.

The scope of this baseline project was limited and designed to conduct only straightforward presence/absence surveys for Topeka shiners in chosen stream segments. Even so, a few observations were noted. These observations are essentially the same as witnessed during the 2004 and 2005 surveys: (a) The stream segments that did not produce Topeka shiners tend to be continuously-flowing raceways/flowing waters, (b) A few of the 1-mile segments had good numbers of individuals and what appeared to be an abundance of suitable habitat, and may warrant a closer look for future habitat enhancement/landowner involvement projects; and (3) the GIS cover of critical habitat/stream channels needs to be updated using current aerial imagery to account for changes in stream position due to the ever-changing stream channels.

INTRODUCTION

(reproduced with some modifications from Ceas & Monstad, 2005)

This work represents the third year of a long-term surveying project (Ceas & Anderson, 2004; Ceas & Monstad, 2005) to conduct presence/absence surveys for Topeka shiners within the federally designated critical habitat in Minnesota. As summarized by Ceas & Anderson (2004), recent studies have shown that the Topeka shiner was once a common, wide-ranging species in the small prairie streams of portions of Minnesota, South Dakota, Nebraska, Kansas, Missouri, and Iowa. The species has experienced a widespread decline throughout its historic range, and was listed by the U.S. Fish and Wildlife Service (USFWS) as endangered, effective January 14, 1999.

The consensus among Topeka shiner researchers is that the species is not nearly as abundant in Minnesota (or elsewhere) as it was prior to European settlement and the subsequent alteration of the prairie ecosystem. However, recent surveys of Minnesota waters have shown that the Topeka shiner is "far more common in [this state] than was once thought" (Hatch, 2001). As stated in Tabor (2002), while much habitat in these Minnesota streams has been altered by channelization, erosion, and sedimentation, "current [Minnesota] habitat conditions provide most or all of the primary constituent elements consistent with designation as critical habitat." Topeka shiners appear to exist in disjunct populations that are subject to local extirpation, but recolonization events do seem to occur if a source population is near. Therefore, nearly all streams and associated off-channel pools within the Rock and Big Sioux watersheds of southwestern Minnesota are listed as critical habitat.

Identification and life history characteristics of the Topeka shiner can be found in many recent reports (e.g., Tabor, 1998; Dahle, 2001; Berg et al., 2004) and will not be repeated here. As noted in Ceas & Anderson (2004), the habitat in which Topeka shiners are almost always found include (1) off-channel habitats (ponds and oxbows/meander cut-off channels) that occasionally get inundated by high water levels from associated streams, and (2) in-channel pools and backwaters that have little to no flow; this species does not normally live in riffles, raceways, or other constantly-flowing waters (Dahle, 2001; Ceas & Monstad, pers. observ.).

METHODS

Methods followed Ceas & Anderson (2004), and are reproduced with updated information below.

Selection of Stream Segments

Twenty random stream segments (Appendix A) within the Rock and Big Sioux watersheds of southwestern Minnesota were selected using an ArcView extension program written by Tim Loesch (Minnesota DNR). A brief description of this extension file follows (T. Loesch, pers. comm.):

> The extension randomly selects stream segments of user-specified size (one mile lengths in this case). Each line segment that represents a river or stream has a unique value assigned to it that represents the record number in the database for that stream segment. The program doesn't actually pick random points; instead it picks random record numbers that relate to stream segments. The program randomly selects segments by using a random number that is generated between 0 and the number of records in the database (e.g., if the random number is 2014 then the line segment that is record number 2014 in the database is chosen). If that segment is longer than the required length then the middle of the segment is selected and 1/2 of the segment distance is measured out from there and the line is clipped at those positions. If the line is not longer than the desired line length, then the lines that connect to the line are merged together. If that segment is long enough then it will select the center of the line and generate a line that is the correct length.

Landowner Contact

Permission from landowners was required to access the property containing the selected random stream segments. Landowner contact information was determined using plat maps and/or contacting the County Auditor's Office. Y. A Monstad contacted landowners by phone before the survey, explained the purpose and procedure of the survey, and requested permission to come onto their property. If permission was not granted or landowners were not available (we also stopped by their houses if they live on site), the portion of the stream segment outside of the property in question was surveyed. In the latter cases (which were few), Topeka shiners were found in the sampling sites outside of the property; so further sampling within the stream segment was not required.

Selection and Reconnaissance of Sampling Sites

Based on known habitat preferences, we reviewed aerial photos (U.S. Department of Agriculture, Farm Services Agency, Aerial Photography Field Office, Summer 2003, FSA NAIP 2003) of the 20 stream segments to identify the 10 most likely sampling sites within each stream segment. If off-channel habitats (OCH) were present then these were always included as potential sample sites. We then conducted a brief reconnaissance of each stream segment, and ranked the ten sites within each segment according to which sites appeared most suitable for Topeka shiners. Reconnaissance of the streams and sampling for fishes occurred during May 16-18 (Segments 41-44, 46, 49, 50, 51, 54-56) and May 23-25 2006. GPS coordinates were taken at each sampling site using a Garmin GPSmap 76.

Sampling for Fishes

Table 1 (Appendix B) lists the twenty stream segments, and provides locality information & basic habitat descriptions of all sampling sites. For each of the 20 stream segments, we began sampling at the site deemed most likely to contain Topeka shiners. Sampling techniques included standard seine hauls, set-kicks, and "working" undercut banks and vegetated shorelines while using a 10' x 5' eighth-inch mesh minnow seine.

Given the differences in stream sizes and habitat heterogeneity, no attempt was made to standardize sampling effort or time between the sampling sites (quantitative sampling was not a goal of this project). At the sites where Topeka shiners were not found, sampling time varied from 5 minutes (e.g., a simple unobstructed 10-foot long pool) to 30 minutes. All available habitats within a given site were thoroughly sampled until either (1) Topeka shiners were found or (2) in the professional judgment of P. Ceas it was reasonably determined that there were no Topeka shiners present. Some additional exploratory sampling took place at a few sites that appeared to contain relatively large numbers of shiners and/or "good" habitat.

RESULTS

Topeka shiners were found at eighteen of the twenty 1-mile stream segments (Table 1, Appendix B; Appendices A & C); they were not found in Segments 41 and 43. In 9 of the 18 stream segments that did contain Topeka shiners, we found the species in the first site sampled (e.g., Site 55-1). These 9 segments & corresponding sites are 45-1, 46-1, 47-1, 48-1, 50-1, 54-1, 55-1, 57-1, and 60-1. We captured Topeka shiners in the first seine haul in 6 of these 9 segments; and in the 2nd haul at Sites 48-1, 55-1, and 60-1. Topeka shiners were also found in Sites 42-2 (first haul), 44-6, 49-2 (first haul), 51-4, 52-2(first haul), 53-2, 56-3, 58-2, and 59-7.

Although differing somewhat in size, the two stream segments in which Topeka shiners were not found (41 and 43) were similar to each other and to other segments from that failed to yield shiners in 2004 & 2005 in that they were relatively fast-flowing streams that did not have the typical pool habitat associated with Topeka shiners, whether the pools were in-stream or off-channel habitats (OCH). There was one shallow & widened section in Segment 41 (created by cattle), but even this was best classified as a gently flowing run.

Only three of the twenty stream segments (43, 53, and 57) contained off-channel habitats (OCH). Segment 43 did not contain Topeka shiners, and the OCH in Segment 57 was not sampled since Topekas were found in a connected backwater on the first seine haul. Topeka shiners were found in the OCH at Segment 53.

As with Segments 41 and 43, Segment 54 lacked any "Topeka-friendly" pools or backwaters; however, one female was still captured on the first seine haul. Segment 59 (creek & unnamed trib) had been channelized, but Topeka shiners were common in the one man-made pond on the tributary, which appeared to be spring-fed. The remaining sixteen stream segments contained well-connected backwaters or in-stream pools, and all sixteen segments produced Topeka shiners.

DISCUSSION

The scope of the third year of this study was to continue to conduct straightforward presence/absence surveys for Topeka shiners in a randomly chosen group of 20 one-mile stream segments. Given the random choosing of stream segments, the streams varied in size and variety of habitats. Therefore, no attempt was made to quantify habitat assessment or sampling effort & time between sites. Even so, we continued to make a few observations that seem to support our conclusions of the results from the 2004 & 2005 surveys.

(a) As with '04 & '05, the stream segments that did not produce Topeka shiners (41 and 43) were almost continuously flowing raceways/flowing waters. Given the species' preference for pools and slow-moving waters, we were not surprised that Topeka shiners were not found. Although these stream segments do not "appear" to contain habitat that is generally considered typical for Topeka shiners, and it is unlikely that such stream segments would ever support large numbers of individuals, it would be premature to conclude that Topeka shiners are not found here (e.g., a Topeka shiner was found in Segment 54 even though no pools were present). It may simply be necessary to sample more than 10 sites within such stream segments to be successful in capturing Topeka shiners.

(b) A few of the 1-mile segments had relatively large numbers of individuals (including breeding individuals) and what appeared to be suitable habitat. However, given that all streams within the Rock and Big Sioux watersheds of Minnesota have experienced the fate of most prairie streams and now exist in altered and degraded states, these segments, along with the segments mentioned in Ceas & Anderson (2004) and Ceas & Monstad (2005), warrant a closer look for future habitat enhancement/landowner involvement projects. These segments include numbers 45, 47-51, 55, 57, 59, and 60.

We recognize that there are limited available resources for improving the streams within the range of the critical habitat of the Topeka shiner, and we recognize the value of enhancing habitat to hopefully allow for the establishment of new populations. However, we also recognize that there is value in further enhancing the habitat of stream segments that presently support the populations that are potential/functioning "source" populations. Such habitat enhancements will likely result in an increase in the population size of current sources, which could then result in a higher colonization rate of other stream segments that have no/low numbers of Topeka shiners (especially if the habitats in these stream segments are also enhanced).

(c) As one can see from the red-dashed lines representing the "federally-proposed designated critical habitat for the Topeka Shiner" on the aerial photographs (Appendix A) of the stream segments sampled in this study, the GIS cover of some of the critical habitat/stream channels needs to be updated using current aerial imagery.

LITERATURE CITED

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Tabor, V. M. 1998. Final rule to list the Topeka shiner as endangered. Federal Register. 63:69008-69021.

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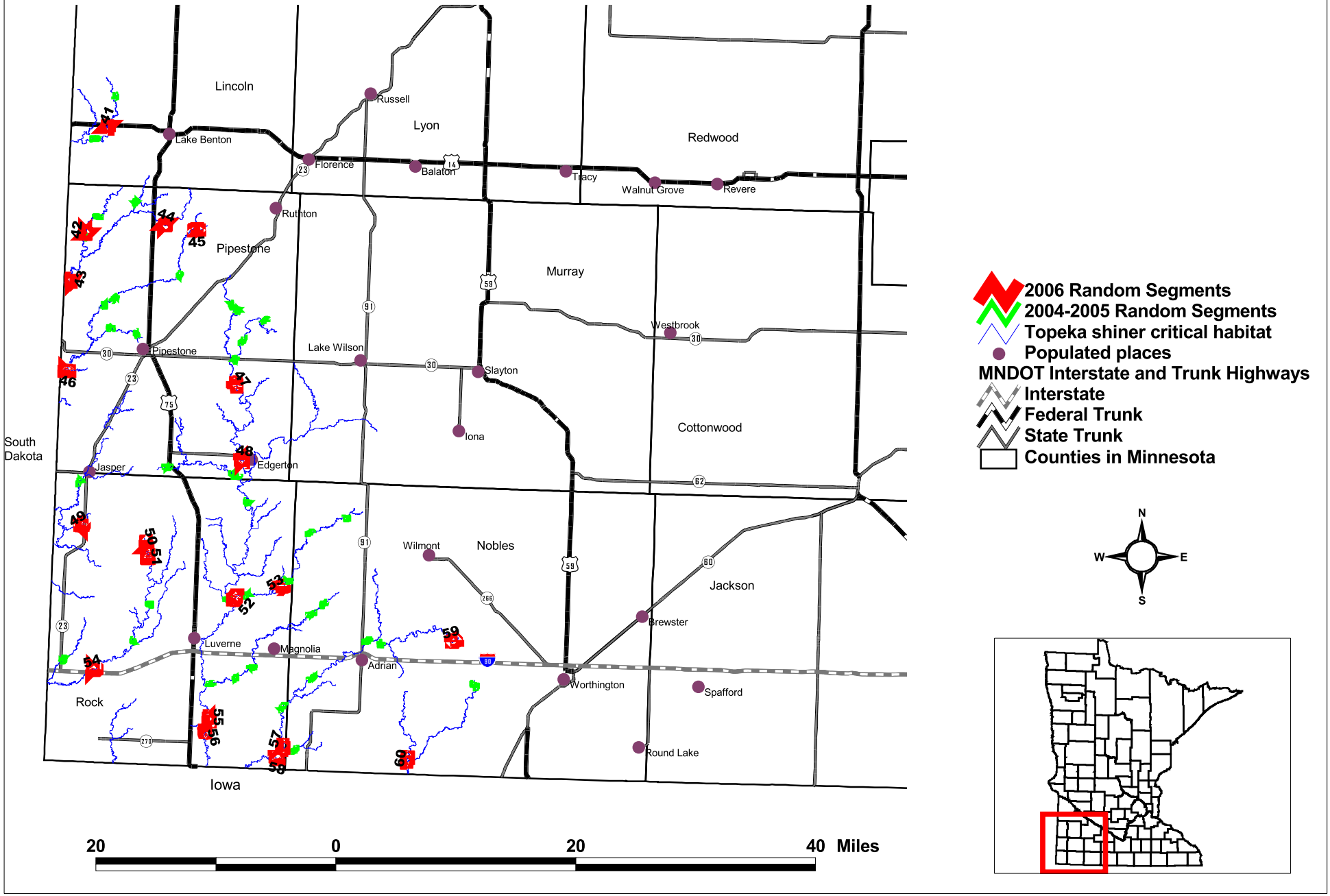
APPENDIX A – MAPS OF STREAM SEGMENTS

The red dots mark the beginning and end points for a given 1-mile stream segment.

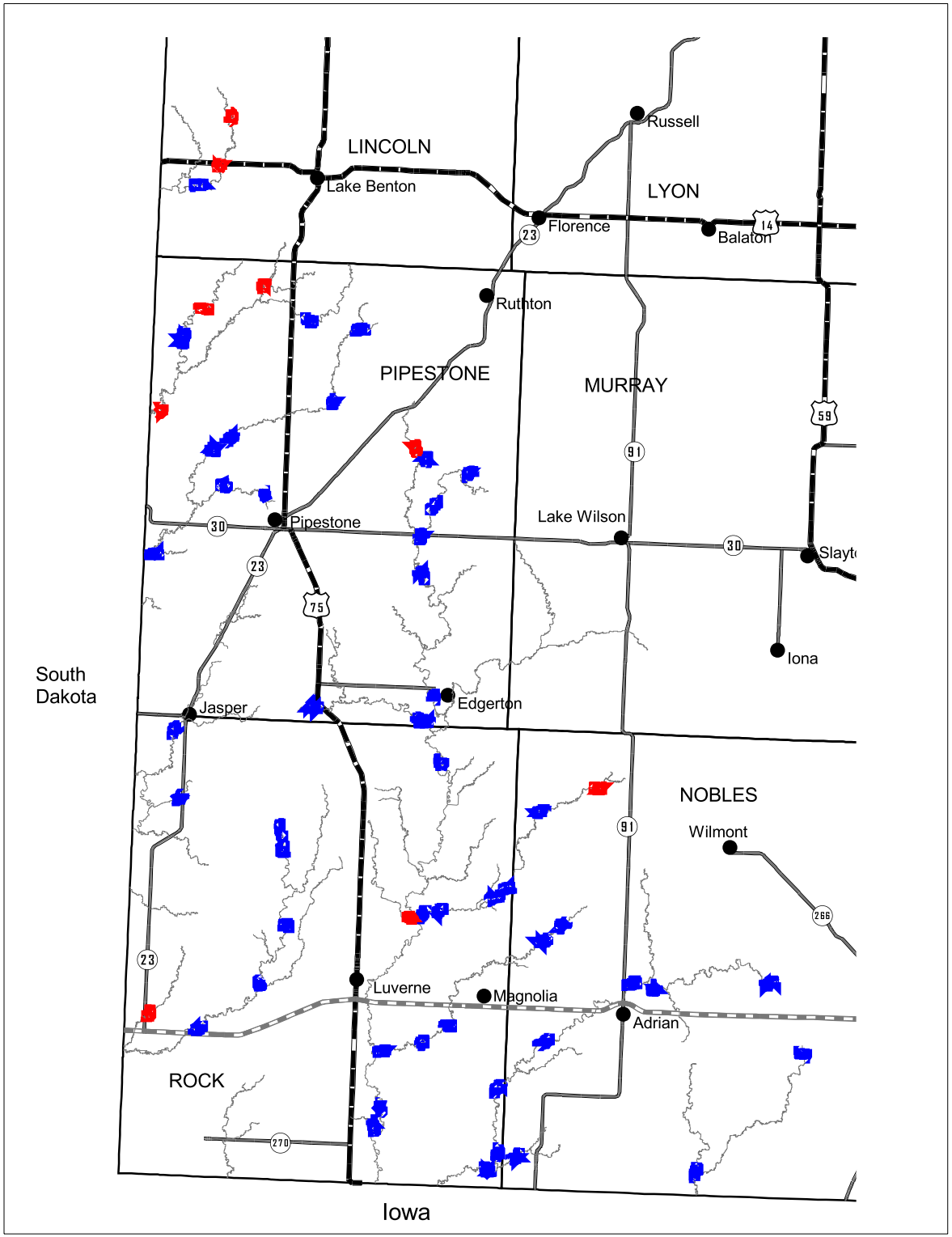
The yellow dots (with white numbers) correspond to the Sites given in Table 1, Appendix B.

The red-dotted lines show the actual stream channel as currently defined in the Federally proposed critical habitat shapefile.

Overview of Segments 2006



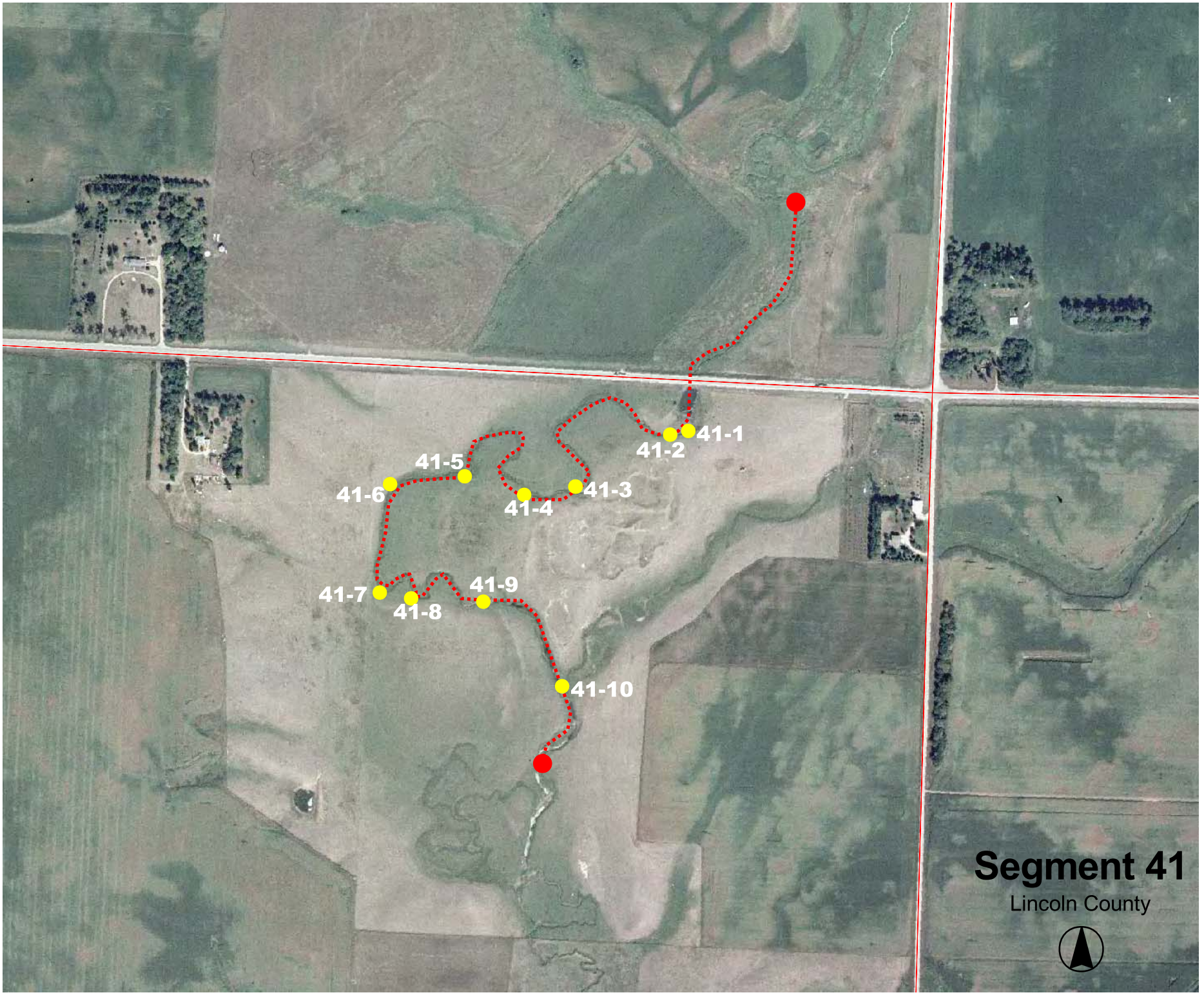
Overview of Segments where Topekas were found 2004-2006

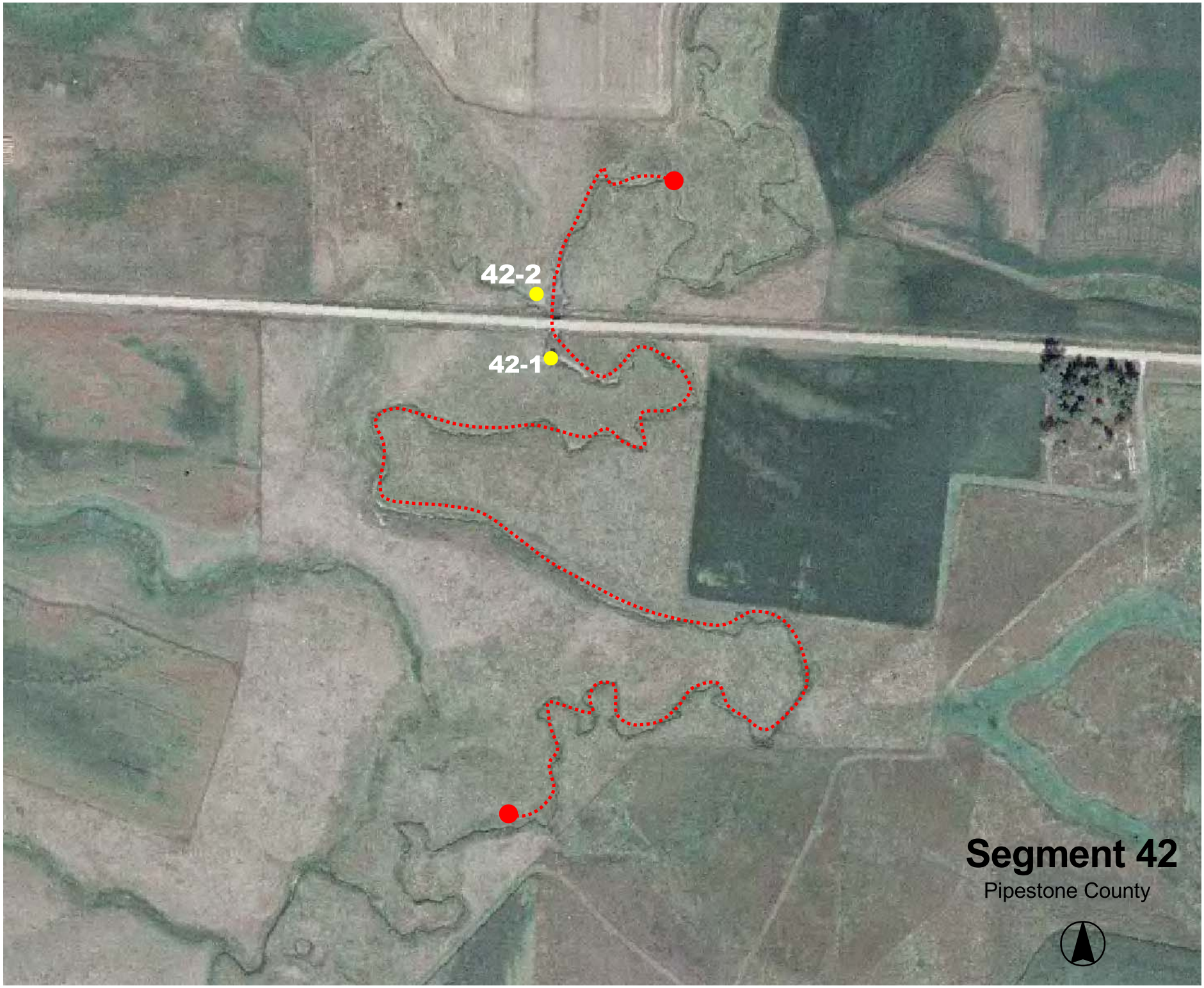


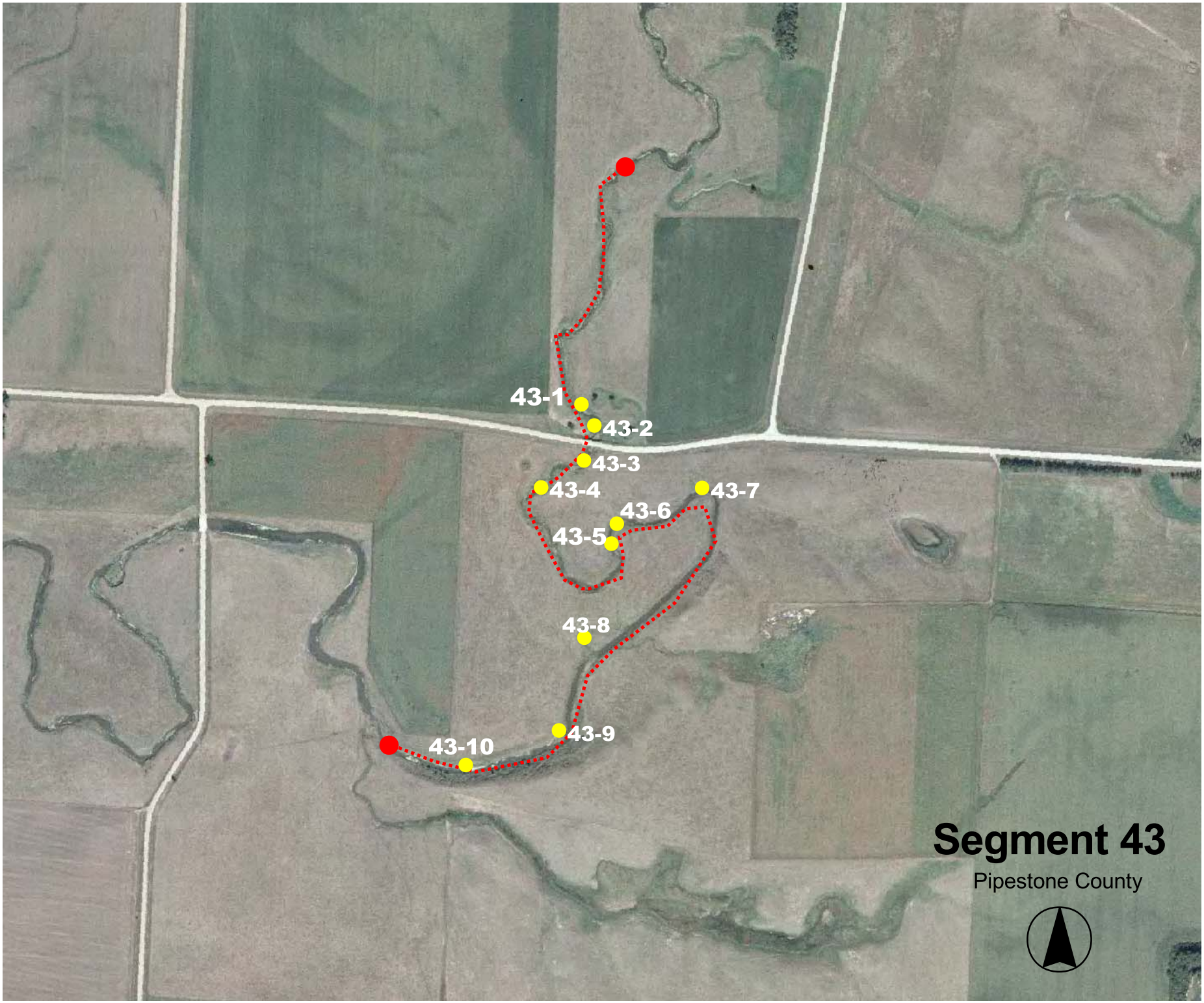
Random segments sampled 2004-2006
- Topekas found (n = 51)
- Topekas not found (n = 9)
- Topeka shiner critical habitat
- Populated places

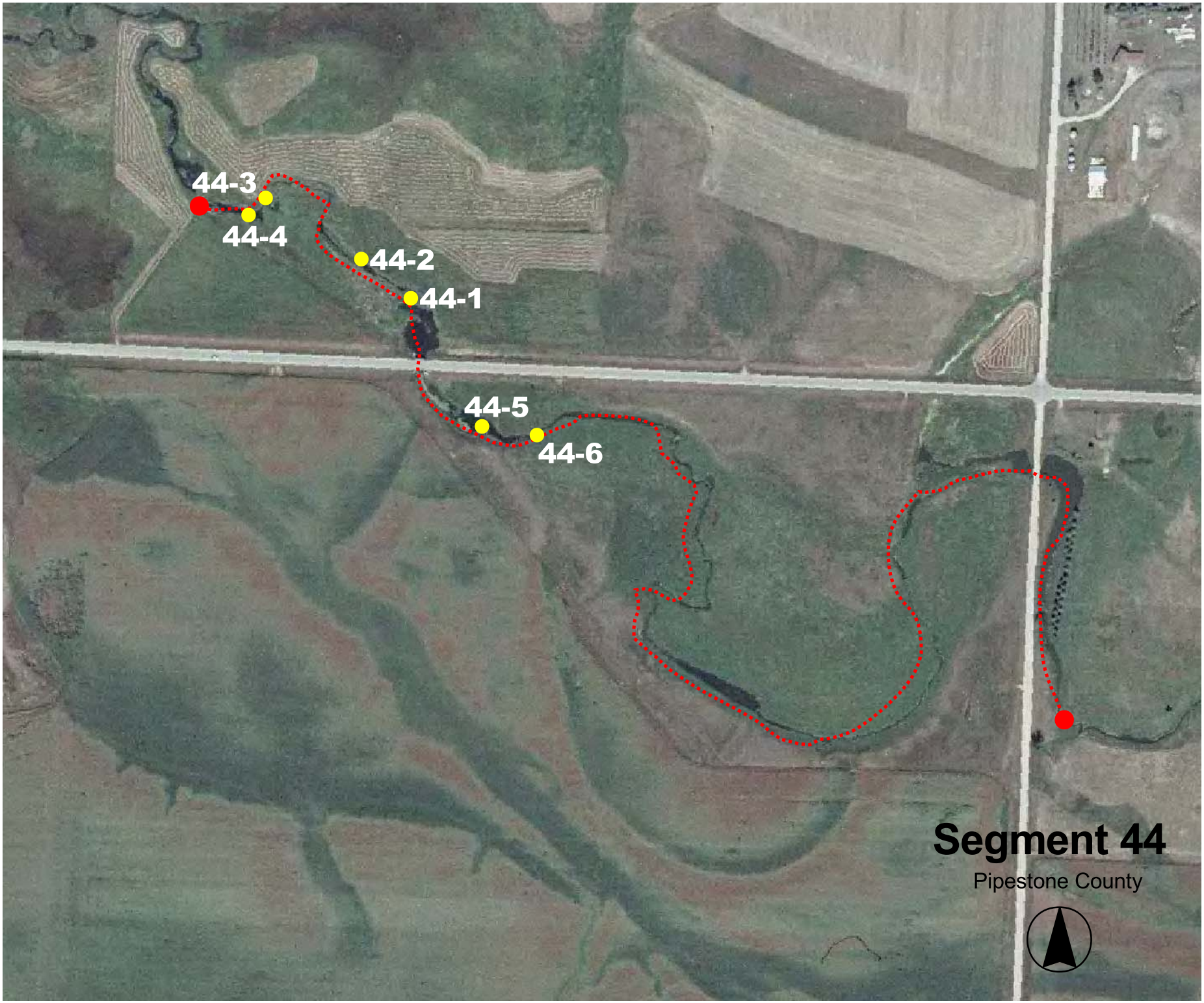
MNDOT Interstate and Trunk Highways
- Interstate
- Federal Trunk
- State Trunk
- Counties in Minnesota

N
W
E
S


41-1
41-2
41-3
41-4
41-5
41-6
41-7
41-8
41-9
41-10
Segment 41
Lincoln County


42-2
42-1
Segment 42
Pipestone County


43-1
43-2
43-3
43-4
43-7
43-6
43-5
43-8
43-9
43-10
Segment 43
Pipestone County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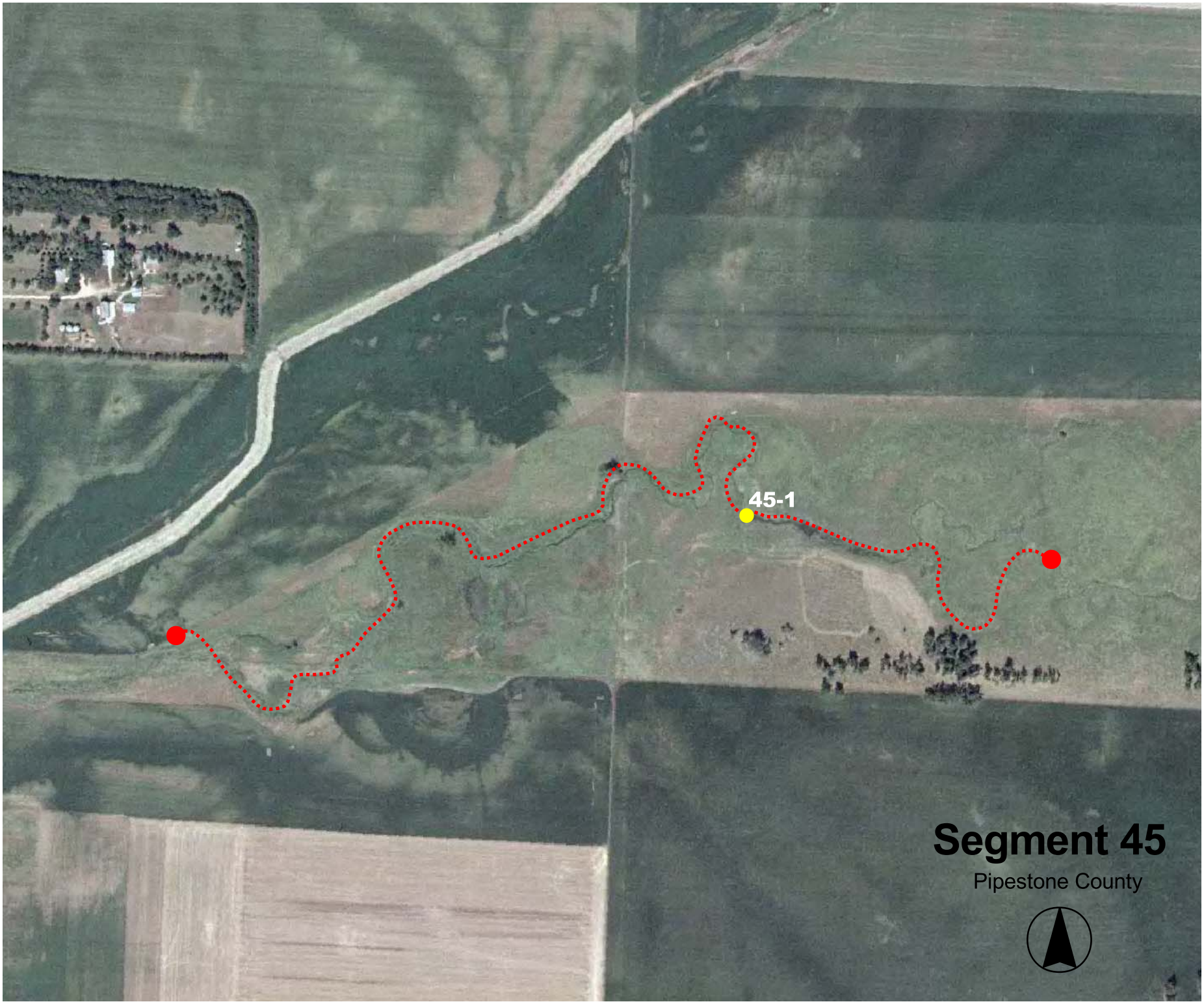
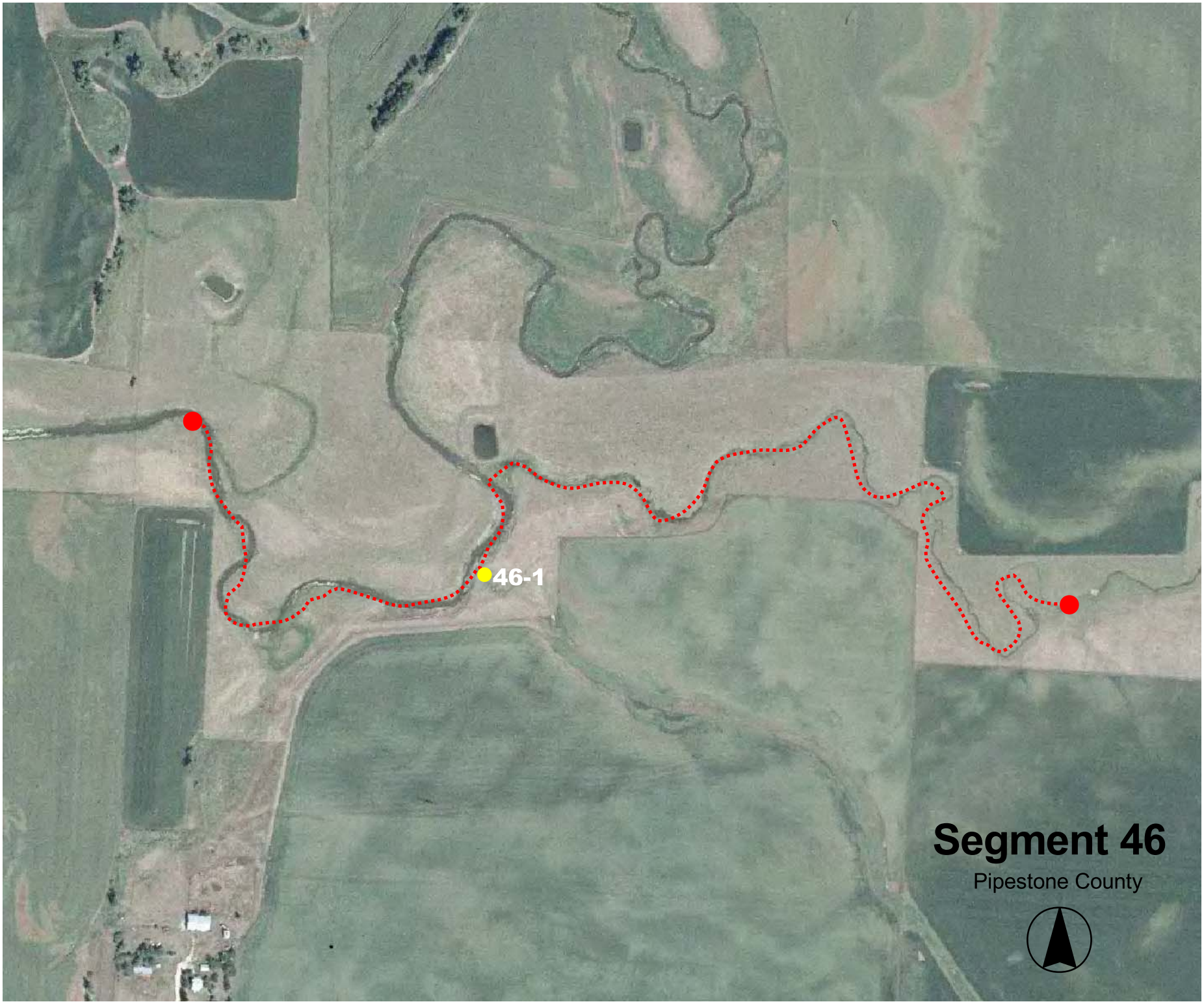
44-4
44-2
44-1
44-5
44-6
Segment 44
Pipestone County


45-1
Segment 45
Pipestone County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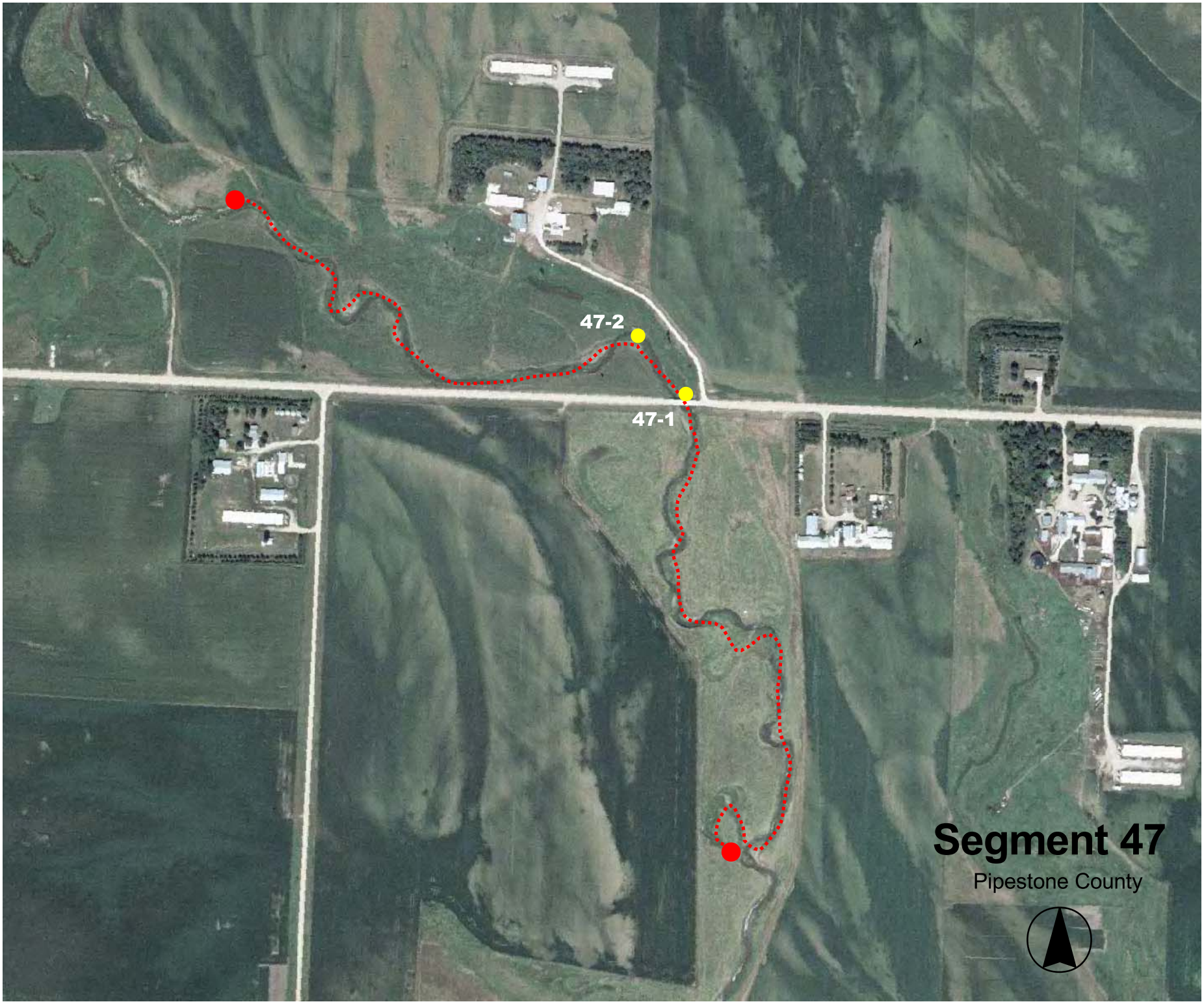
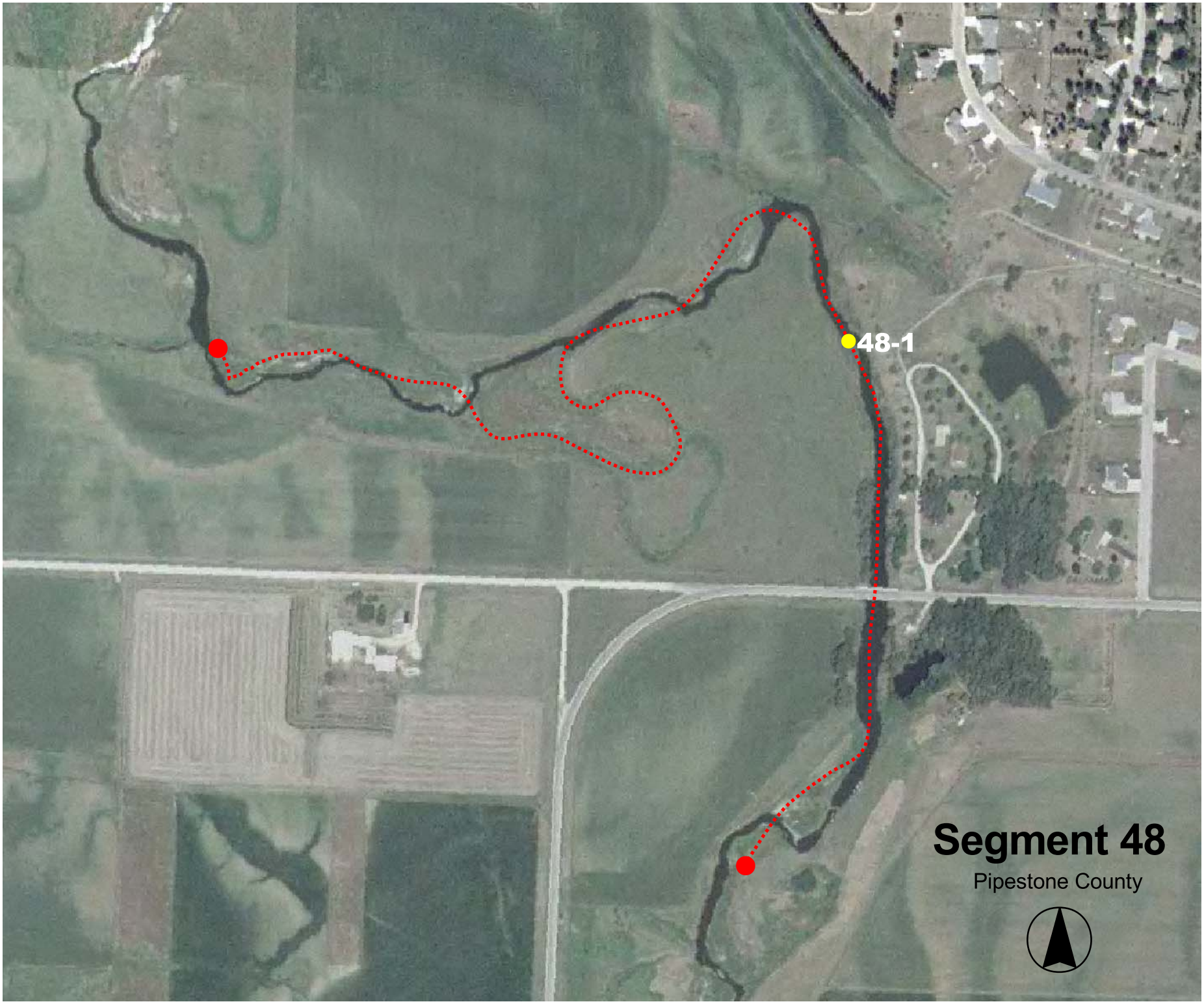
Segment 46
Pipestone County


47-2
47-1
Segment 47
Pipestone County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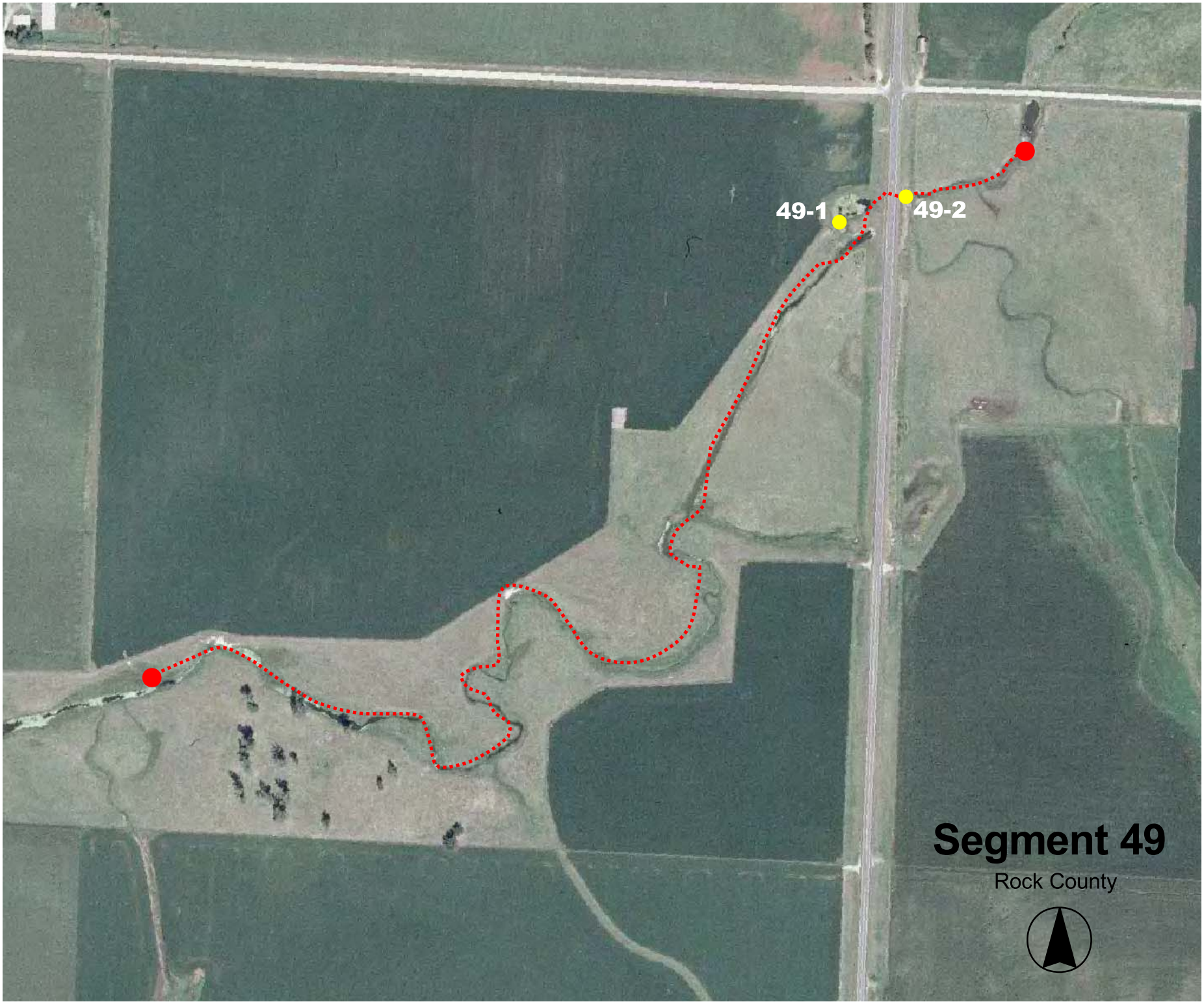
Segment 48
Pipestone County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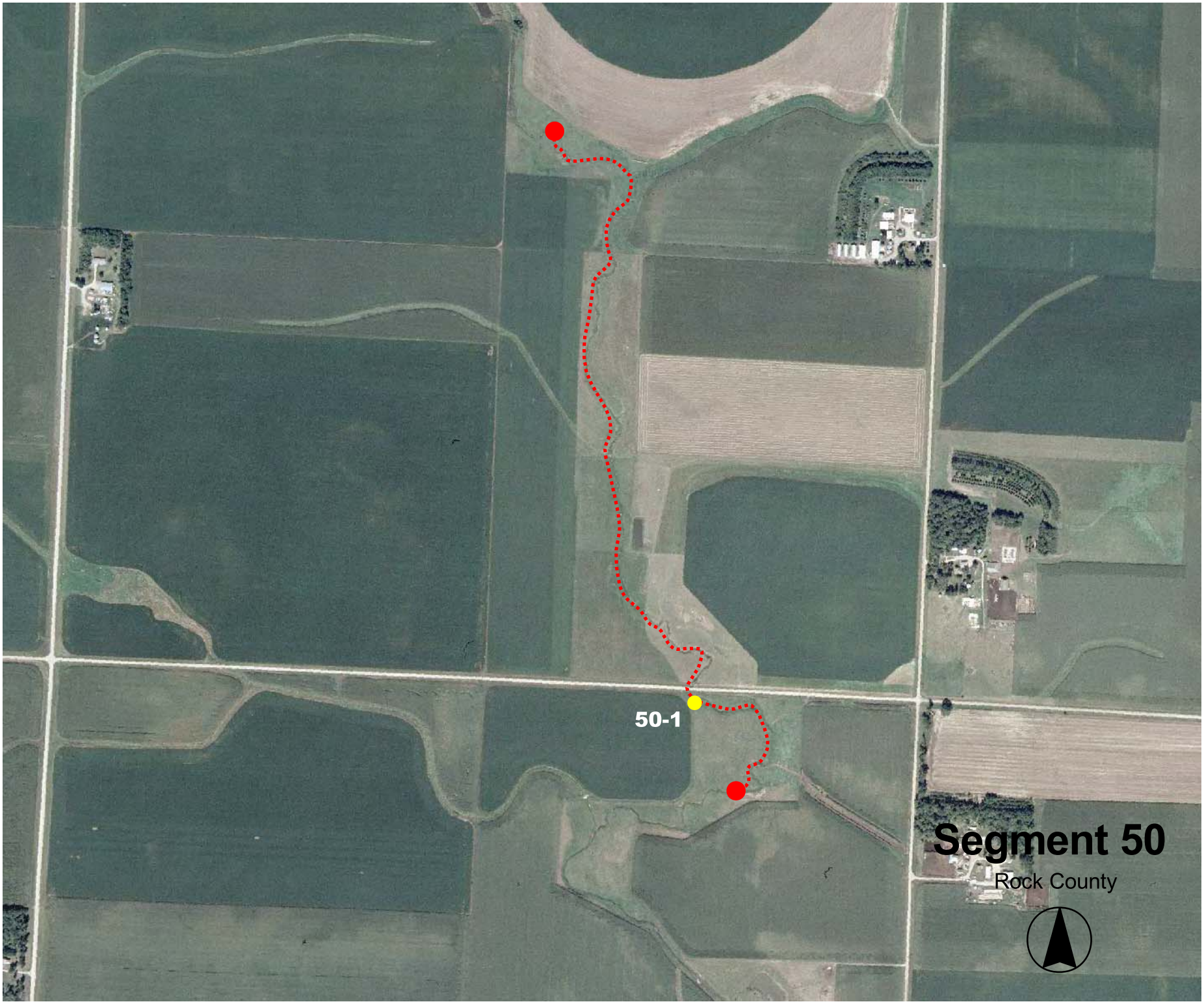
49-2
Segment 49
Rock County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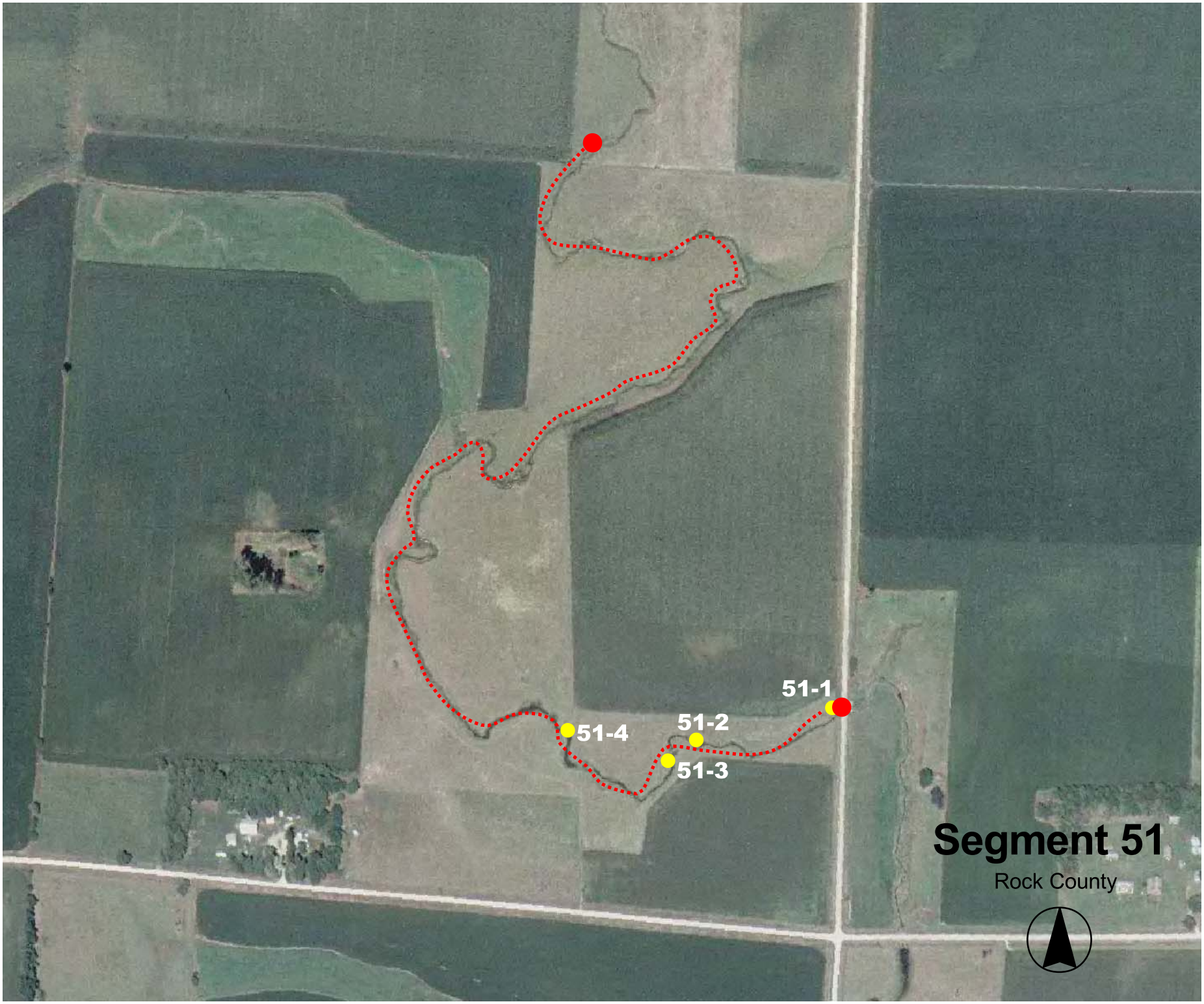
Rock County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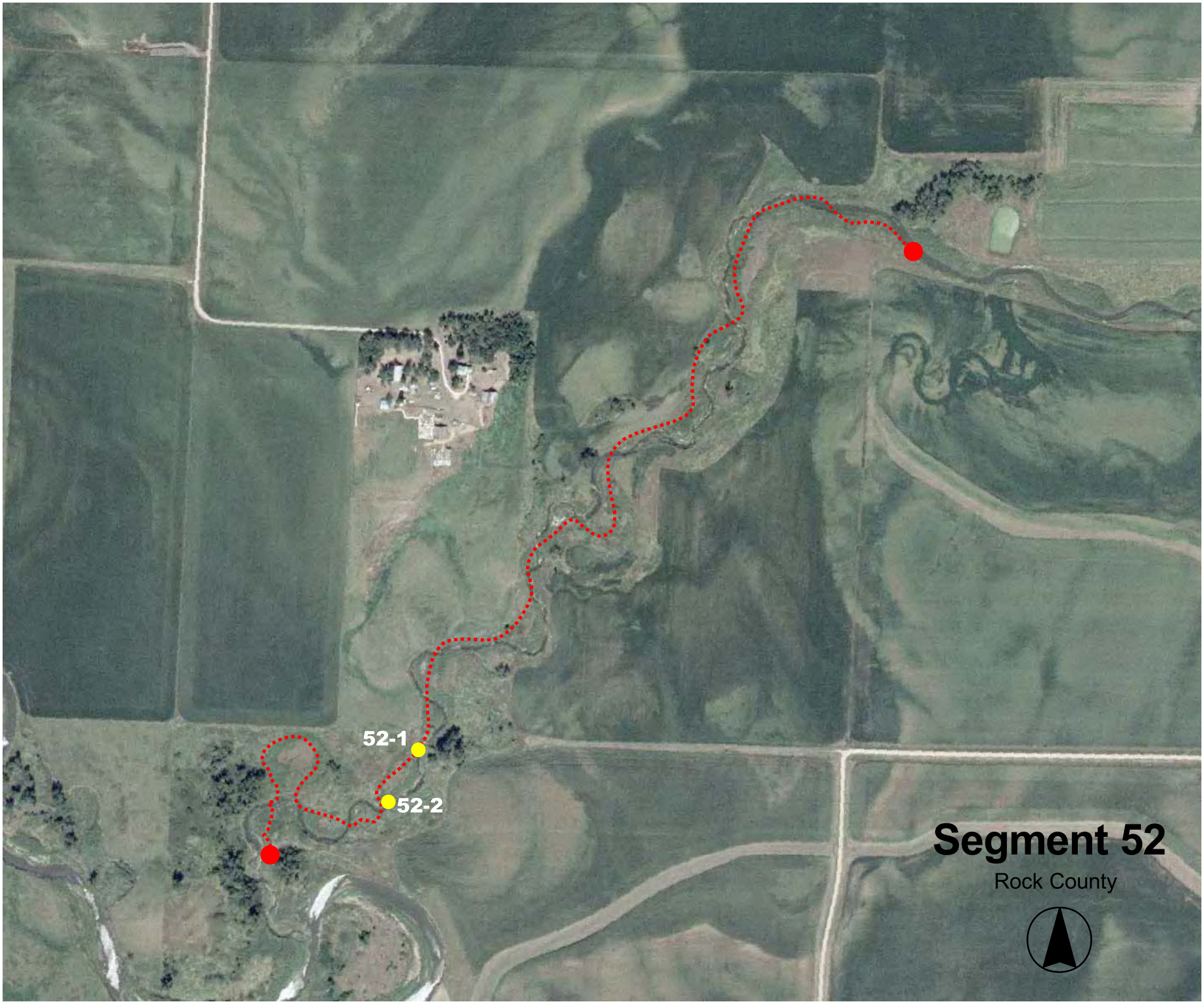
51-2
51-3
51-4
Segment 51
Rock County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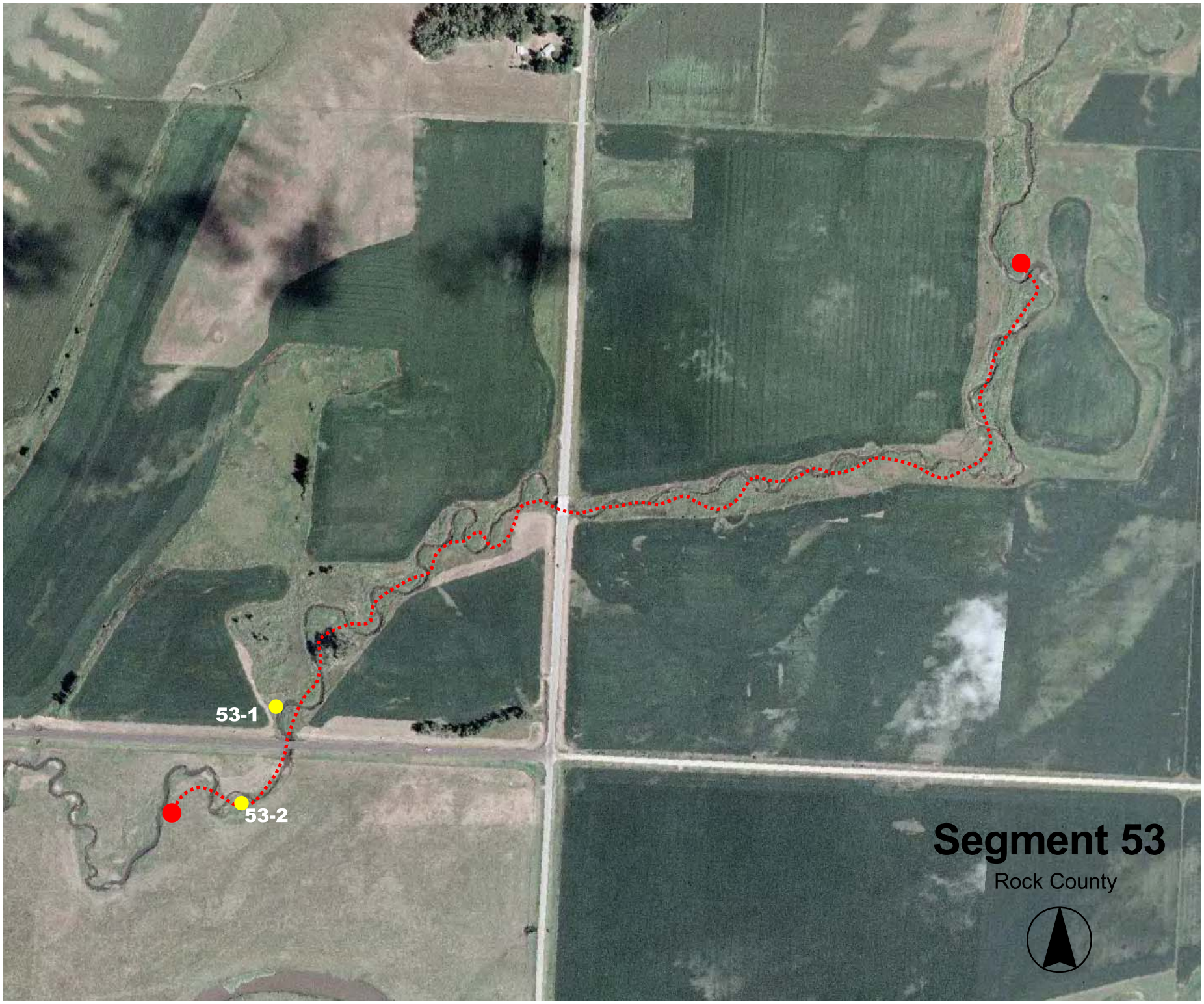
52-2
Segment 52
Rock County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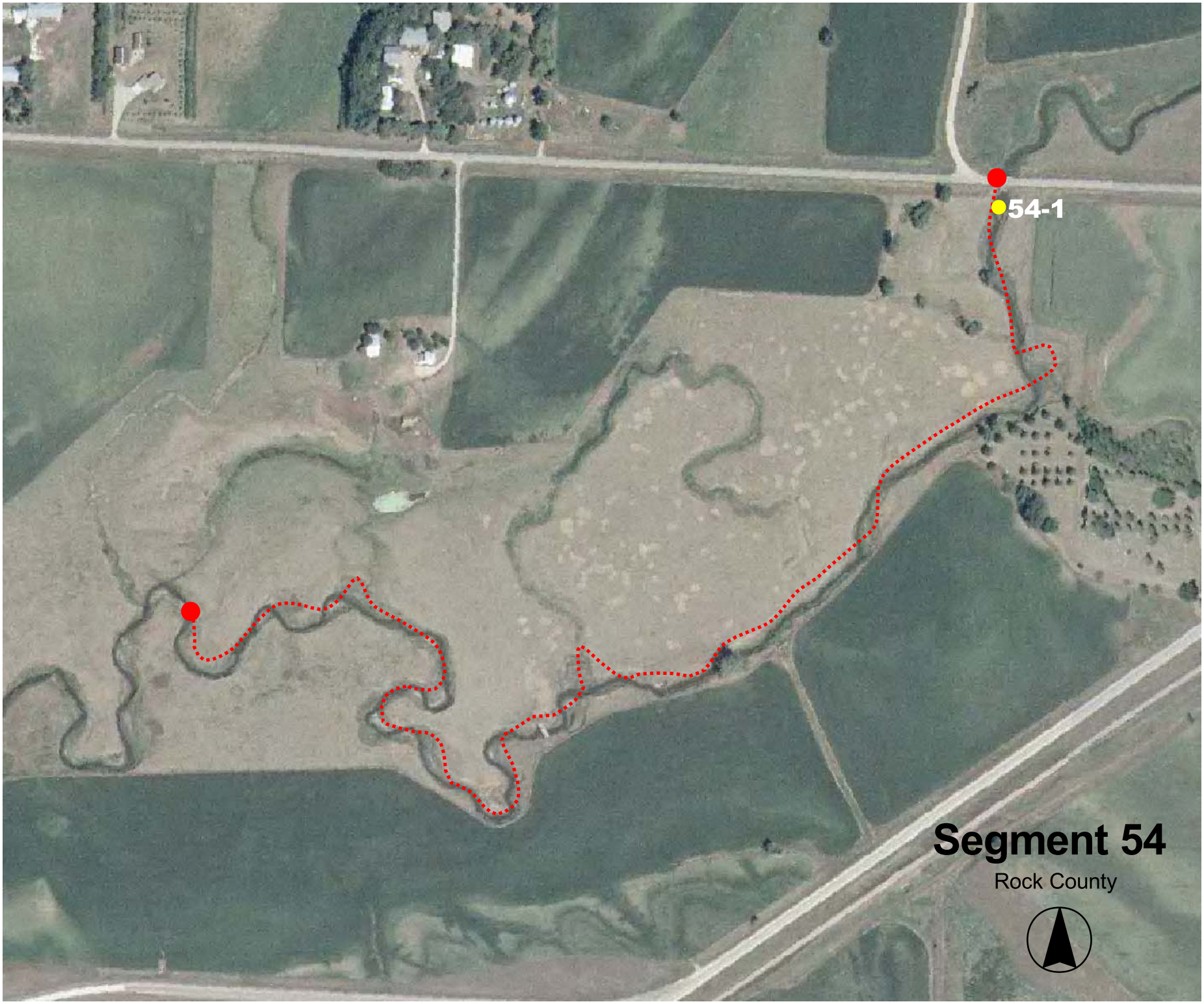
53-2
Segment 53
Rock County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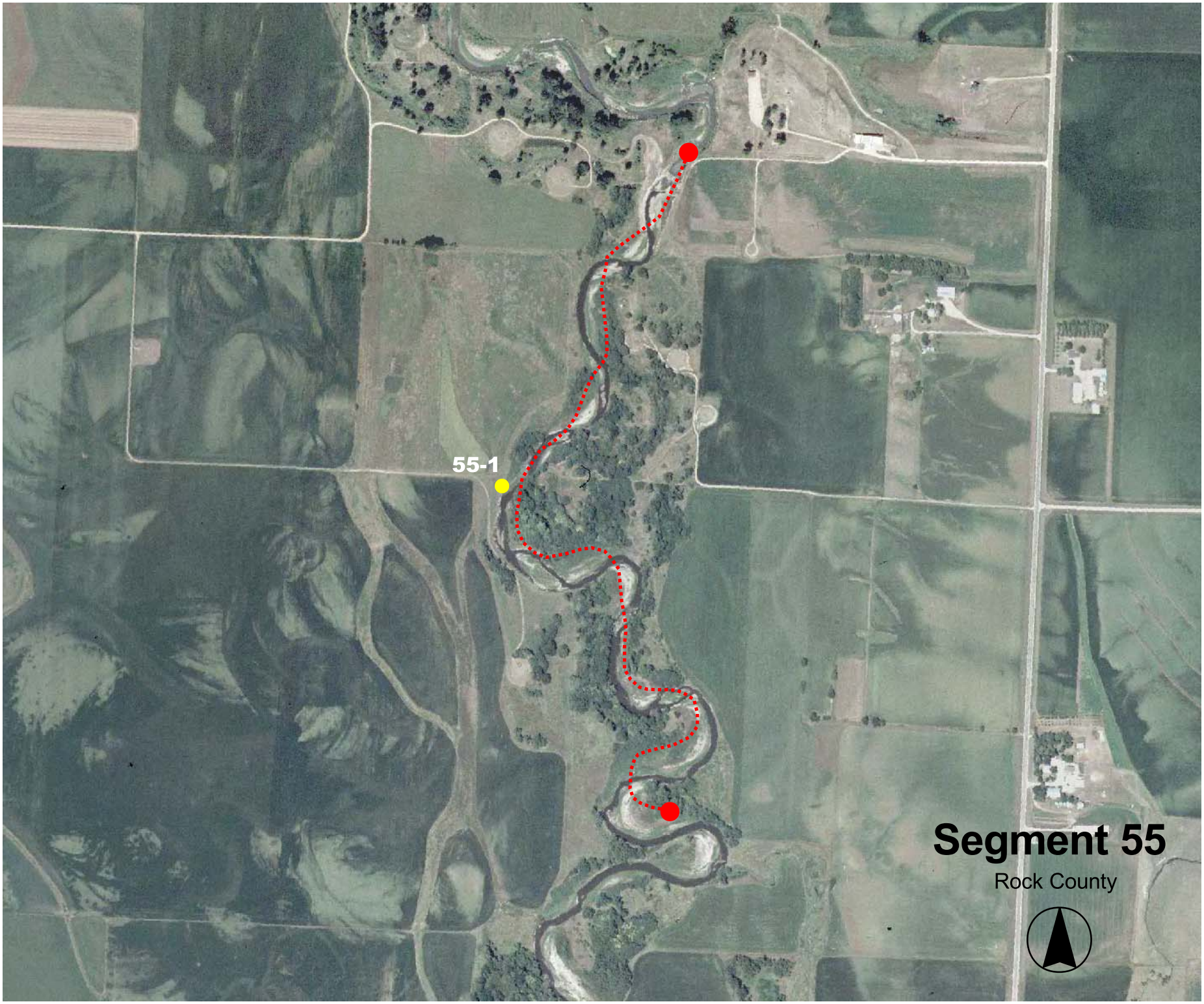
Segment 54
Rock County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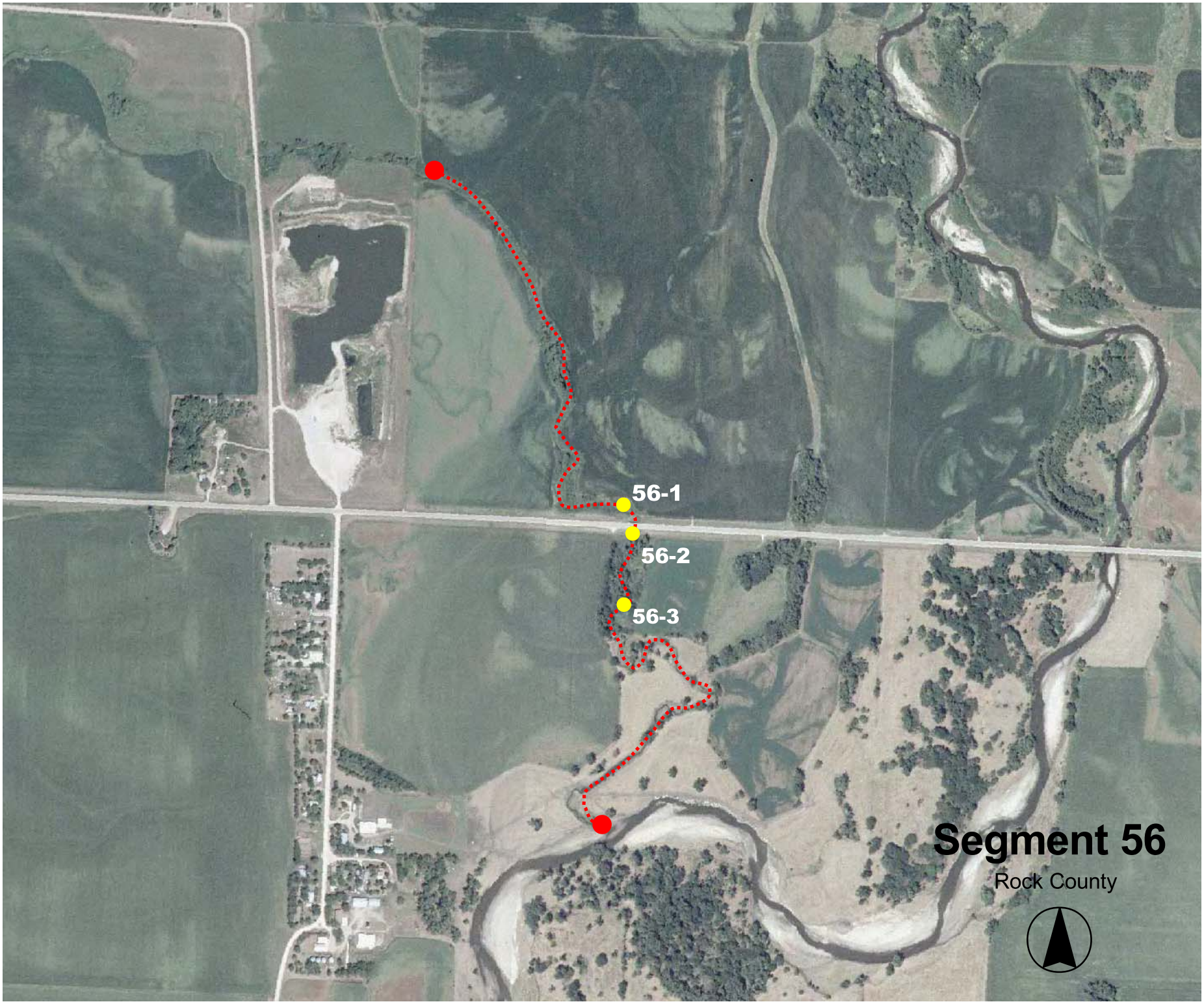
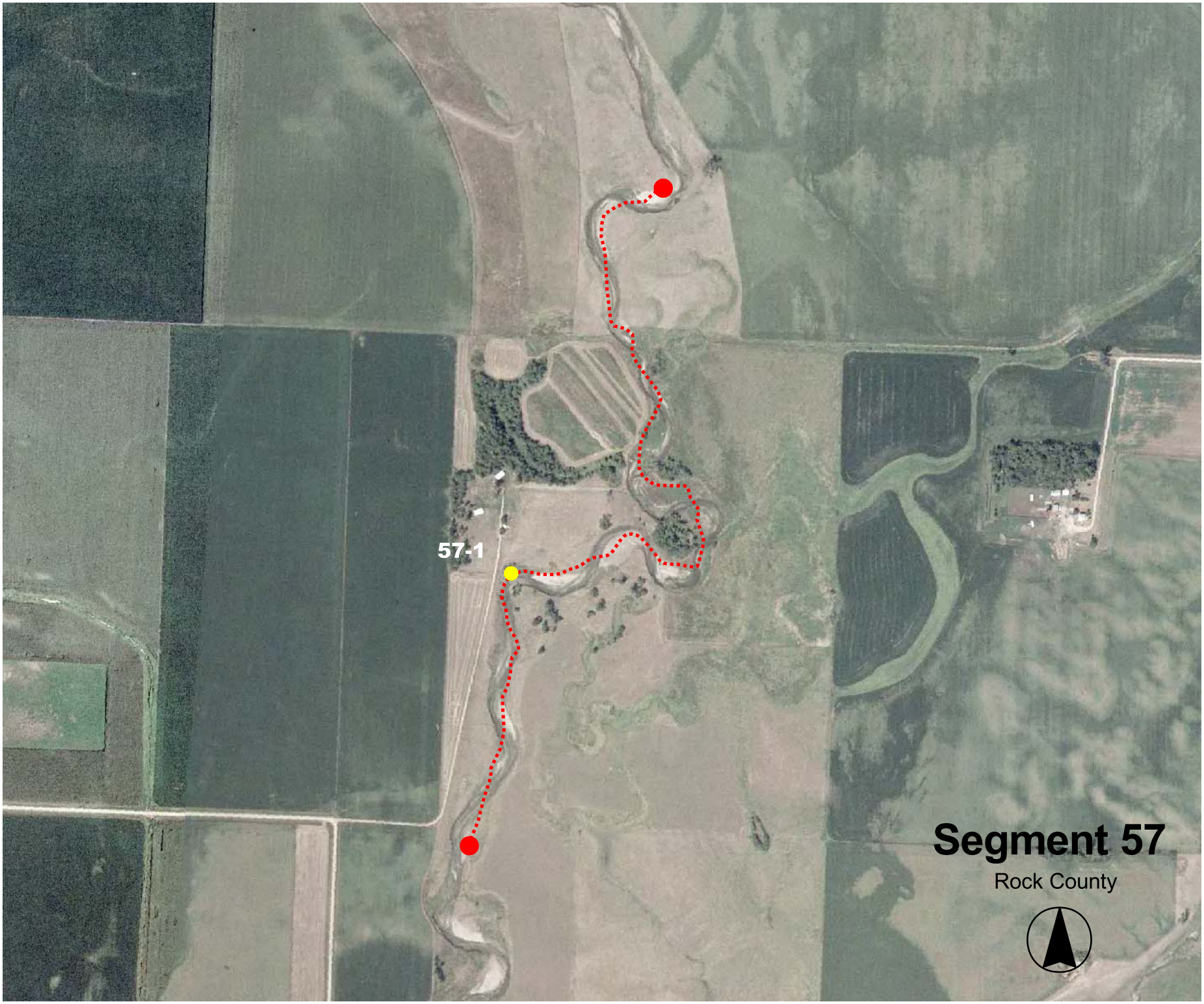
Segment 55
Rock County


56-1
56-2
56-3
Segment 56
Rock County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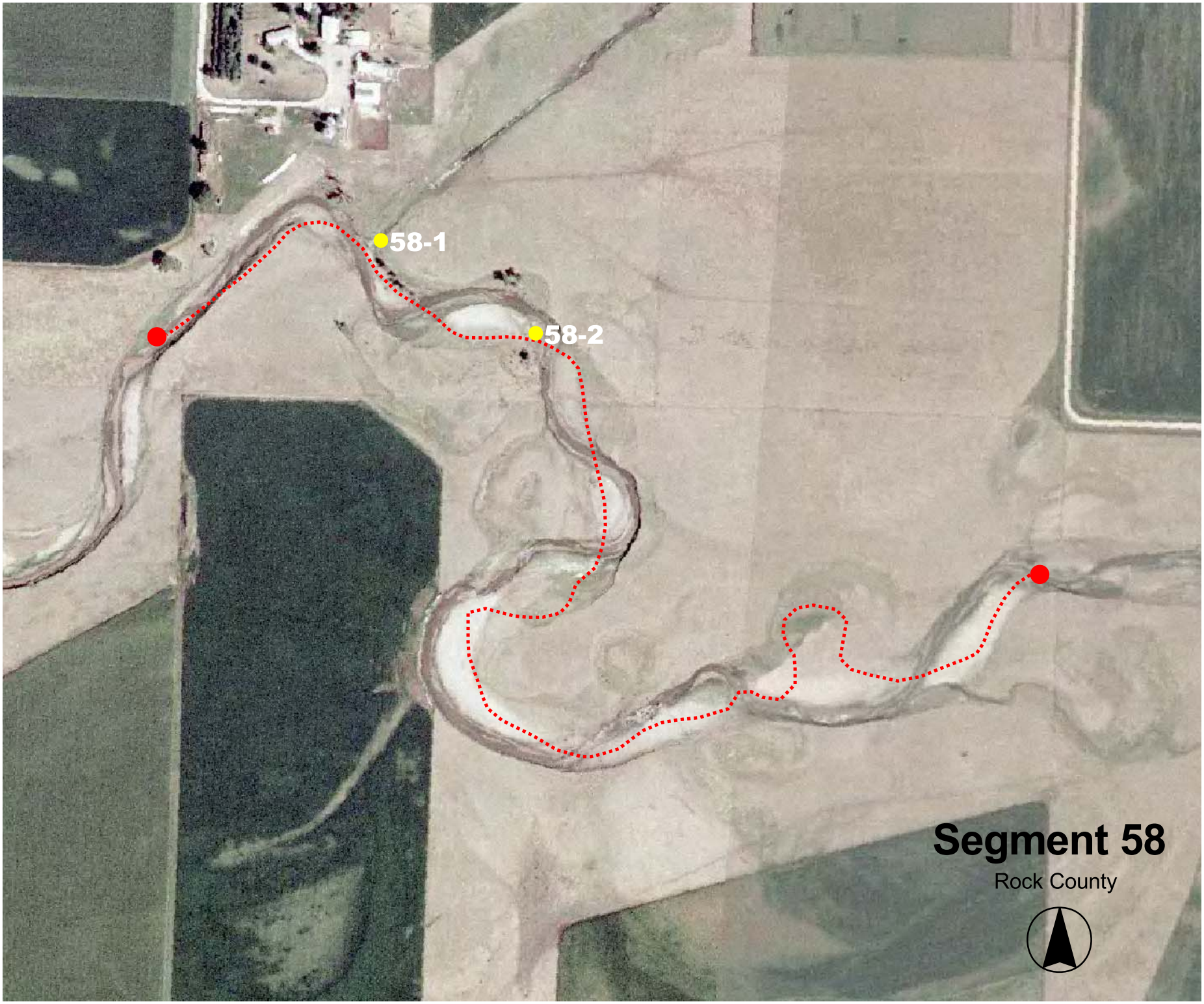
Rock County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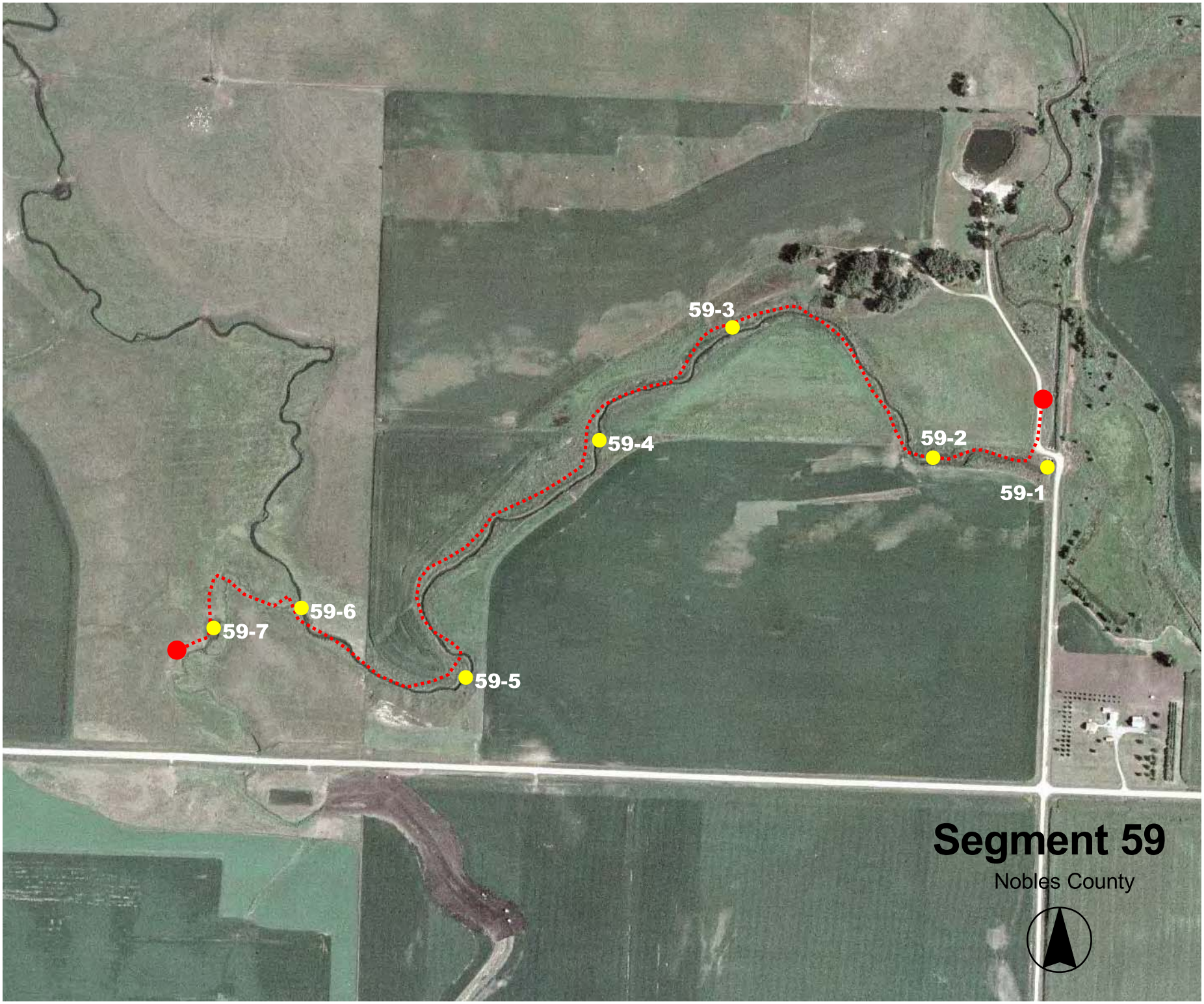
Segment 58
Rock County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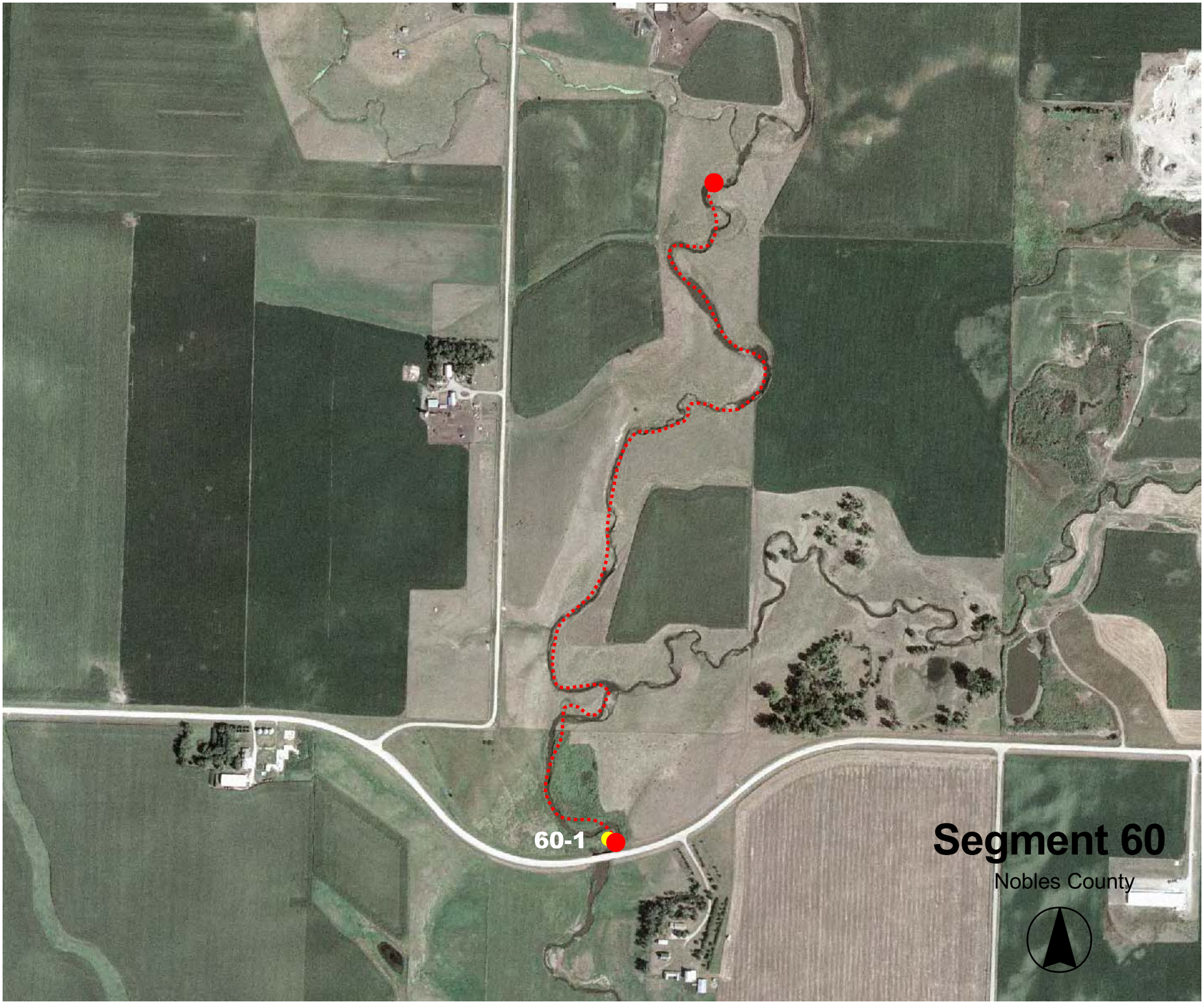
59-4
59-2
59-1
59-6
59-7
59-5
Segment 59
Nobles County


60-1
Segment 60
Nobles County

APPENDIX B – DESCRIPTIONS OF STREAM SEGMENTS AND SITES

Table 1 lists the twenty stream segments, and provides locality information & basic habitat descriptions of all sampling sites.

Table 1. Locations of the 2006 twenty stream Segments (sites 41-60 and corresponding sampling Sites within each Segment, along with a brief habitat description for each Site from which Topeka shiners were collected. Included are a "Common Location" descriptor (approximate mileage & direction to nearest town/highways), the Township/Range for the 20 Segments, and UTM coordinates for each sampling Site. For stream segments 42, 44, 49, 51-53, 58, and 59, the Site Number that is the highest (e.g., 59-7) is where the Topeka shiners were found. Topeka shiners were not found in Segments 43 and 57.

Segment	Stream Name & Common Location							UTM Coordinates (Zone 15)	
	County	T	R	Section(s)	Township Name	Site Number	Habitat Type	Northing	Easting
41	**Medary Creek** 5 mi W Benton @ US Hwy 14								
	Lincoln	109	46	4, 9	Verdi	41-1	in-channel	4907309.08809859	229578.94906511
						41-2	in-channel	4907303.55680931	229553.24156627
						41-3	in-channel	4907229.71517457	229418.90062897
						41-4	in-channel	4907218.08197070	229345.69380845
						41-5	in-channel	4907244.22047284	229260.98186750
						41-6	in-channel	4907233.08932064	229154.74376815
						41-7	in-channel	4907078.89130552	229140.19899221
						41-8	in-channel	4907070.61332564	229184.71103266
						41-9	in-channel	4907066.09655620	229287.58343513
						41-10	in-channel	4906945.31723510	229399.47413605
	Small headwater (ave width ≤ 10 ft); many widened areas by cattle crossings that seemed to have the proper habitat morphometry, but this stream may become too choked with filamentous algae (caused by excessive nutrient loads). Substrate = sandy/gravel runs and silted pools.								
42	**Willow Creek** **6 mi NW Cazenovia**								
	Pipestone	108	46	19, 30	Altona	42-1	in-channel	4893092.27972333	226342.94750357
						42-2	in-channel	4893145.64876454	226331.00444658
	Small meandering headwater; shallow wide pools around bridge Appears to be a potentially good spawning area for Topeka shiners. Substrate = firm sand-silt mixture								

Table 1. Continued.

Segment	Stream Name & Common Location							UTM Coordinates (Zone 15)	
	County	T	R	Section(s)	Township Name	Site Number	Habitat Type	Northing	Easting
43	**Flandreau Creek** ca. 3.5 mi NW Cazenovia								
	Pipestone	107	47	12	Troy	43-1	in-channel	4886756.06586711	224471.27562623
						43-2	in-channel	4886727.31315881	224488.62822081
						43-3	in-channel	4886680.36464831	224474.56230300
						43-4	in-channel	4886643.96401809	224416.78766517
						43-5	in-channel	4886568.22967770	224511.83106521
						43-6	in-channel	4886595.04631995	224518.89548932
						43-7	in-channel	4886643.48977974	224633.95693174
						43-8	in-channel	4886441.54043463	224474.96627854
						43-9	in-channel	4886316.25298952	224440.95526093
						43-10	in-channel	4886269.94565137	224315.25213805
	Meandering stream but with no well-developed pool habitat.								
	Many fishes and species present, but not good habitat for Topeka shiners.								
	Substrate = sand & gravel; silt along the edges.								
44	**E. Br. Flandreau Creek** 6 mi NW Holland								
	Pipestone	108	45	18, 19	Fountain Prairie	44-1	in-channel	4894288.68167357	236738.94595386
						44-2	in-channel	4894322.07920429	236696.49699638
						44-3	in-channel	4894374.29277941	236614.79636320
						44-4	in-channel	4894359.68402271	236600.27931365
						44-5	in-channel	4894178.95944170	236799.72099118
						44-6	in-channel	4894171.78921257	236846.49151743
	Small headwater stream; pools with depths of 2-3 feet; much filamentous algae already present.								
	This segment used/grazed heavily by cows.								
	Substrate = sand/gravel in raceways; silted pools.								

Table 1. Continued.

Segment	Stream Name & Common Location							UTM Coordinates (Zone 15)	
	County	T	R	Section(s)	Township Name	Site Number	Habitat Type	Northing	Easting
45	**Unnamed trib., North Br Pipestone Creek** 4.5 mi NNW Holland								
	Pipestone	108	45	22	Fountain Prairie	45-1	in-channel	4893427.05056220	241420.27720063
	Very small (5' width) headwater with numerous wide & shallow pools at cattle crossings; abundant habitat. Topekas caught in first seine haul. Substrate = sand/fine gravel.								
46	**Pipestone Creek & unnamed trib.** 5.5 mi NW Ihlen								
	Pipestone	106	47	14	Sweet	46-1	in-channel	4874400.59261937	223745.12721510
	The unnamed trib is dry except at confluence with Pipestone Creek; therefore, this creek is essentially a large backwater. Topekas common; caught in first seine haul. Substrate = firm sand.								
47	**Rock River** 1.5 mi NE Hatfield								
	Pipestone	106	44	20, 29	Burke	47-1	in-channel	4872813.53709960	246600.20724302
	Meandering flowing stream (25' width, 3' depth); numerous pools, but the bottomlands are heavily overgrazed. Topekas caught in first seine haul. Substrate = sand/fine gravel mixture; deep silt in backwaters.								
48	**Rock River** W edge of Edgerton @ City Park								
	Pipestone	105	44	28, 29	Osborne	48-1	in-channel	4862510.89903571	247586.25219145
	Many potentially good backwaters in this segment of the river. Topekas caught in second seine haul. Substrate = sand/gravel mixture.								
49	**unnamed trib., Split Rock Creek** **ca. 4 mi S Jasper @** Hwy 23								
	Rock	104	46	30	Rose Dell	29-1	in-channel	4854156.12971949	226210.05475846
						29-2	in-channel	4854182.52108664	226279.89376041
	Headwater that is generally < 10' width. Substrate = sand/gravel mixture; some silt in pools. Topekas common; caught in first seine haul of Site 2.								

Table 1. Continued.

Segment	Stream Name & Common Location							UTM Coordinates (Zone 15)	
	County	T	R	Section(s)	Township Name	Site Number	Habitat Type	Northing	Easting
50	**Beaver Creek** ca. 5 mi W Hardwick								
	Rock	104	46	36	Rose Dell	50-1	in-channel	4850661.38377940	234623.18056482
	Headwater stream that shows some excessive erosion from cattle, but with some well-developed pool-riffle-run sequences. Topekas common; caught in first seine haul in pool just upstream of riffle but downstream of bridge (in T103, R 46, Section 1). Substrate = cobble, gravel & sand.								
51	**Beaver Creek** 5 mi WSW Hardwick								
	Rock	103	46	1	Springwater	51-1	in-channel	4849297.49760119	234980.88189190
						51-2	in-channel	4849263.52129191	234835.50480919
						51-3	in-channel	4849241.38258549	234805.55049277
						51-4	in-channel	4849273.48719703	234698.51327068
	Small headwater (ave width 10 ft) that is mainly a flowing channel; however, there are a number of areas used by cattle to cross/drink water. These sections of stream are wider, pooled habitats, and contain Topekas (are common here). Substrate = sandy/gravel runs and silted pools.								
52	**Champepadan Creek** **1.5 mi E Blue Mounda State Park**								
	Rock	103	44	20, 29	Vienna	52-1	in-channel	4843716.64747029	246284.28857445
						52-2	in-channel	4843654.31832261	246248.32990239
	Meandering stream with occasional backwaters. Topekas caught on first seine haul of second site. Substrate = sand/gravel mixture								
53	**Champepadan Creek** 2.5 mi S Kenneth								
	Rock	103	44	13, 14	Vienna	53-1	in-channel	4845176.81753844	252120.96986481
						53-2	off-channel	4845054.81579097	252077.24009643
	Water is about 18" higher than usual from rains. During lower water levels there appears to be much potential backwater Substrate = sand & gravel.								

Table 1. Continued.

Segment	Stream Name & Common Location							UTM Coordinates (Zone 15)	
	County	T	R	Section(s)	Township Name	Site Number	Habitat Type	Northing	Easting
54	**Beaver Creek** 0.5 mi W Beaver Creek								
	Rock	102	46	29	Beaver Creek	54-1	in-channel	4834743.92148230	227910.37781033
	Channelized stream segment, but one female Topeka shiner was captured in the first haul just downstream of the bridge. Substrate = shifting sand.								
55	**Rock River** 2 mi. NE Ash Creek								
	Rock	101	45	13	Clinton	55-1	in-channel	4827728.15414558	242773.13305556
	Although the water was slightly high (here and in all 20 segments) it was still possible to discern backwater habitats. Topekas caught in second seine haul, appear to be common. Landowner is already involved with habitat restoration, etc. Substrate = relatively firm sand-gravel combination; silty backwaters.								
56	**Ash Creek** 1 mi. NNE Ash Creek @ CR 1								
	Rock River	101	45	24	Clinton	56-1	in-channel	4826176.48661159	242411.22953812
						56-2	in-channel	4826129.17908659	242426.29377591
						56-3	in-channel	4826011.41796793	242411.69709015
	Meandering headwater; severely downcut, but a few quiet pools can be found. Substrate = deep shifting sand; sand/gravel riffles.								
57	**Kanaranzi Creek** 2.5 mi WNW Ellsworth								
	Rock	101	44	24, 25	Kanaranzi	57-1	in-channel	4823746.76447393	252727.42851500
	Meandering stream in extensive bottomlands; large OCH on east side (did not sample). Topekas caught in first seine haul. Substrate = shifting sand, deepr silt in backwaters.								

Table 1. Concluded.

Segment	Stream Name & Common Location							UTM Coordinates (Zone 15)	
	County	T	R	Section(s)	Township Name	Site Number	Habitat Type	Northing	Easting
58	**Norwegian Creek** 2.5 mi W Ellsworth								
	Rock	101	44	25, 36	Kanaranzi	58-2	in-channel	4822701.02514553	251771.84406185
						58-2	in-channel	4822614.58400491	251915.85042881
	Wide shallow meandering stream; 70' ave width. Many cattle with direct access. Substrate = shifting sand in main channel; deep "muck" at cattle crossings.								
59	**East Branch Kanaranzi Creek& unnamed trib** 3 mi NE Rushmore								
	Rock	102	41	5	Summit Lake	59-1	in-channel	4838211.93210291	276368.52726982
						59-2	in-channel	4838223.08419883	276231.88956209
						59-3	in-channel	4838378.79927870	275992.63913151
						59-4	in-channel	4838243.96233508	275833.19446761
						59-5	in-channel	4837960.65753486	275673.96251140
						59-6	in-channel	4838043.83381372	275477.36403408
						59-7	in-channel	4838019.88912738	275372.76356217
	Most of the creek has been channelized; with continuous flow (no pools). The trib has one large man-made pond (trib flows in & out) that appears to be spring-fed. Topekas are abundant in this pool. Substrate = sand/gravel								
60	**Little Rock River** 8 mi W Bigelow @ CR 54								
	Rock	101	42	26, 35	Little Rock	60-1	in-channel	4821739.32421229	269520.41907523
	Meandering stream with many backwaters and wide floodplain. Terrific potential for habitat restoration. Topekas found on second haul,are common. Substrate = sand/silt mixture.								

APPENDIX C –PHOTOGRAPHS OF HABITATS & FISHES

Stream photographs for Segments 41, and 43 (no Topeka shiners captured) are photographs of representative stream habitat for the 1-mile stream segments. Stream photographs for the remaining segments are of the actual stream sites where Topeka shiners were collected. The yellow outlined areas on these photographs represent the exact location where the shiners were captured. Due to camera (or perhaps operator) error, there are no photographs of Segment 42, and no photographs of a Topeka shiner from Segments 42 & 54. Voucher photographs of Topeka shiners from other stream segments are included. Photos by P. Ceas.

Site 41 - no Topeka shiners

Site 42-2

No photo of Topeka shiner or stream habitat.

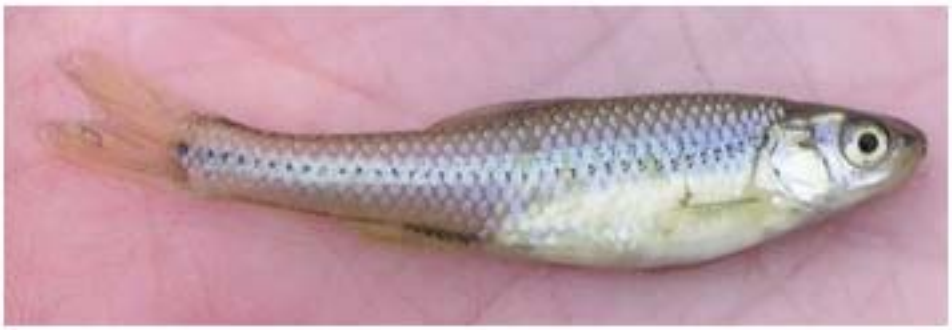
Site 43 - no Topeka shiners

Site 44-6

In this and all following photos the area of capture is outlined in yellow

Site 45-1

Site 46-1



Site 47-1

Site 48-1

Site 49-2

Site 50-1

Site 51-4

Site 52-2

Site 53-2

Site 54-1 (no photo of Topeka shiner)

Site 55-1

Site 56-3

Site 57-1

Site 58-2 (*N. stramineus* on top, *N. topeka* below)

Site 59-7

Site 60-1