

**Results of a Pilot Monitoring Project
for Topeka Shiners
in Southwestern Minnesota**

submitted to:

Richard J. Baker

Natural Heritage and Nongame Research Program
Division of Ecological Services
Minnesota Department of Natural Resources
500 Lafayette Road
St. Paul, Minnesota 55155

prepared by:

Patrick A. Ceas¹ and Yvette C. Anderson²

June 2004

¹ St. Olaf College, 180 Science Center, Northfield, MN 55057

² Minnesota Department of Natural Resources, Natural Heritage and Nongame Research Program

ABSTRACT

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 is now listed by the U.S. Fish and Wildlife Service (USFWS) as endangered. This study was undertaken as a pilot project to conduct baseline presence/absence surveys for Topeka shiners within the federally proposed critical habitat in Minnesota. These data will comprise the initial 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.

Twenty random stream segments within the Rock and Big Sioux watersheds of southwestern Minnesota were selected using an ArcView extension program. Based on known habitat preferences, aerial photos of the 20 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 always 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 4' (or, depending on stream size, a 25' x 4') eighth-inch mesh minnow seine.

Topeka shiners were found at 17 of the 20 1-mile stream segments, and in 11 of these 17 stream segments Topeka shiners were found at the first site sampled. Few true off-channel habitats existed within the 20 1-mile stream corridors, but 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 pilot-year project was limited and designed to conduct only straightforward presence/absence surveys for Topeka shiners in 20 1-mile stream segments. Even so, a few observations were noted: (a) The three stream segments that did not produce Topeka shiners were all very small headwaters with narrow down-cut channels and almost continuous 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

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 (Tabor, 1998; Dahle, 2001). 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 (Tabor, 1998). In response to a court settlement in “Biodiversity Legal Foundation *et al.* v. Ralph Morganwick *et al.* C00-D1180” the USFWS proposed as critical habitat a total of 186 stream segments representing 2,340 miles of stream and associated off-channel pools (Tabor, 2002).

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. We do note that 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).

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, all streams and associated off-channel pools within the Rock and Big Sioux watersheds of southwestern Minnesota have been proposed as critical habitat.

This study was undertaken as a pilot project to conduct baseline presence/absence surveys for Topeka shiners within the federally proposed critical habitat in Minnesota. Up to 10 sampling sites within each of 20 randomly selected 1-mile stream segments (and associated off-channel habitats) were surveyed. These data will comprise the initial 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. The data obtained during this first year's fieldwork will also be used to conduct a power analysis for evaluating whether or not the sample size of 20 stream segments is adequate for detecting an acceptable level of change in the population's presence/absence. (R. Baker, pers. comm.).

METHODS

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. We contacted landowners by phone one week before the survey. We 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, 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 10-12 (Segments 1-10) and June 7-9 (Segments 11-20) 2004. 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 4’ (or, depending on stream size, a 25’ x 4’) 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 numerous 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 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 “good” habitat.

RESULTS

Topeka shiners were found at 17 of the 20 1-mile stream segments (Table 1; Appendices A & C); they were not found in Segments 11, 13, and 19. In 11 of the 17 stream segments that did contain Topeka shiners, we found the species in the first site sampled (e.g., Site 2-1). These 11 segments & corresponding sites are 2-1, 3-1, 4-1, 7-1, 8-1, 9-1, 10-1, 14-1, 15-1, 16-1, and 17-1. In eight of these 11 segments we captured Topekas in the first seine haul. Topeka shiners were also found in Sites 1-3, 6-2, 18-3, 12-4, 20-8, and 5-10.

Of the 17 stream segments where Topeka shiners were found, four of these (Segments 1, 6, 7, and 9) contained at least one off-channel habitat or an oxbow/pool that was likely to become an OCH as the summer water levels receded (identified as “off-channel” in Table 1). Segments 18 & 20 each contained a site that had a well-defined backwater pool with Topeka shiners. Ten of the 11 remaining segments (Segments 2, 3, 4, 8, 10, 12, 14, 15, 16, 17) had at least one well-developed in-channel pool. Segment 5 was essentially a flowing stream through its entire length, but we did capture one Topeka Shiner in Site 5-10.

Stream segments 11, 13, and 19 were relatively small down-cut headwaters, with narrow channels and essentially continuously flowing water. Site 11-4 was a long pool and Site 11-9 was an OCH, but neither contained Topeka shiners.

DISCUSSION

The scope of this pilot-year project was limited and designed to conduct only straightforward presence/absence surveys for Topeka shiners in 20 1-mile stream segments. By design, these segments were randomly chosen, which (as expected) resulted in streams of various size and variety of habitats. Therefore, no attempt was made to quantify habitat assessment or sampling effort & time between sites. Even so, we did make a few of observations that seem worthwhile to include in this report.

(a) The three stream segments that did not produce Topeka shiners (11, 13, and 19) were all very small headwaters with narrow down-cut channels and almost continuous raceways/flowing

waters. Given the species' preference for pools and slow-moving waters, we were not surprised that Topekas were not found. Although these stream segments do not "appear" to contain habitat that is generally considered typical for Topeka shiners, it would be premature to conclude that Topeka shiners do not use such small, constant-flow streams (i.e., no pool habitat). It may simply be necessary to sample more than 10 sites within these smaller stream segments to be successful in capturing Topekas.

(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. These segments include numbers 3, 4, 7, 16, and 17.

(c) As one can see from the red-dashed lines representing the "federally-proposed designated critical habitat for the Topeka Shiner" on the 2003 aerial photographs (Appendix A) of the stream segments sampled in this study, the GIS cover of critical habitat/stream channels needs to be updated using current aerial imagery.

LITERATURE CITED

Berg, J.A., T.A. Petersen, Y. Anderson, and R. Baker. 2004. Hydrogeology of the Rock River watershed, Minnesota and associated off-channel habitats of the Topeka shiner. Minnesota Department of Natural Resources Report. 13 pp.

Dahle, S. P. 2001. Studies of Topeka shiner (*Notropis Topeka*) life history and distribution in Minnesota. M.S. Thesis, University of Minnesota, St. Paul. iv + 69 pp.

Hatch, J. T. 2001. What we know about Minnesota's first endangered fish species: the Topeka shiner. Journal of the Minnesota Academy of Science. 65:39-46.

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

Tabor, V. M. 2002. Endangered and Threatened Wildlife and Plants; Designation of critical habitat for the Topeka shiner. Federal Register. 67:54261-54306

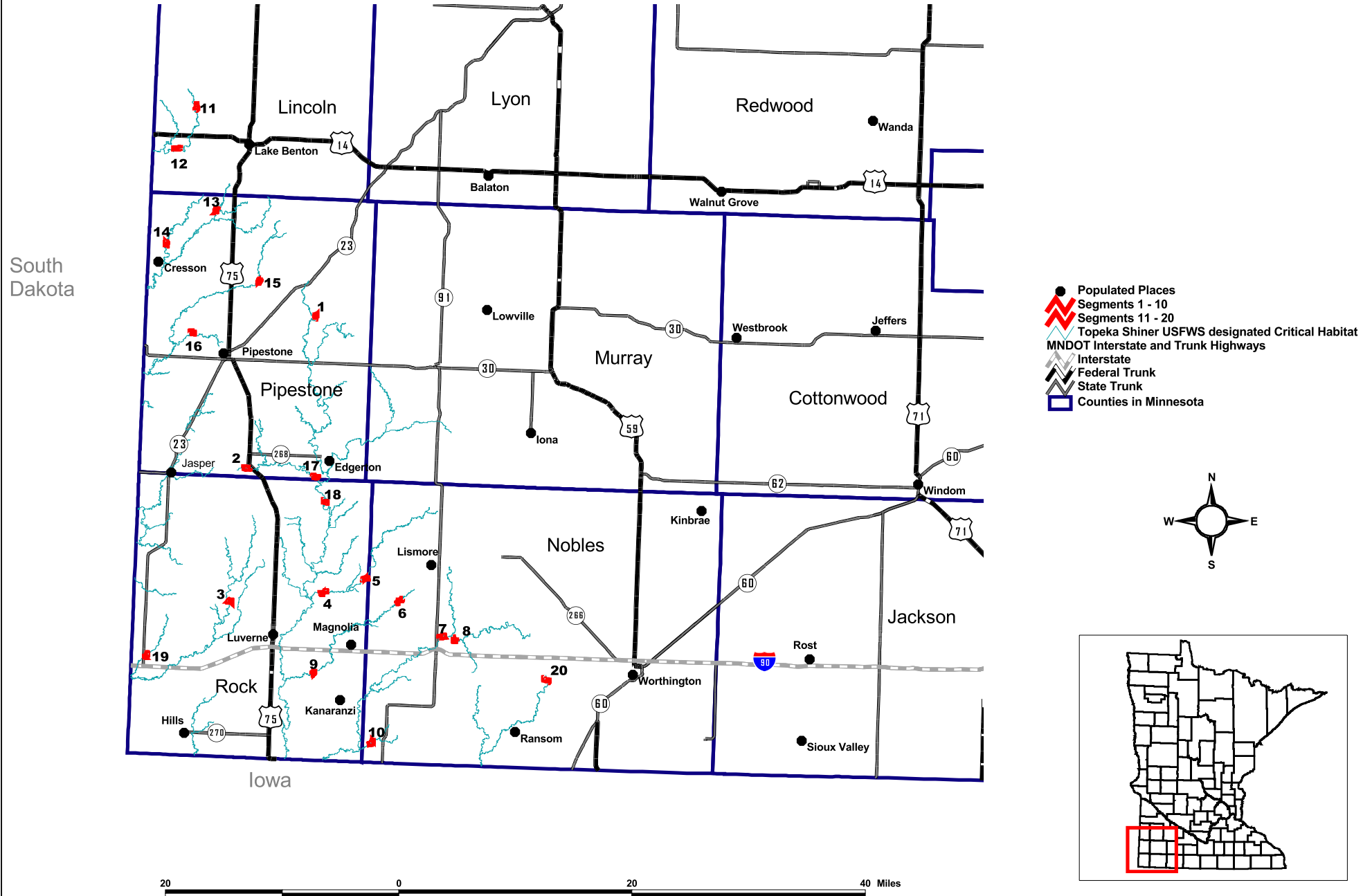
APPENDIX A – MAPS OF STREAM SEGMENTS

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

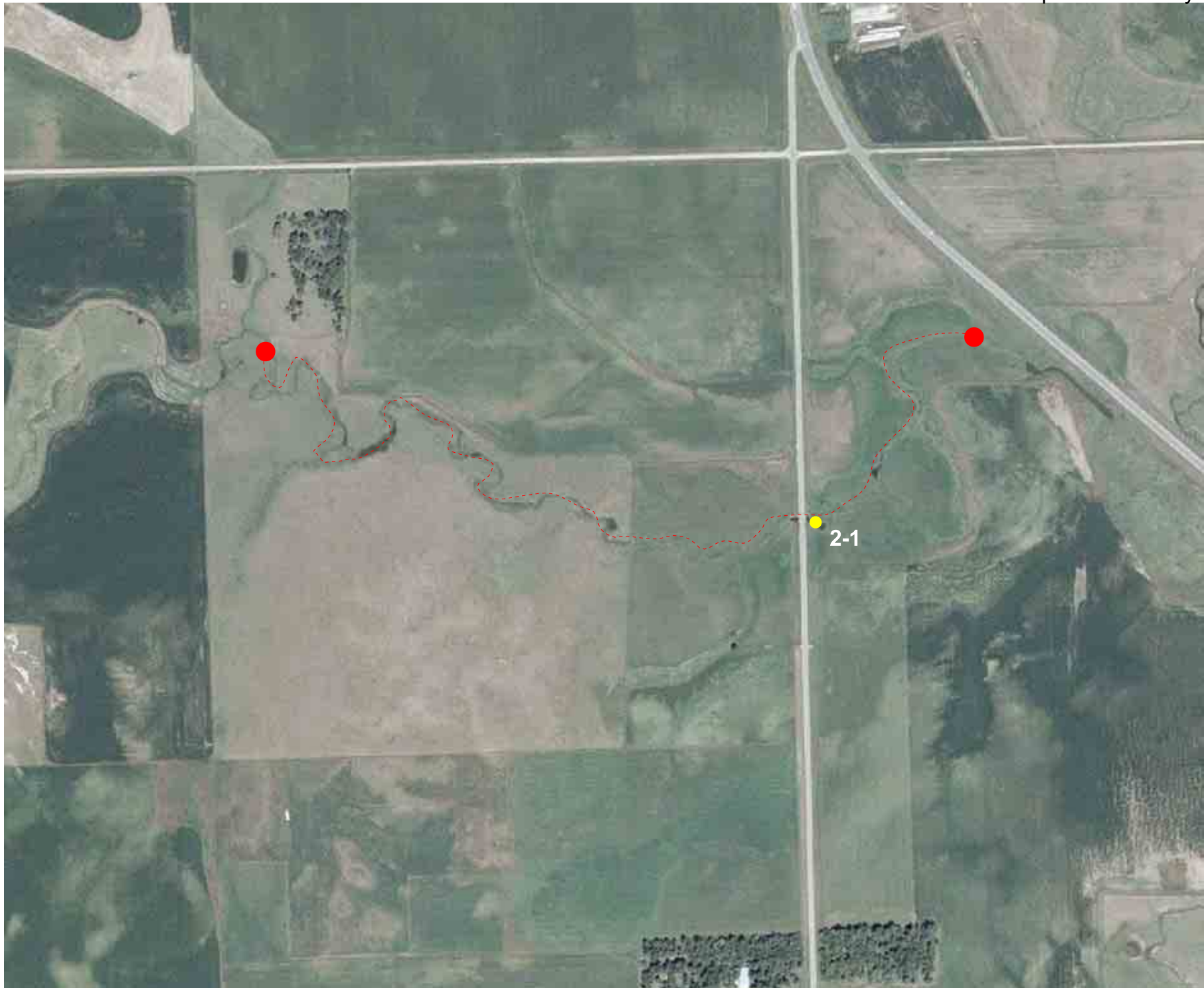
The yellow dots (with white numbers) correspond to the Sites given in Table 1.

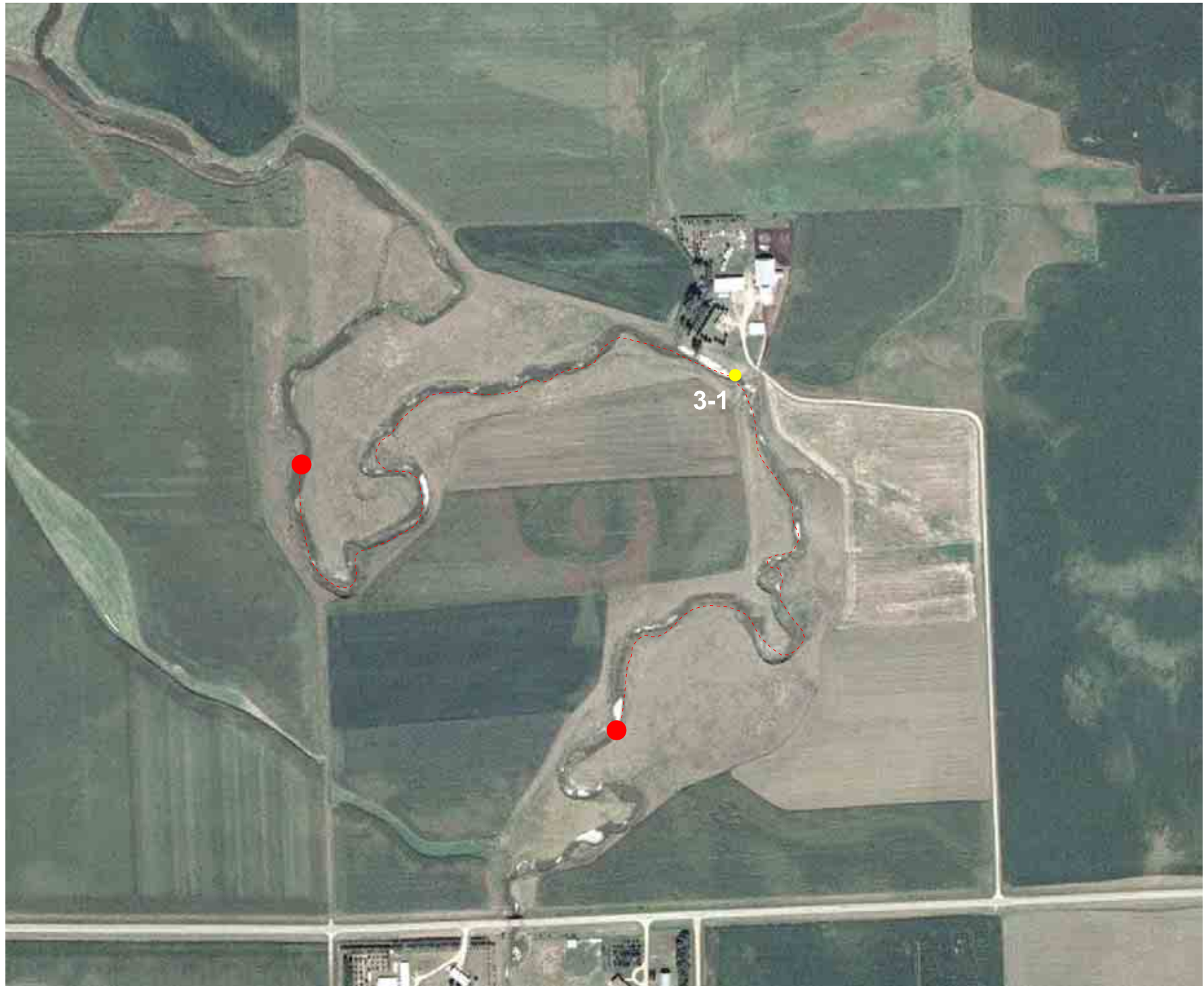
The red-dotted lines show the actual stream channel as currently defined in the Federally proposed critical habitat shapefile.

Overview of Segments

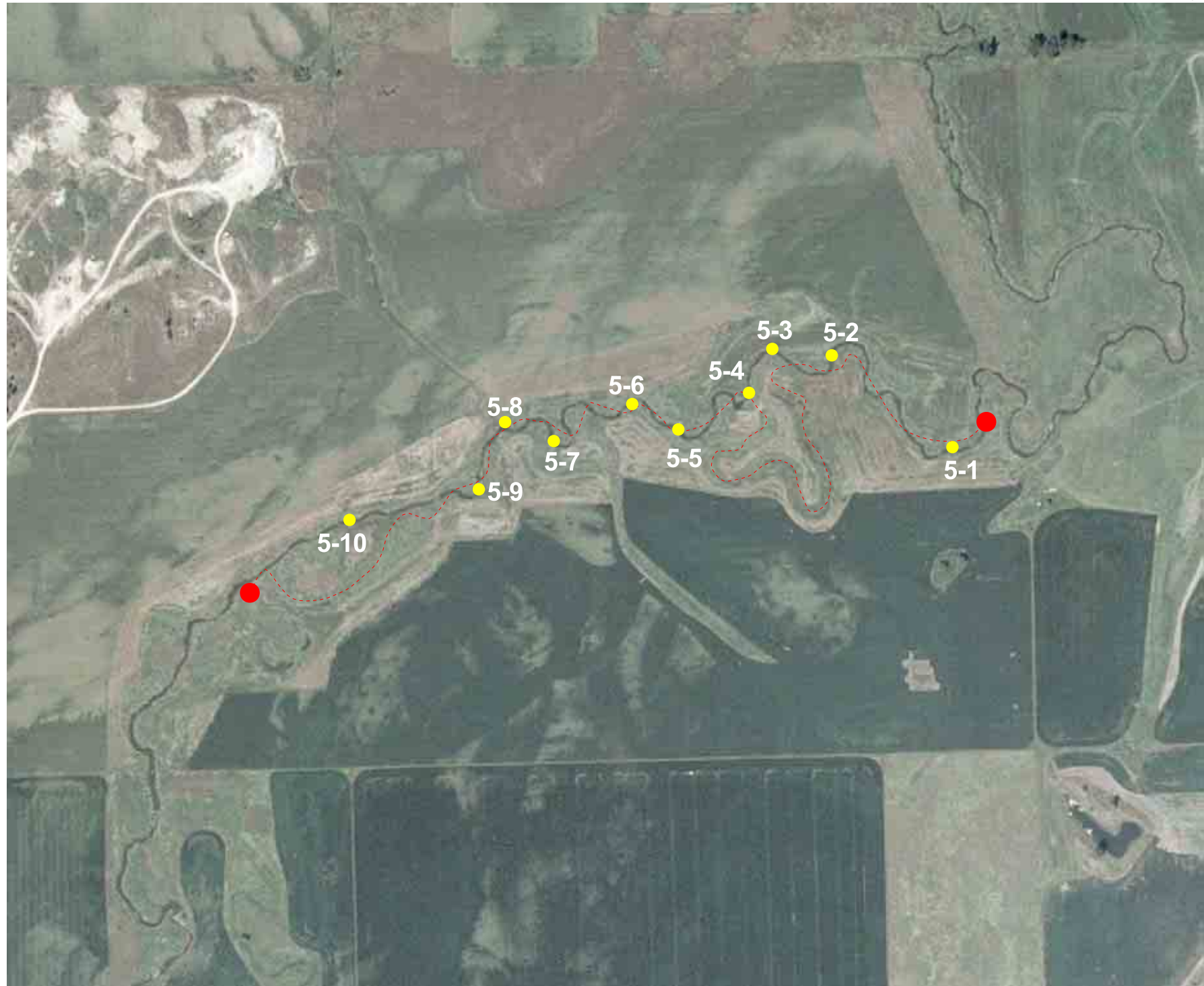




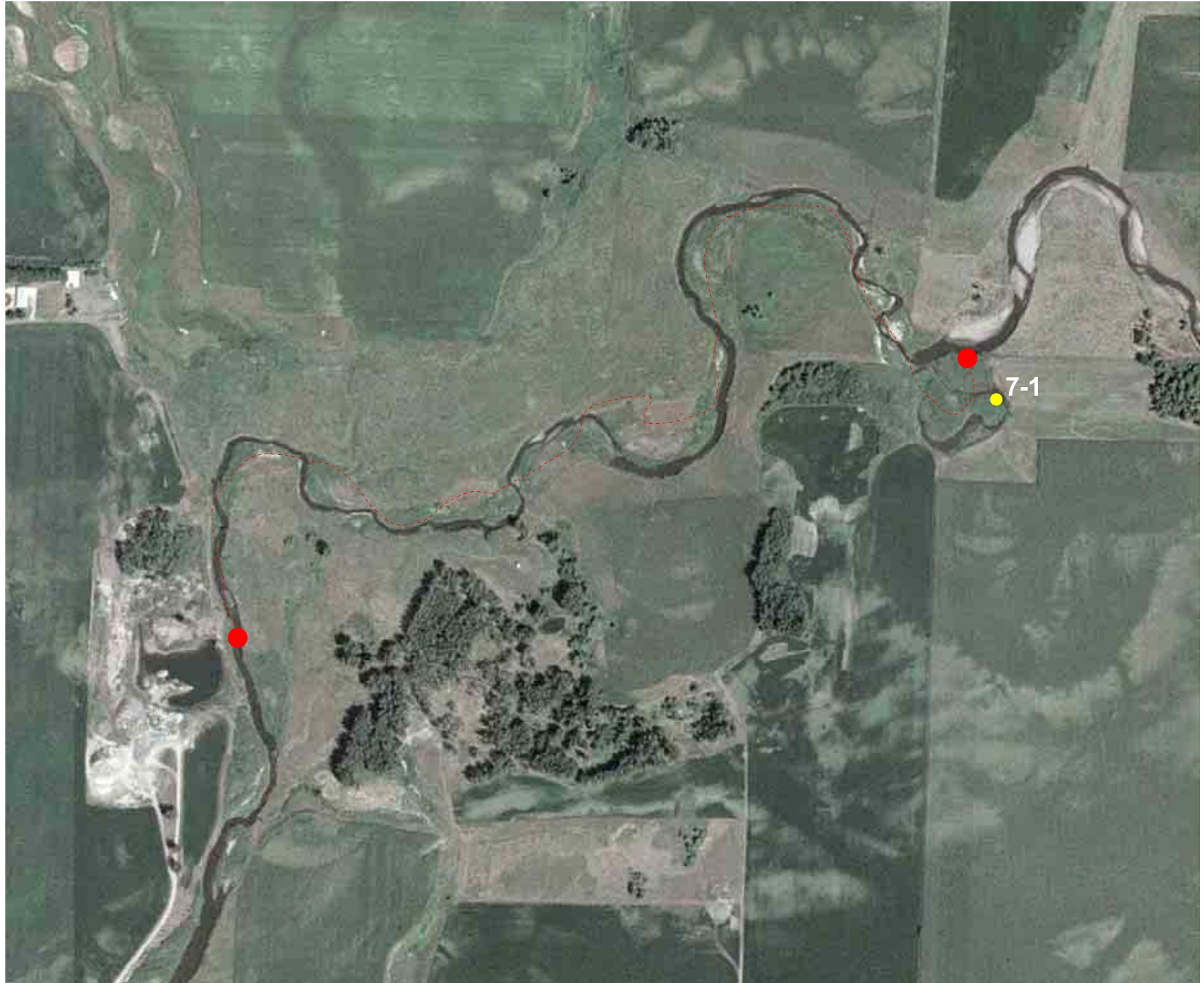




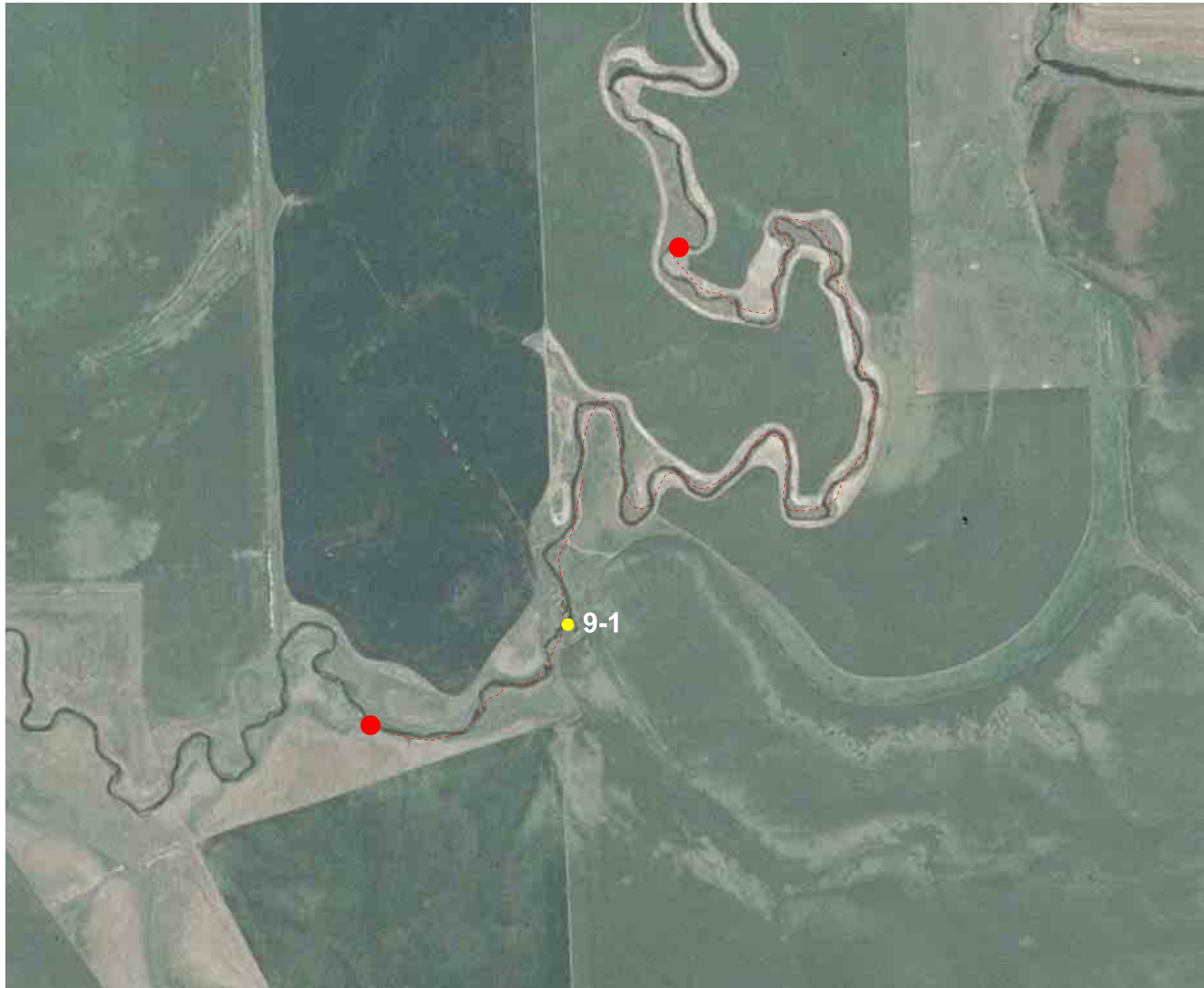




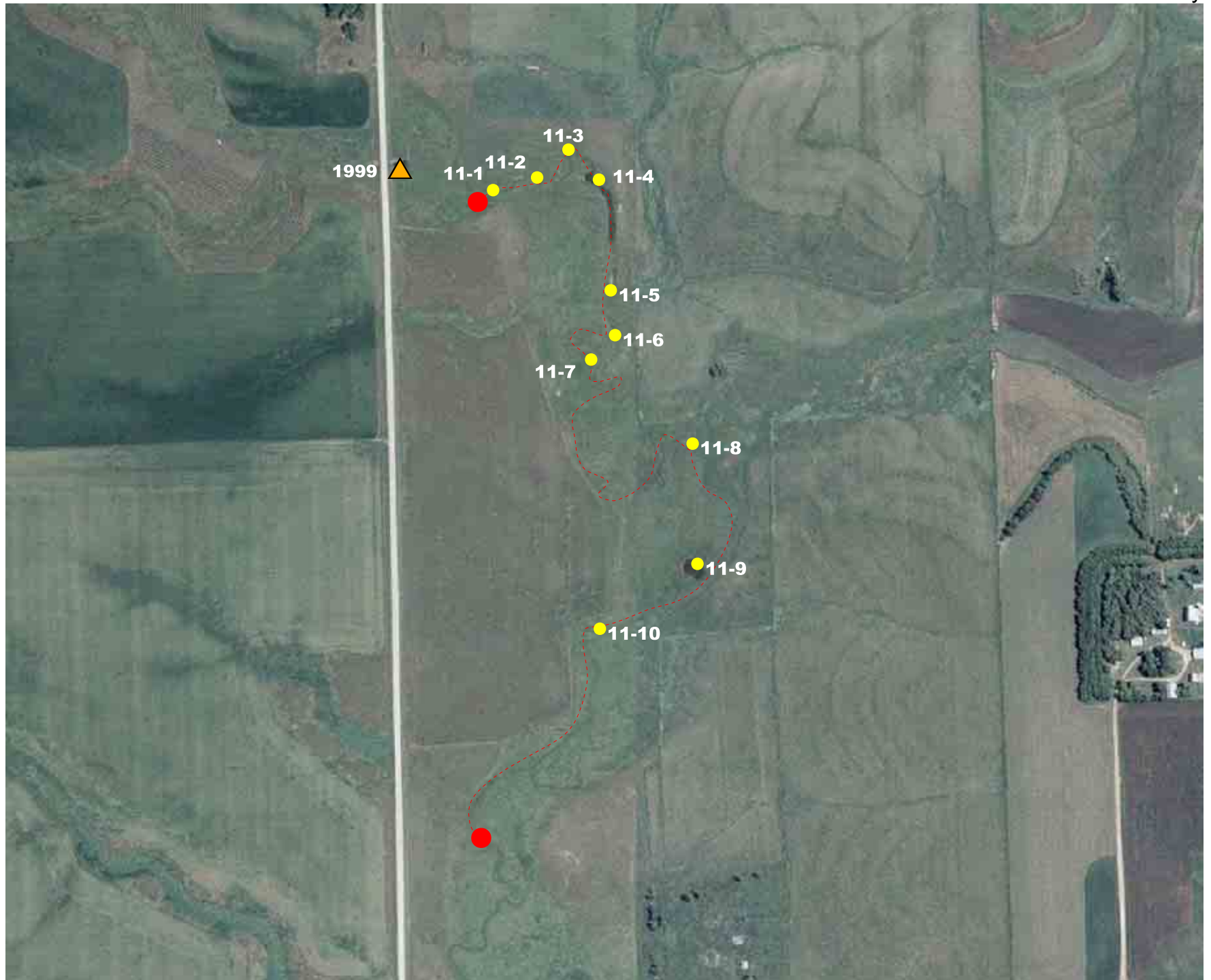




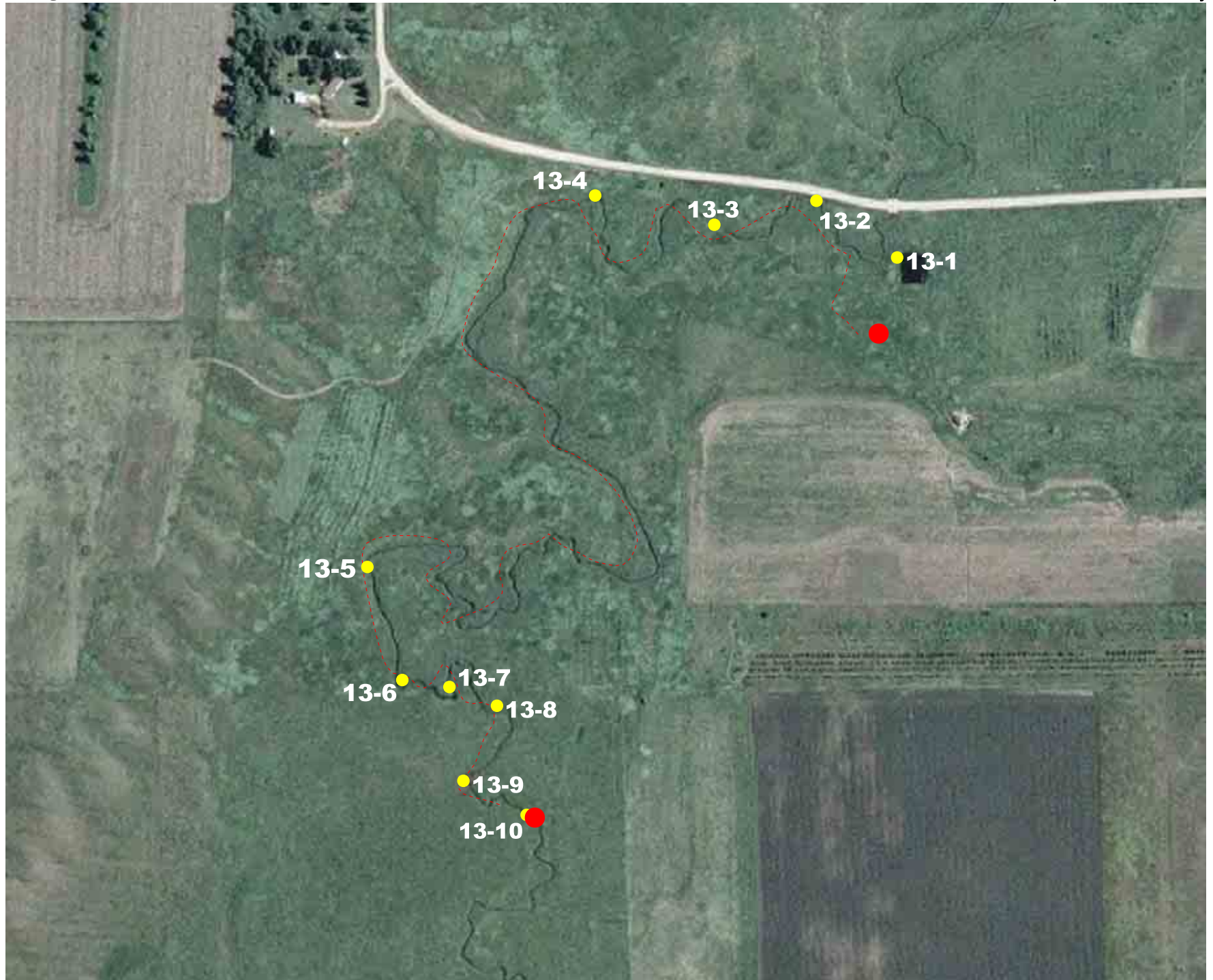


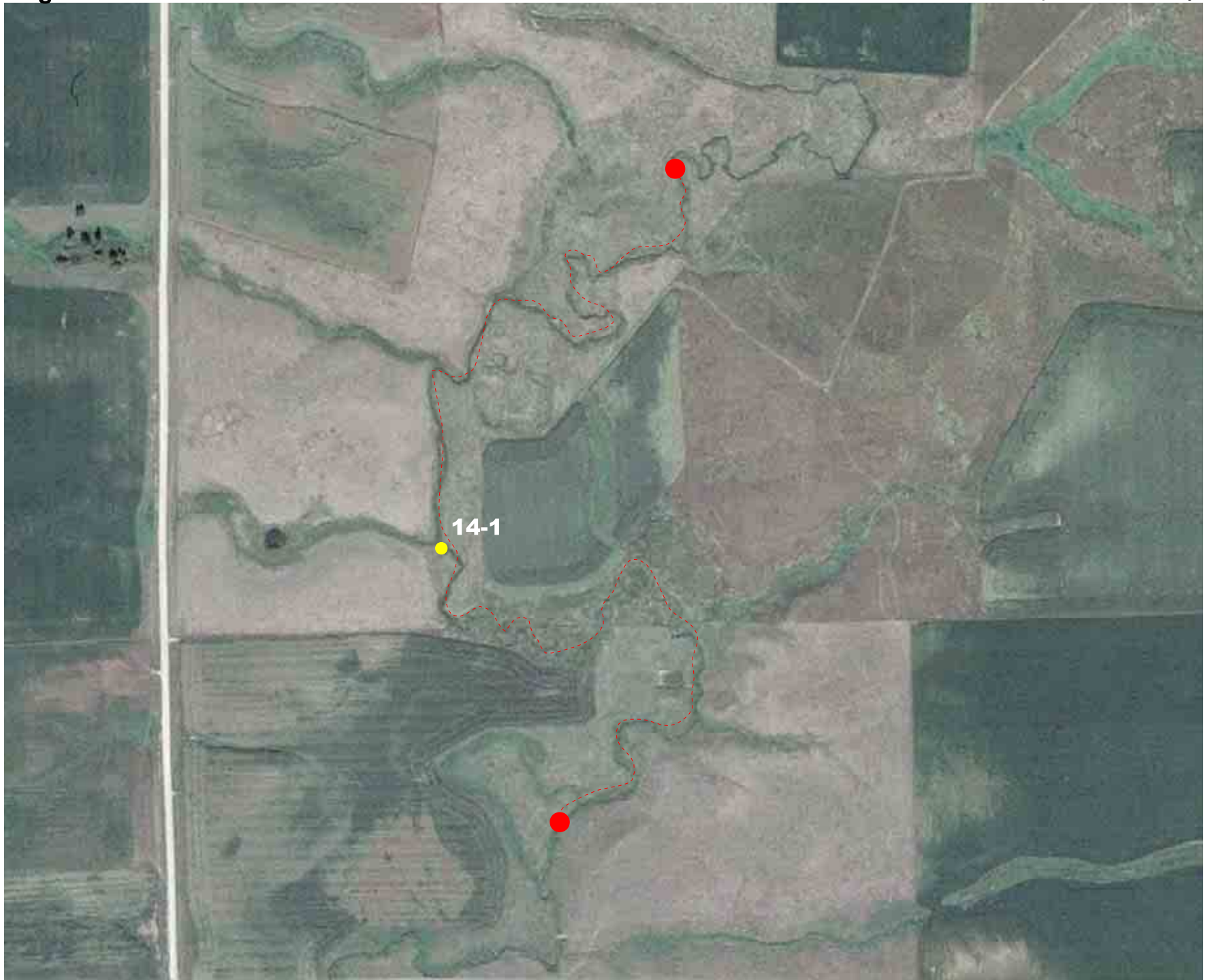










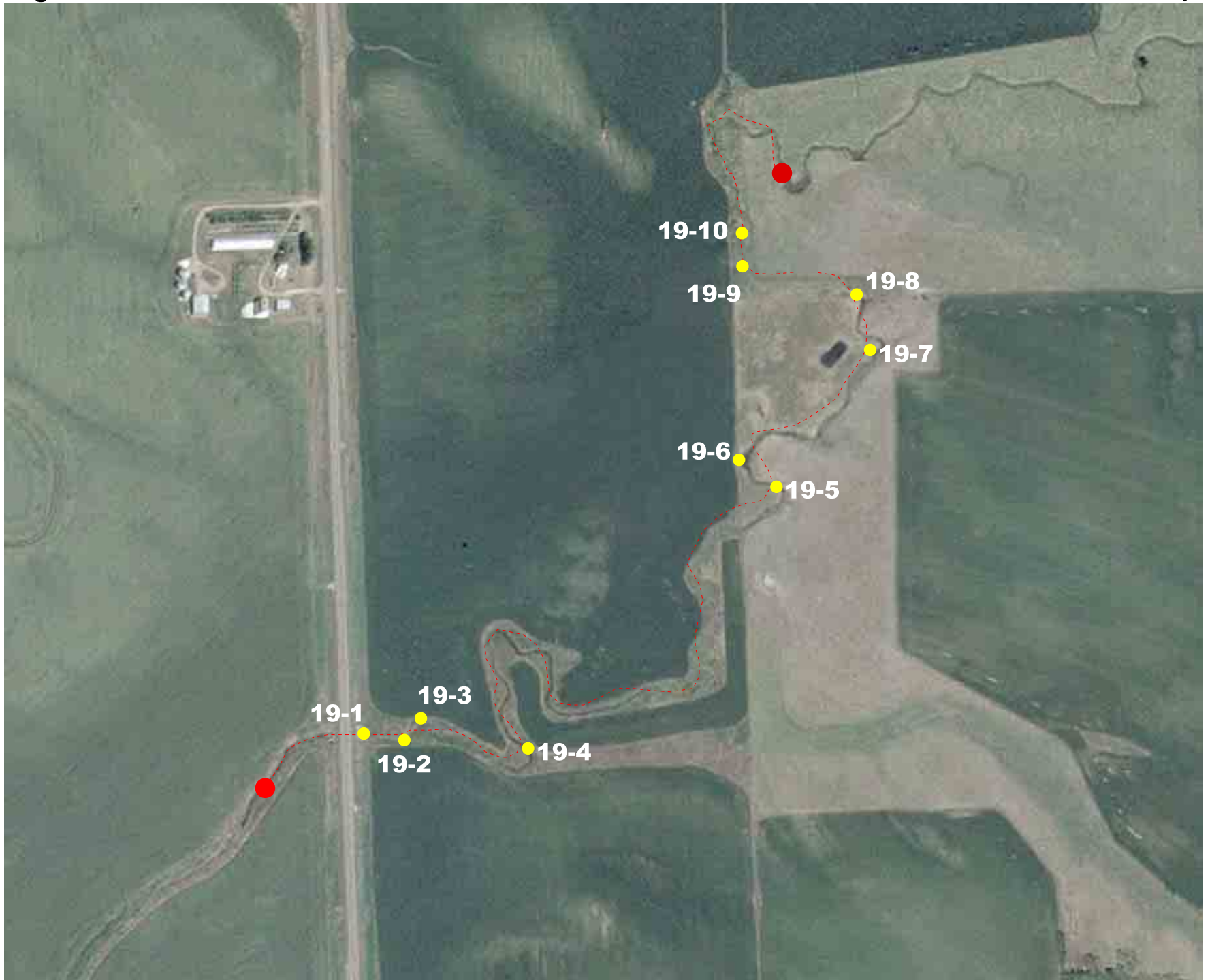














APPENDIX B – DESCRIPTIONS OF STREAM SEGMENTS AND SITES

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

Table 1. Locations of the 20 stream Segments 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) and the legal location for the 20 Segments, and UTM coordinates for each sampling Site. For stream segments 1 to 10, 12, 14 to 18, and 20, the Site Number that is the highest (e.g., 1-3) is where the Topeka shiners were found. Topeka shiners were not found in Segments 11, 13, or 19.

<u>Segment Stream Name & Common Location</u>							<u>UTM Coordinates</u>	
County	T	R	Section(s)	Township Name	Site Number	Habitat Type	Northing	Easting
<u>1</u>	<u>tributary, Rock River</u> <u>4 mi NW Woodstock along CR 82</u>							
Pipestone	107	44	20, 29	Rock	1-1	"off-channel"	4882493.70916632	247116.22121536
					1-2	"off-channel"	4882491.29015193	247304.82303635
					1-3	"off-channel"	4882483.80536046	247392.11553304
Tributary of Rock River that was a series of isolated long pools (pools obviously reconnect into a flowing stream after heavier rains). Topekas found in the third upstream pool. Substrate = silt over firm sand.								
<u>2</u>	<u>tributary, Poplar Creek</u> <u>2 mi S Trosky @ CR 58</u>							
Pipestone	105	45	31, 32	Elmer	2-1	in-channel	4861357.22154336	237602.69750164
Small headwater with numerous well-developed main channel pools. Topekas caught in first seine haul.								
Substrate = deep "muck."								
<u>3</u>	<u>Beaver Creek</u> <u>3.75 WNW intersection U.S. 75 & CR 8</u>							
Rock	103	45	30	Mound	3-1	in-channel	4843216.97338916	235194.78719674
Main channel pool; stream banks in grasses, pastureland. Topekas caught in first seine haul.								
Substrate = relatively clean firm sand.								
<u>4</u>	<u>Champepadan Creek</u> <u>4 mi SW Kenneth @ CR 9</u>							
Rock	103	44	20, 21	Vienna	4-1	in-channel	4844270.91048541	247607.92867930
Main channel pool created by beaver dam. Topekas caught in first seine haul.								
Substrate = firm silt/mud.								

Segment	Stream Name & Common Location					UTM Coordinates			
	County	T	R	Section(s)	Township Name	Site Number	Habitat Type	Northing	Easting
<u>5</u>	<u>Champepadan Creek</u> <u>2 mi SE Kenneth</u>								
	Rock	103	44	13	Vienna	5-1	in-channel	4846201.85710974	254031.39322489
						5-2	in-channel	4846318.85188757	253898.76272340
						5-3	in-channel	4846331.59228944	253830.26015523
						5-4	in-channel	4846282.56372453	253799.20054884
						5-5	in-channel	4846245.92390682	253714.08964268
						5-6	in-channel	4846279.26367580	253662.58791942
						5-7	in-channel	4846242.63021569	253568.04637093
						5-8	in-channel	4846269.05281464	253512.80075195
						5-9	in-channel	4846192.99621567	253476.94663992
						5-10	in-channel	4846168.17371573	253323.60413101
	Flowing water throughout; no well-developed pools. No off-channel habitats.								
	Substrate = much topsoil runoff.								
<u>6</u>	<u>Elk Creek</u> <u>5.5 mi NW Adrian along CR 14</u>								
	Nobles	103	43	21, 28	Lismore	6-1	"off-channel"	4843247.04766188	258646.99199312
						6-2	"off-channel"	4843214.25668661	258227.75317380
	Small tributary of Elk Creek that is expanded into a pool; pool may become an OCH as summer water levels recede.								
	Substrate = deep "muck" and much algae.								
<u>7</u>	<u>Kanaranzi Creek</u> <u>1.5 mi NNE Adrian</u>								
	Nobles	102	42	6, 7	Olney	7-1	"off-channel"	4838175.75471616	264678.17855515
	This is a large oxbow that was connected to the mainchannel; it appears that the oxbow loses the connection as the water levels recede during the summer. Topekas caught in first seine haul.								
	Substrate = relatively firm sand-mud combination.								
<u>8</u>	<u>East Branch Kanaranzi Creek</u> <u>2 mi NE Adrian</u>								
	Nobles	102	42	8	Olney	8-1	in-channel	4838142.45359983	265796.53386746
	No off-channel habitats. Overall, the mainstem has continuous flow and no well-developed pools, except for immediately upstream of the bridge (Site 8-1), where the flow decreases and the channel widens slightly into a large, silt-bottomed pool.								
	Substrate = silt/mud over firm sand.								

<u>Segment</u>	<u>Stream Name & Common Location</u>					<u>UTM Coordinates</u>			
	County	T	R	Section(s)	Township Name	Site Number	Habitat Type	Northing	Easting
<u>9</u>	<u>Elk Creek</u> <u>3.5 mi NW Kanaranzi @ abandonde RR bridge</u>								
	Rock	102	44	29	Magnolia	9-1	off-channel	4833006.03129031	246325.97534404
	Numerous OCH's located between concrete bridge supports of old RR right-of-way. Substrate = silt/mud over firm sand.								
<u>10</u>	<u>Norwegian Creek</u> <u>ca. 1 mi NW Ellsworth @ CR 11</u>								
	Nobles	101	43	30	Grand Prairie	10-1	in-channel	4823998.52091510	254863.71292180
	Beaver dam has created a long gravel-bottom pool. Topekas caught in first seine haul. Rest of segment is channelized. Substrate = relatively clean gravel & sand.								
<u>11</u>	<u>trib., Medary Creek</u> <u>ca. 5.5 mi NW Lake Benton, between CR 12 & CR 137</u>								
	Lincoln	110	46	27	Dramen	11-1	in-channel	4911708.59591790	230249.03040691
						11-2	in-channel	4911720.98264700	230308.78539617
						11-3	in-channel	4911755.58640171	230353.68985700
						11-4	in-channel	4911712.06555285	230391.53944889
						11-5	in-channel	4911562.59350439	230396.70360569
						11-6	in-channel	4911502.09752589	230397.96461932
						11-7	in-channel	4911472.16495187	230363.70056803
						11-8	in-channel	4911349.64757915	230490.92180897
						11-9	off-channel	4911187.65415041	230486.04239396
						11-10	in-channel	4911110.23371604	230348.39871404
	Small headwater (ave width $\leq$ 5 ft); primarily flowing water throughout. One main channel pool & one OCH were present. Substrate = clay & silt; silt in pools.								

Segment Stream Name & Common Location

<u>Segment Stream Name & Common Location</u>							<u>UTM Coordinates</u>	
County	T	R	Section(s)	Township Name	Site Number	Habitat Type	Northing	Easting
<u>12</u>	<u>Medary Creek</u> ca. 6 mi W Lake Benton, between CR 12 & CR 137							
Lincoln	109	46	17	Verdi	12-1	in-channel	4905644.41293275	227454.11457659
					12-2	in-channel	4905641.19642815	227538.55719575
					12-3	in-channel	4905583.57684436	227853.39998540
					12-4	in-channel	4905520.00364084	227822.51561404
Small narrow headwater with occassional widenings at cow crossings (Topekas found at one of these crossings). Substrate = boulders & sand-silt mixture.								
<u>13</u>	<u>Flandreau Creek</u> ca. 1.5 mi E U.S. 75, 1.5 mi S Pipestone-Lincoln county line							
Pipestone	108	46	11	Altona	13-1	off-channel	4897184.05311192	233400.84851203
					13-2	in-channel	4897238.73790455	233334.05832885
					13-3	in-channel	4897224.29343789	233243.60161829
					13-4	in-channel	4897257.37076099	233142.00274069
					13-5	in-channel	4896948.37372597	232919.96062124
					13-6	in-channel	4896847.80003366	232943.22510120
					13-7	in-channel	4896838.60952175	232983.47075093
					13-8	in-channel	4896819.23552086	233023.69071205
					13-9	in-channel	4896756.06452709	232989.94573954
					13-10	in-channel	4896722.50506349	233042.61111258
Small headwater (ave width 5-10 ft); primarily flowing water throughout. One artificial OCH. Substrate = silt & clay.								
<u>14</u>	<u>Willow Creek</u> 1.5 mi E MN-SD state line, 4.5 mi S Pipestone-Lincoln county line							
Pipestone	108	46	30	Altona	14-1	in-channel	4892404.33536840	226059.33520028
Cattle have caused a widening/pooling of stream. Topekas caught in first seine haul (dropped fish, did not recapture). Substrate = boulders scattered in a sand-silt mixture.								
<u>15</u>	<u>Pipestone Creek</u> 3.5 mi W Holland, between DR 8 & CR 69							
Pipestone	107	45	9	Grange	15-1	in-channel	4887584.90974798	239261.25067843
Large pool located under and downstream of CR 8. Substrate = sand-silt mixture.								

Segment Stream Name & Common Location

Segment	Stream Name & Common Location					UTM Coordinates					
						County	T	R	Section(s)	Township Name	Site Number
<u>16</u>	<u>Pipestone Creek</u>	3 mi S Cazenovia									
	Pipestone	107	46	33	Troy	16-1	in-channel	4880003.54615101	230067.75217086		
	Numerous backwater pools that appear to be permanantly connected to the main channel. Topekas caught in first seine haul. Substrate = relatively firm sand & silt.										
<u>17</u>	<u>Poplar Creek</u>	ca. 1.5 mi SW Edgerton @ CR 1									
	Pipestone	105	44	32	Osborne	17-1	in-channel	4859910.35713327	247201.25973219		
	Horse pastures surrounding stream. Stream has nice meanders & pools downstream of beaver dam. Topekas caught in first seine haul (in pool created by dam). Substrate = firm silt and sand.										
<u>18</u>	<u>Rock River</u>	2 mi S Rock-Pipestone county line, 1 mi W CR 2									
	Rock	104	44	8, 9	Battle Plain	18-1	in-channel	4857438.19359988	247981.71522992		
						18-2	in-channel	4857489.99916897	247904.14819212		
						18-3	in-channel	4857396.06982447	247936.76416692		
	Well-defined backwater pool. This pool appears to stay connected to the river all year. Substrate = silt & mud.										
<u>19</u>	<u>Springwater Creek</u>	1.25 mi E MN-SD state line, 1 mi N I-90, along CR 23									
	Rock	102	47	24	Beaver Creek	19-1	in-channel	4835391.24131977	223070.62329584		
						19-2	in-channel	4835402.68288206	223129.47714941		
						19-3	in-channel	4835402.68288206	223129.47714941		
						19-4	in-channel	4835364.06976590	223235.79934394		
						19-5	in-channel	4835610.25223897	223505.79909450		
						19-6	in-channel	4835640.42435705	223469.83183164		
						19-7	in-channel	4835741.50505087	223610.47631261		
						19-8	in-channel	4835798.63295575	223601.03458882		
						19-9	in-channel	4835835.44999930	223487.50973717		
						19-10	in-channel	4835868.93638364	223489.57064315		
	Small downcutting headwater; flowing water entire length of stream segment.										

Substrate = clay & "muck."

Table 1. Concluded.

<u>Segment Stream Name & Common Location</u>						<u>UTM Coordinates</u>				
	County	T	R	Section(s)	Township Name	Site Number	Habitat Type	Northing	Easting	
<u>20</u>	<u>Little Rock River</u>	<u>2.5 mi ESE Rushmore</u>								
		Nobles	102	41	27	Dewald	20-1	in-channel	4832576.13973963	278360.61810800
							20-2	in-channel	4832562.59912886	278346.20771765
							20-3	in-channel	4832473.69852562	278283.99430806
							20-4	in-channel	4832376.74276956	278279.85010498
							20-5	in-channel	4832247.60876081	278445.47868891
							20-6	in-channel	4832265.40240589	278580.41160667
							20-7	in-channel	4831961.82047724	278859.25626052
							20-8	in-channel	4832110.13852638	278964.98544058

Channelized creek with almost constant flow. One small backwater pool where one Topeka shiner was found.

Substrate = clay and silt.

APPENDIX C –PHOTOGRAPHS OF HABITATS & FISHES

Pictures for Segments 11, 13, and 19 (no Topeka shiners captured) are photos of representative stream habitat for the 1-mile stream segments. Photos for the remaining segments are of the actual stream sites where Topeka shiners were collected.

For 16 of the 17 stream segments where Topeka shiners were found, voucher photographs of at least one fish specimen are included (the specimen for Segment 14-1 was dropped back into the water before the photo was taken).

Photos by P. Ceas.

Topeka shiner Site 1-3



Topeka shiner Site 2-1



Topeka shiner Site 3-1



Topeka shiner Site 4-1



Topeka shiner Site 5-10

<PICTURE OF SITE NOT AVAILABLE>



Topeka shiner Site 6-2



Topeka shiner Site 7-1



Topeka shiner Site 8-1



Topeka shiner Site 9-1



Topeka shiner Site 10-1



Topeka shiner Site 11 - no topekas



Topeka shiner Site 12-4



Topeka shiner Site 13 - no topekas



Topeka shiner Site 14-1- topeka female caught, dropped



Topeka shiner Site 15-1



Topeka shiner Site 16-1



Topeka shiner Site 17-1



Topeka shiner Site 18-3



Topeka shiner Site 19 - no topekas



Topeka shiner Site 20-8

