

Topeka Shiner Monitoring in Minnesota: 2019



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ABSTRACT

In response to a range-wide decline in abundance and distribution, the Topeka shiner (*Notropis topeka*) was designated as a federally endangered species in 1999. In 2004, the Minnesota Department of Natural Resources (MN DNR) began a presence/absence survey effort to monitor Minnesota populations of Topeka Shiners at randomly selected sites within the federally designated critical habitat for the species. Averaged over the first fourteen years of monitoring from 2004-2018, Topeka shiners were present at 66% (min: 30%; max: 90%) of randomly selected reaches of streams. During 2019, Topeka shiners were found at 65% of randomly selected one-mile segments. Overall, our monitoring results indicate that Topeka shiner populations in Minnesota may be relatively stable despite short-term fluctuations in observed occupancy and relative abundance.

INTRODUCTION

The Topeka shiner (*Notropis topeka*) was historically widespread and abundant in low order streams (1st through 3rd order) throughout the central plains region of the United States. Since the early 1970s, the species has exhibited significant decline across much of its range and is estimated to occur in only 10-15 percent of its historic geographic distribution (Tabor 2002). Habitat loss, predominately the mass conversion of tallgrass prairie for agricultural purposes, has been implicated as the primary driver in the rapid decline of Topeka shiners across their range (Cross 1967; Eddy and Underhill 1974; Gelwicks and Bruenderman 1996; Berg et al. 2004). Historically, the landscape contained meandering streams and adjacent floodplain areas covered in native vegetation. Landscape-level alterations including extensive ditching and straightening of stream channels has led to significant hydrologic changes, including a decrease in base flows, disruption of floodplain connectivity, elevated sedimentation, increased turbidity, higher water temperatures, and loss of aquatic vegetation; all of these factors contribute to the degradation and loss of the Topeka shiner's preferred habitat (Tabor 1993). In response to the rapid and dramatic decline in abundance and distribution, the U.S. Fish and Wildlife Service designated the species as endangered under the Endangered Species Act of 1973 (Tabor 1998).

Surveys conducted during the late 1990s indicated that Minnesota harbored viable populations of Topeka shiners throughout its distribution in the state, and that compared with previous survey efforts in the 1970s and 80s, these populations appeared to be stable (Dahle 2001; Hatch 2001). These findings were in stark contrast to survey efforts in other portions of the Topeka shiner's historic range, where they were sampled at only 17% of historic localities in Kansas (Tabor 1998) and 15% of historic localities in Missouri (Gelwicks and Brunderman 1996). This discrepancy between presence/absence at historic sites in Minnesota versus the other 4 regions within the species' range led Dahle (2001) to conclude that "Minnesota populations may represent the largest and most stable population remaining in the species' range." In 2004, the Minnesota Department of Natural Resources began a program to monitor populations of Topeka shiners within the state and established a protocol (Ceas and Anderson 2004) to conduct annual presence/absence surveys of Topeka shiners at twenty randomly selected segments (one-mile) of stream within the federally-designated critical habitat in the Big Sioux and Rock River drainages in southwestern MN. Surveys were conducted from 2004 to 2010, and Topeka shiners were found at an average of 76.4% of sites over the seven year period (Ceas and Anderson 2004; Ceas and Monstad 2005, 2006; Ceas and Plain 2007; Ceas and Larson 2008, 2009, 2010). However, the percentage of segments where Topeka shiners were observed began to decline in 2010 (60%; Ceas and Larson) and declined further during 2012-2014 (40%, 30% and 45% respectively; Nagle and Larson 2012, 2013, 2014). Cunningham saw marked increases in sites where Topeka shiners were present during 2015, 2016 and 2017 (65%, 90% and 60% respectively; Cunningham 2015, 2016, 2017). This trend in increased presence continued in 2018 with Herberg et al. finding Topeka shiners present at 70% of sites.

In addition to changes in occupancy, surveyors also began to note a marked decline in 2010 in relative abundance at sites that were occupied (Ceas and Larson 2009, 2010). Over the next seven years (2012-2018), the relative abundance of Topeka shiners at occupied sites continued to be in decline. Results from monitoring surveys conducted in 2019 are detailed in this report.

METHODS

Methods for 2019 Topeka shiner monitoring follow Ceas and Anderson (2004) and are reproduced below with updated information.

Selection of Stream Segments

For each year of Topeka shiner monitoring, 20 one-mile reaches of stream were selected at random from the federally designated Topeka shiner critical habitat within Minnesota, employing an ArcView extension program developed by MN DNR (Appendix A, Map 21).

Landowner Contact

A large percentage of the randomly-selected stream segments occur on privately-owned lands, and we obtained permission from landowners to access those reaches. Contact information for landowners was provided to the DNR by the County Auditor's offices of Pipestone and Nobles counties. Landowner contact information for Rock County was accessed online at <http://rock.houstoneng.com>. Additional online resources were also used for obtaining landowner information (e.g., White Pages, Nuwber). All landowners received a letter in the mail in April 2019 requesting access to the property to conduct aquatic surveys. Each landowner also received a follow up telephone call during April 2019. If a landowner was not reached in some form, then we attempted to reach them at their primary residence in early May and/or during the week of the surveys (June 12th-18th, 2019). When possible, stream segments were accessed at public right-of-ways at bridge crossings.

Selection and Reconnaissance of Sampling Sites

Based on habitat preferences characterized in the literature (Minckley and Cross 1959; Bailey and Allum 1962; Pflieger 1997; Berg et al. 2004; Eddy and Underhill 1974; Dahle 2001; Hatch 2001), sampling sites were identified within each randomly-selected reach of stream using aerial photography viewed in ArcGIS ver 10.6. For each sample segment, a brief reconnaissance was conducted to prioritize sampling of potential Topeka shiner habitat. Basic habitat descriptions and locality information for each of the twenty stream segments sampled in 2019 are presented in Table 1 of Appendix B. Lists of fish species captured within each of the sample segments are presented in Table 2.

Fish Sampling

Presence/absence surveys were conducted for Topeka shiners using 10' x 5' x 1/8" pole seines from June 12th to 18th, 2019. Sampling efforts were focused on low-flow areas along the main channel boundary (MCB), backwaters, and off-channel pools and oxbows. Seines were dragged along unobstructed reaches of substrate, and set-kicks were performed in vegetation or undercut banks. Due to substantial habitat and stream character heterogeneity across randomly selected sample segments, sampling efforts were not standardized between segments. Stream segments were sampled until either Topeka shiners were captured or all suitable Topeka shiner habitat within the segment had been sampled. In cases where no Topeka shiners were captured and no suitable habitat was present, a minimum of ten sites were sampled within each segment.

The monitoring effort focuses on presence/absence of Topeka shiners, and no methodologies were employed to quantify population size or numbers of individuals within the sample reaches. However, within segments where Topeka shiners were captured, a qualitative assessment of relative abundance was made based on the professional judgment of the surveyor (Ceas and Larson 2010).

While these assessments are inherently subjective, they are intended to provide a coarse characterization of Topeka shiner relative abundance at sites where they are present. At sites where Topeka shiners were captured, they were categorized as either ‘abundant’ (Topeka shiner is most numerous species present, or >10 individuals collected in the initial seine haul at capture site), ‘common’ (Topeka shiner individuals appear in low numbers relative to other species, or 5-10 individuals captured in the initial seine haul), or ‘present’ (<5 individuals captured after substantial sampling effort).

RESULTS

2019 Monitoring Surveys

Topeka shiners were collected at 13 of the 20 one-mile stream segments (Appendix A, Map 21). See Figure 1 for yearly totals of segments with Topeka shiners from 2004-2019. In all instances where Topeka shiners were captured in 2019 they were found in areas of low-flow, pool, or backwater habitat; no individuals were captured in free-flowing (main channel) reaches of stream. Topeka shiners were captured at the first site we sampled within segments 282, 283, 285, 287, 288, 289, 292, and 295. Habitat and voucher photographs for 2019 stream segments are presented in Appendix C.

Based on Ceas and Larson’s abundance criteria, Topeka shiner abundance was slightly lower in 2019 than 2017 and 2018, but higher than the previous five years (2012-2016). Of the segments where Topeka shiners were captured, four yielded Topeka shiners in abundant numbers (n = 11-42 in the initial seine haul). Topeka shiners were common or present at the remaining nine sites where they were found (1 site = common, 8 sites = present). Segment 298 yielded three individuals at the 8th site we sampled. This is the second year in a row Topeka shiners have been found at the 8th-10th site within a segment, and highlights the need for sampling a minimum of 10 sites when Topeka shiners are not found at the first few sites with the ‘best’ habitat within the segment.

Six segments contained off-channel pool habitat (282, 285, 288, 291, 298, and 300). Topeka shiners were found in four of these, but only found in the off-channel pools in three of those. We found Topeka shiners in segment 282 (Rock River), but not in the off-channel pool, which appeared to have limited connectivity with the main channel and a small outflow suggesting that it may be spring fed. It was saturated with aquatic macrophytes, and plains topminnows (*Fundulus sciaticus*) were abundant, which is notable because they share habitat requirements with the Topeka shiner. The thick vegetation limited our seining effectiveness and may have prevented us from capturing Topeka shiners if they were present. We did not find Topeka shiners in segments 291 and 298. Two small off-channel pools in segment 291 (Karananzi Creek) contained only northern leopard frog tadpoles (*L. pipiens*) suggesting water conditions are not suitable to sustain fish year round. Segment 298 (Karananzi Creek) had two off-channel pools with good connectivity and abundant aquatic macrophytes. Ten fish species were captured in these off-channel pools, including plains topminnows.

A complete list of 2019 segments, corresponding samplings sites, number of Topeka shiners captured, and brief habitat descriptions are presented in Table 1. A total of 26 fish species were collected during the 2019 surveys. Plains topminnow (*Fundulus sciadicus*), a Threatened species in MN, were collected in

three segments (282, 289, and 298). A complete list of fish species collected in each segment is presented in Table 2.

DISCUSSION

We found Topeka shiners at 65% of the randomly selected segments that we sampled in 2019 (Figure 1). These results are consistent with the pattern of increased occupancy observed by Cunningham during 2015-2017 and Herberg et al. in 2018. Average relative abundance was higher for the third consecutive year compared to the low abundance observed during 2012-2016 (Figure 2).

2019 Absence localities

The following section describes the seven stream segments where Topeka shiners were not found in 2019, but exhibited suitable habitat and/or contained historic records of the species. Refer to Table 1 for brief habitat descriptions and coordinates of sample sites within each segment. Refer to Appendix C for habitat photographs representative of the habitat along the one-mile segments.

Segment 281 (Norwegian Creek) had deeply incised banks with severe erosion that has led to marked siltation in many areas. Stream channelization has resulted in minimal suitable Topeka shiner habitat. Only small areas along the main channel border and a scour pool at the County Road 11 bridge offer any low-flow habitat. This segment was sampled in 2009; Topeka shiners were present.

Segment 284 (Kanaranzi Creek) was heavily channelized and fast flowing with steeply eroded banks. The Kanaranzi as it nears the confluence with the Rock River is large (mean stream width >10m), fast flowing, turbid, and offers very little off-channel habitat suitable for Topeka shiners. Only small areas along the main channel border offered any low-flow habitat. The western portion of the segment was sampled in 2007; Topeka shiners were present.

Segment 290 (Unnamed Tributary to Beaver Creek) was a medium-sized headwater stream with moderate to fast flows. Numerous riffles and runs were separated by infrequent main channel pools. The upper reaches of the segment were fed by numerous springs. Overall, minimal suitable Topeka shiner habitat was present. This segment was sampled in 2011; Topeka shiners were present.

Segment 291 (Kanaranzi Creek, East Branch) had deeply incised and eroded banks with deep siltation along the channel margins. Wing dams created from concrete pieces offered some of the only low-flow habitat available. However, these areas were too deep to seine effectively. Two small off-channel pools near the Chaney Ave. bridge were sampled, but only northern leopard frog tadpoles (*L. pipiens*) were captured. This segment was sampled in 2004 and 2008; Topeka shiners were present.

Segment 293 (Kanaranzi Creek) was heavily channelized and fast flowing with severely eroded banks. Signs of recent flooding above the banks were present throughout the reach. Much of the habitat could be described as runs and glides. Little to no suitable Topeka shiner habitat was available. This segment was sampled in 2011; Topeka shiners were not found.

Segment 296 (Kanananzi Creek) was fast flowing and incised with heavily eroded banks. The lower Kanananzi as it nears the confluence with the Rock River is large (mean stream width >10m), fast flowing, turbid and offers very little off-channel habitat suitable for Topeka shiners. Only small main channel border areas offered any low-flow habitat along this segment. Upstream less than a tenth of a mile of this segment was sampled in 2006; Topeka shiners were present.

Segment 298 (Kanananzi Creek) was large (mean stream width up to 10m), fast flowing and dominated by riffles, runs and glides. Two off-channel pools were sampled; one large (12x100m) and one small (5x10m). Both were dominated by aquatic macrophytes and had an abundance of fish. This segment was sampled in 2004, 2009 and 2010; Topeka shiners were present. It was sampled again in 2018; Topeka shiners were not found.

Plains Topminnow

The plains topminnow (*Fundulus sciadicus*) is a state-threatened species that was first listed as special concern in 1984. While not the main survey priority, plains topminnow presence/absence has been documented during Topeka shiner surveys since 2004. Since survey efforts focus on low-flow, off-channel and pool habitats, also the preferred habitat of plains topminnows, both species can be sufficiently monitored (Pflieger 1997). Despite the considerable survey effort in suitable plains topminnow habitat, we documented them at only 10% of the segments in 2019. It should be noted that submergent aquatic macrophytes were absent in the majority of low-flow habitat surveyed in 2019. The low number of segments where plains topminnows were documented and low number of individuals observed suggests that this species is need of additional protection and monitoring as suggested by Nagle (2014).

Conclusions

Minnesota's Topeka shiner monitoring effort was designed to detect changes in the species' presence within the state (Ceas and Anderson 2004). Data collected over the past fourteen years of monitoring has shown shifts in the prevalence of Topeka shiners across their range within the state. The first six years of monitoring found Topeka shiners at an average of 79% of segments. Beginning in 2010, observed occupancy began to fall steadily, reaching a low in 2013 (30%) and averaging 44% from 2010-2014. These rates began to increase in 2015, with Cunningham observing Topeka shiners at 70% of segments from 2015-2018 (Cunningham 2015, 2016, 2017, Herberg et al 2018; Figure 1).

Higher occupancy rates observed from 2015-2019 may be partially attributable to the random selection of stream segments sampled during these five years. Fewer headwater streams, which generally do not offer suitable Topeka shiner habitat and historically have had low occurrence rates, were selected during these years. This artifact of random site selection may have contributed to the higher occupancy rates observed compared to 2012-2014 and have affected the proportion of sites where we did not observe Topeka shiners in 2019.

We did not capture Topeka shiners at any sites on Kanananzi creek (n = 5), although they represented 25% of our total sampling effort. The Kanananzi watershed, predominantly the upper reaches, was historically rich in wetlands. The Rock River and surrounding subwatersheds, including Kanananzi Creek, have sustained some of the greatest extent of wetland conversion in Minnesota (Onsrud et al. 2014). Modified land use continues to change flow regimes, sediment loads, channel

morphology, and off-channel connectivity; these factors all may contribute to changes in Topeka shiner habitat over time. All five of this year's segments on Kanaranzi Creek were dominated by fast flows, siltation, and steep, eroded banks, and only one of the segments contained off-channel habitat. Four out of the five segments had Topeka shiners present during surveys sometime prior to 2011, suggesting that suitable Topeka shiner habitat has declined in this area. Topeka shiner presence and abundance appear to be directly related to available suitable habitat. Efforts since 2008 by the U.S. Fish & Wildlife Service to restore oxbows in the upper reaches of Kanaranzi Creek have shown that Topeka shiners will re-colonize areas when suitable habitat is available (Nick Utrup, pers. comm.).

While Topeka shiner presence at monitoring sites has increased since a low of 30% in 2010, relative abundance continues to be lower since peaking in 2008, when Topeka shiners were described as "common" or "abundant" at 55% of segments where they were captured. Of the total number of sites sampled each year during 2010-2016, $\leq 15\%$ were described as common or abundant. This may have been indicative of a population decline in Minnesota. However, relative abundance increased during 2017 (40%), 2018 (30%), and 2019 (25% of segments). It should be noted that the higher number of common/abundant sites observed in 2017 (40%) may have been due to an experimental change in survey methodology in which a full 50m reach of stream was seined at each sampling site within the segments. Sampling intensity in 2018 and 2019 returned to levels consistent with the original protocols. Increases in relative abundance during 2017-2019 could be in part due to hydrological patterns in southwest Minnesota over the last several years. High water events in 2014, as well as sustained high flows from late 2015 to summer 2016, may have increased successful Topeka shiner recruitment in Minnesota. High water conditions may also have created favorable conditions for young of the year recruitment, as well as winter survival of all age classes (Cunningham 2017).

Years of low occupancy and relative abundance may be linked back to hydrologic patterns as well, specifically low water regimes such as those experienced in 2012-2013. Lower flows during late fall and winter could dry off-channel habitats and lower pool depths in main channels/channel borders, creating potentially lethal overwintering conditions for Topeka shiners (Cunningham 2016). Continued landscape changes exacerbate these increasingly intense and variable hydrologic patterns. These patterns and changes continue to alter stream dynamics (sediment loads, flow regimes, channel morphology, off-channel connectivity, etc.), all of which negatively affect Topeka shiner populations in Minnesota. Paired with an ever changing climate, landscape changes will continue to degrade critical Topeka shiner stream habitat in Minnesota. Conservation efforts should focus on mitigating land use changes and increasing off-channel restoration efforts, particularly on the upper reaches of the subwatersheds within the Rock River drainage.

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Figure 1. Percentage of randomly selected stream segments where Topeka shiners (*Notropis topeka*) were captured, 2004-2019.

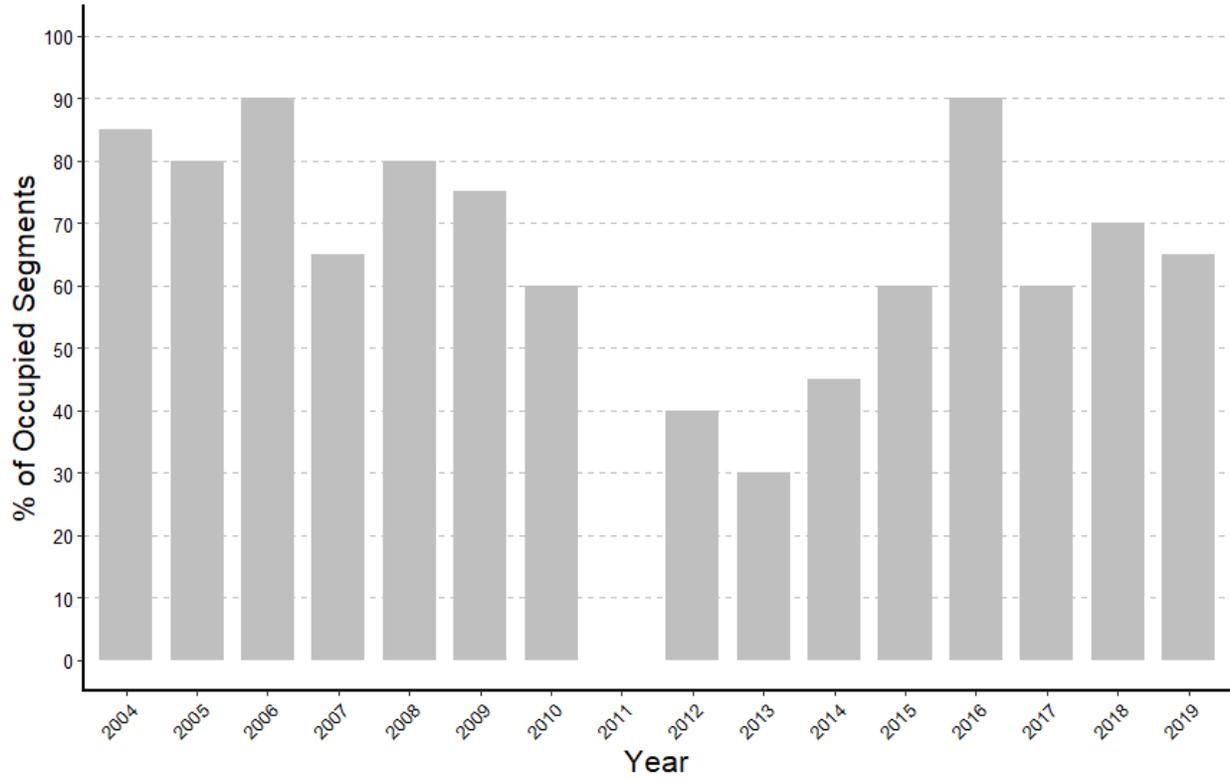
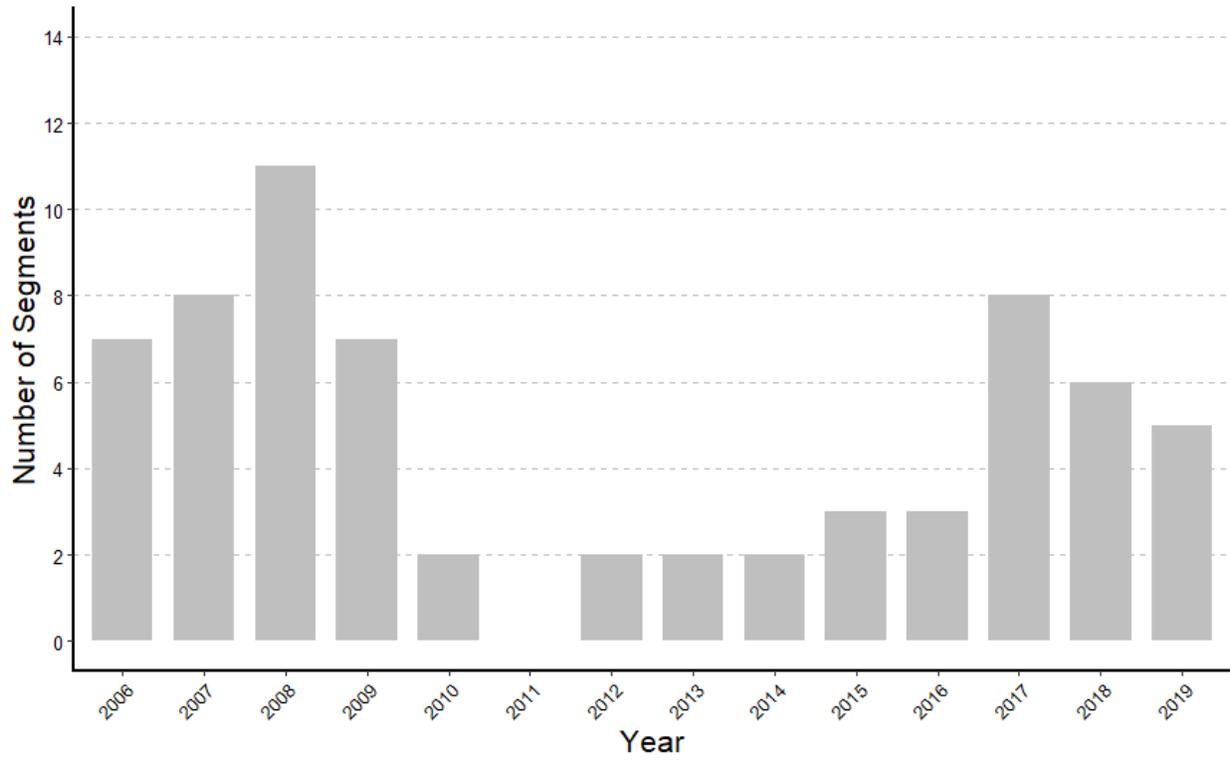


Figure 2. Number of segments where Topeka shiners (*Notropis topeka*) were considered 'common' or 'abundant', 2006-2019.



APPENDIX A: Maps of Stream Segments

Map 1-20. Aerial views of the 20 sample segments sampled in 2019.

Map 21. Overview of 300 one-mile stream segments sampled during 2004-2019.

Map 22. Presence/absence of Topeka Shiners at segments sampled during 2004-2019

Map 1: Segment 281

Norwegian Creek
Nobles County



Map 2: Segment 282

Rock River
Pipestone County



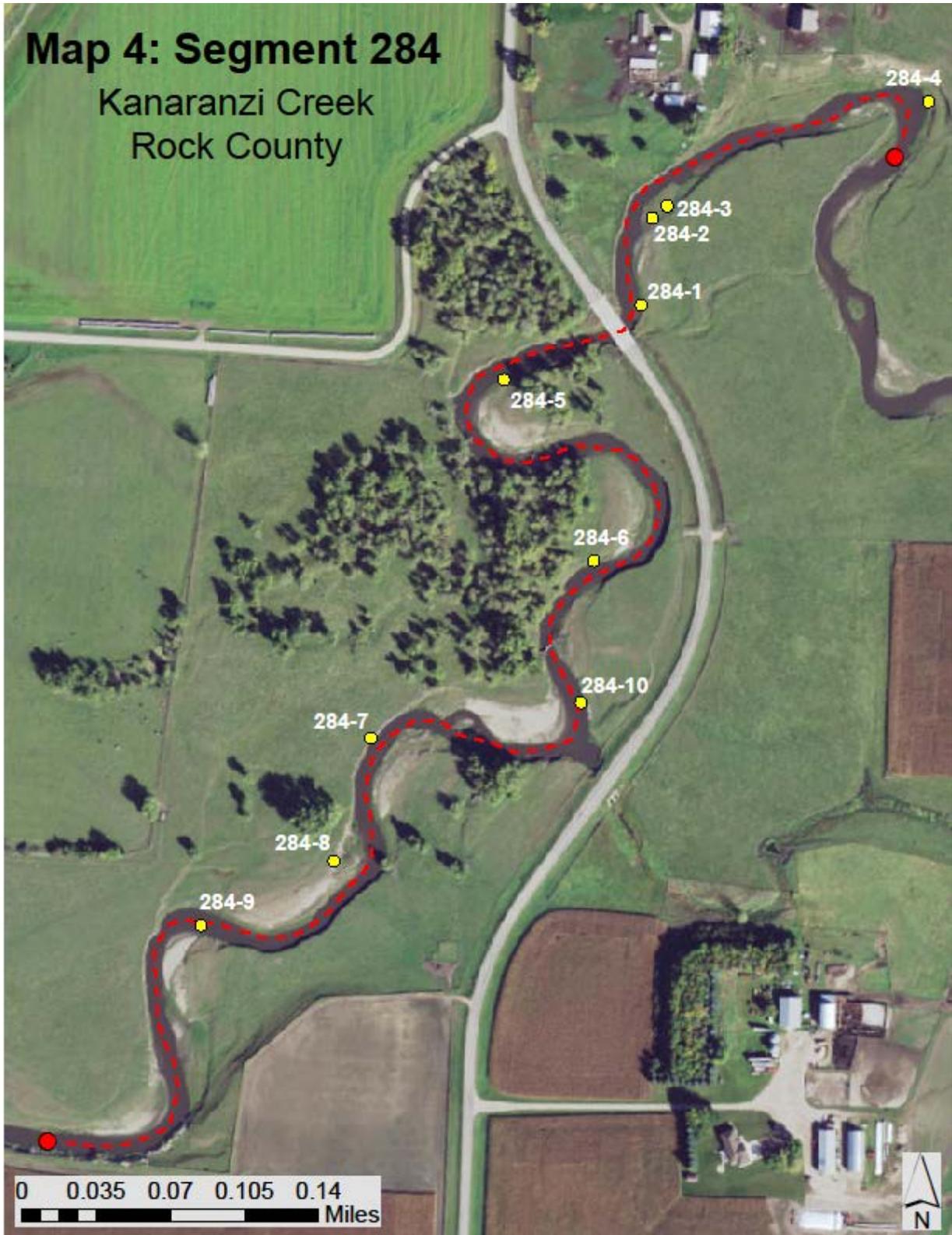
Map 3: Segment 283

Medary Creek
Lincoln County



Map 4: Segment 284

Kanaranzi Creek
Rock County



Map 5: Segment 285

Rock River
Rock County



Map 6: Segment 286

Unnamed Tributary to
Split Rock Creek
Pipestone County



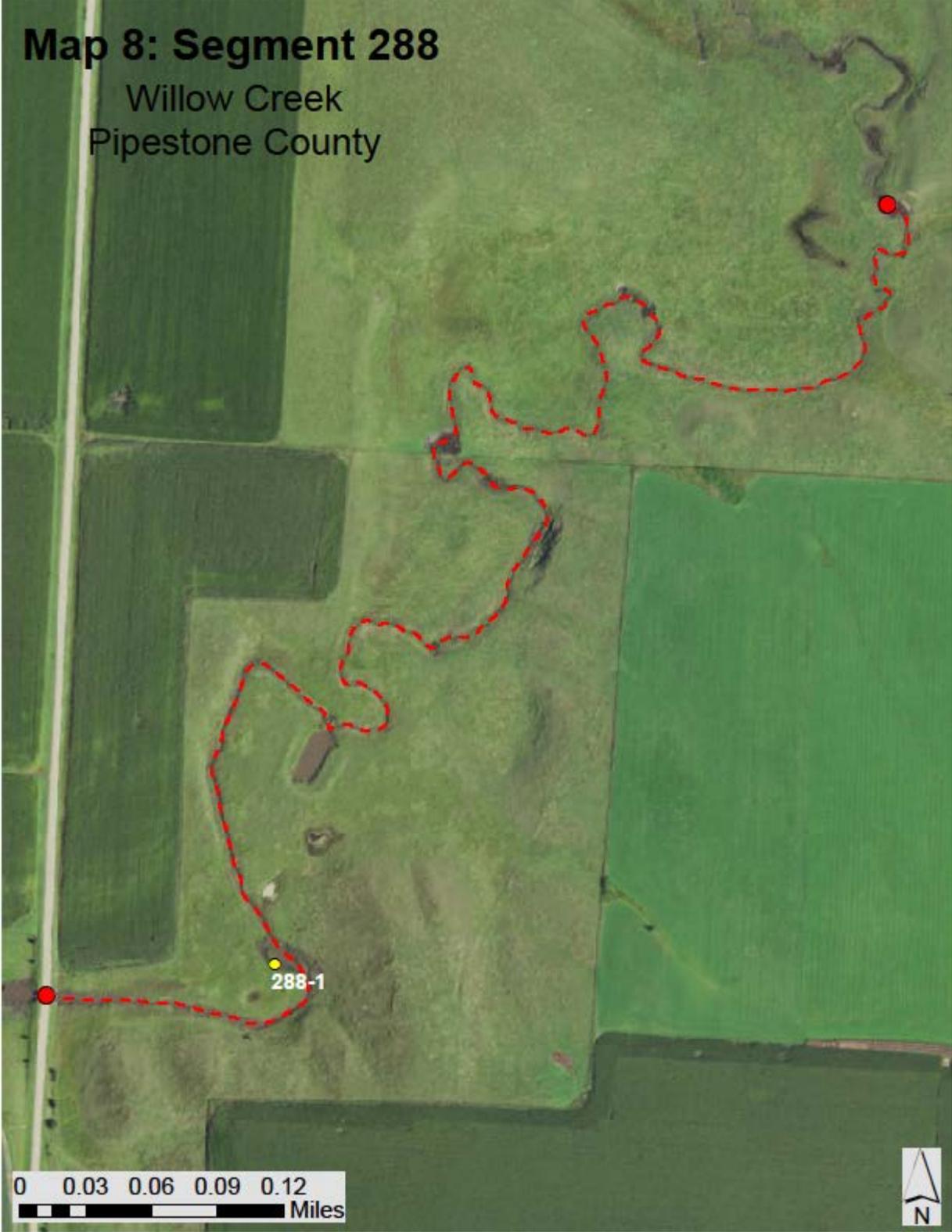
Map 7: Segment 287

Little Rock Creek
Nobles County



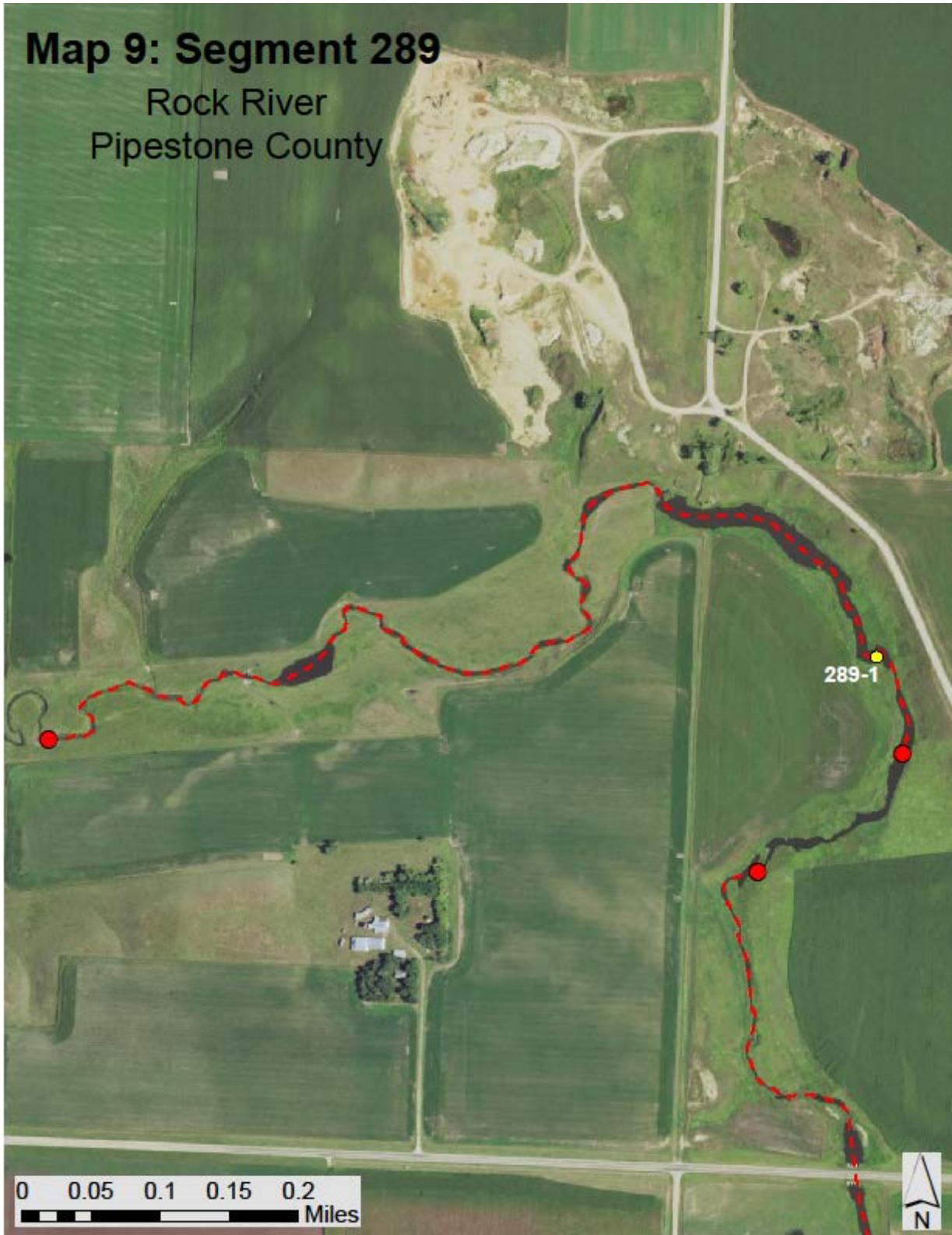
Map 8: Segment 288

Willow Creek
Pipestone County



Map 9: Segment 289

Rock River
Pipestone County



Map 10: Segment 290

Unnamed Tributary to
Beaver Creek
Pipestone County



Map 11: Segment 291



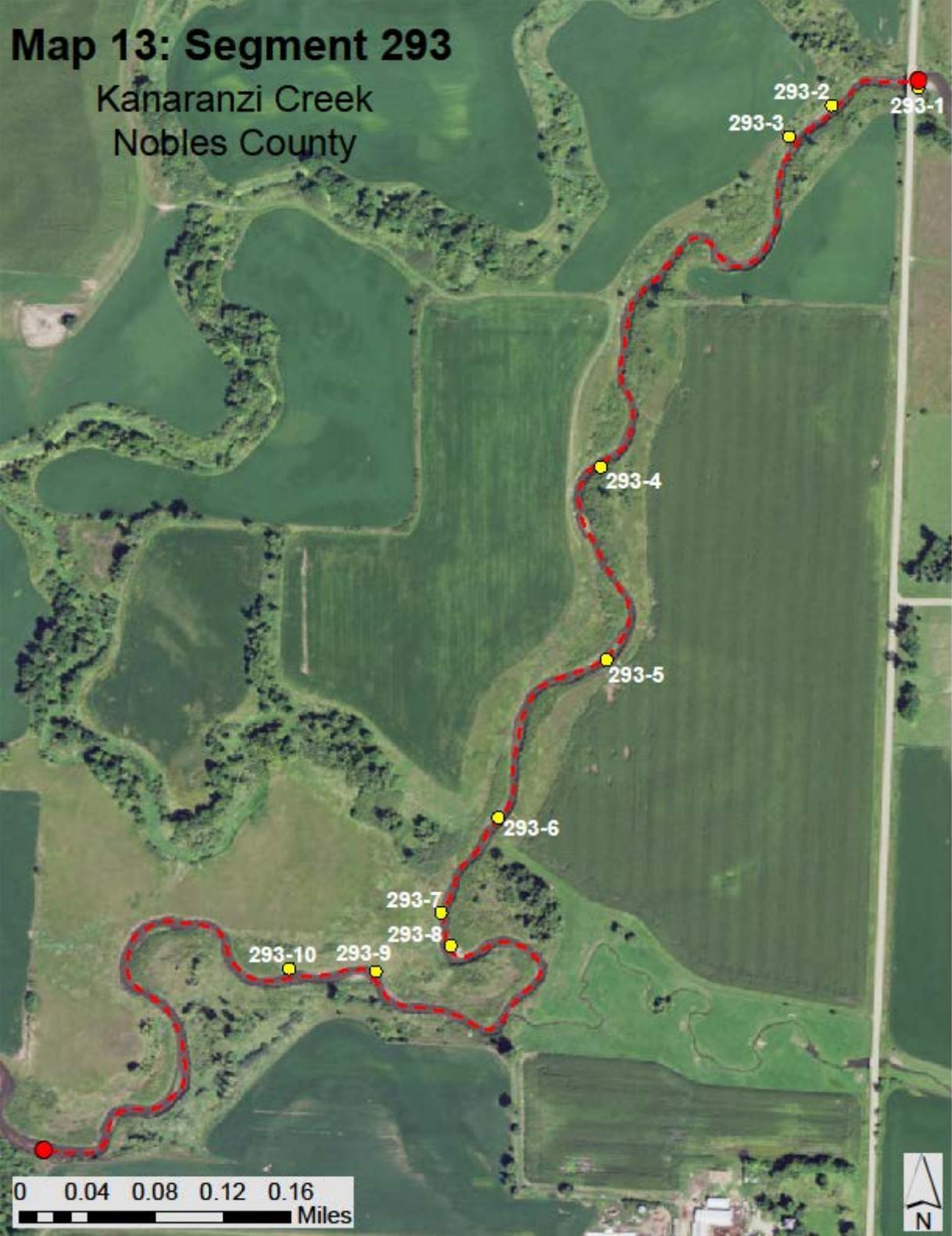
Map 12: Segment 292

Little Rock River
Nobles County



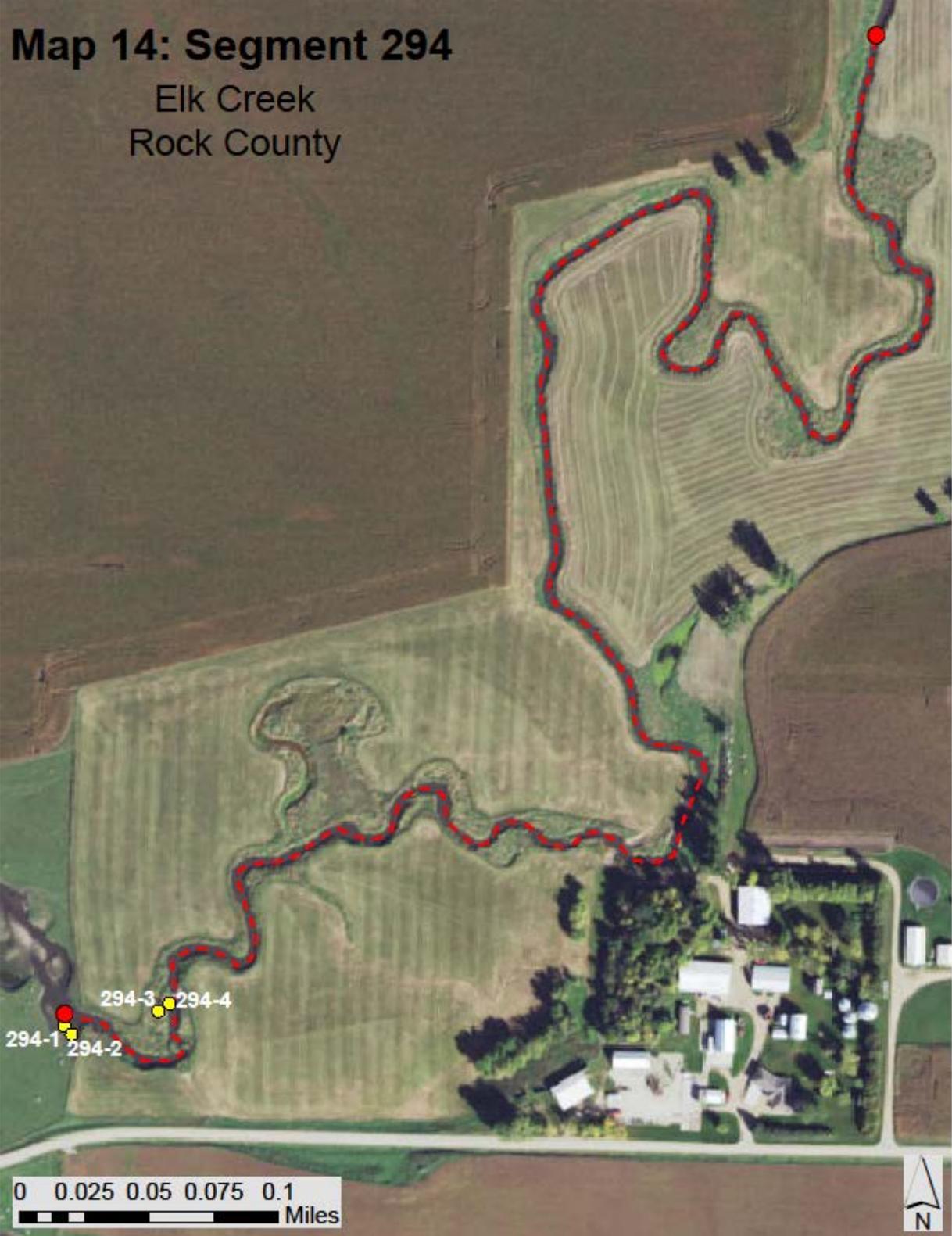
Map 13: Segment 293

Kanaranzi Creek
Nobles County



Map 14: Segment 294

Elk Creek
Rock County



Map 15: Segment 295

Beaver Creek
Rock County



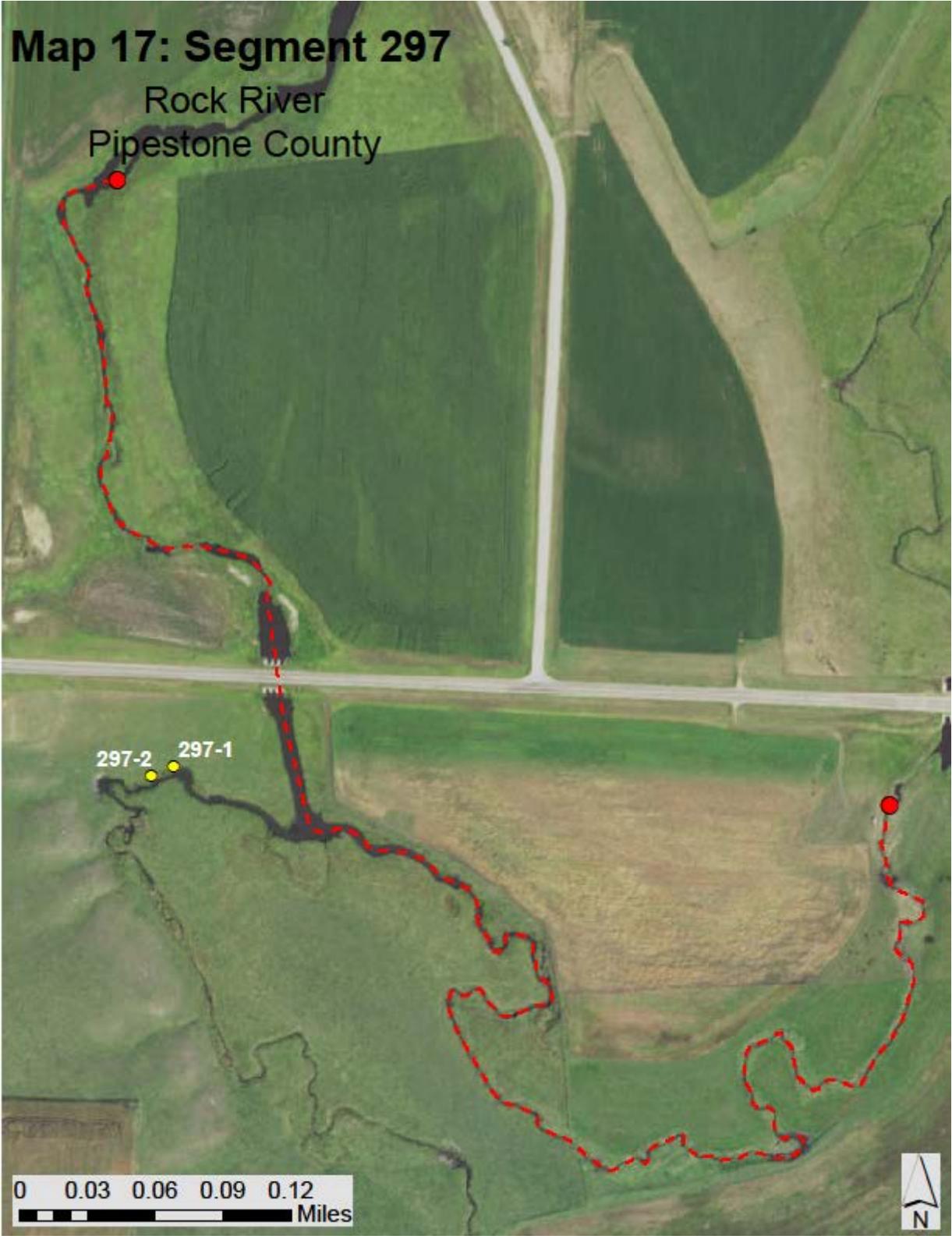
Map 16: Segment 296

Kanaranzi Creek
Rock County



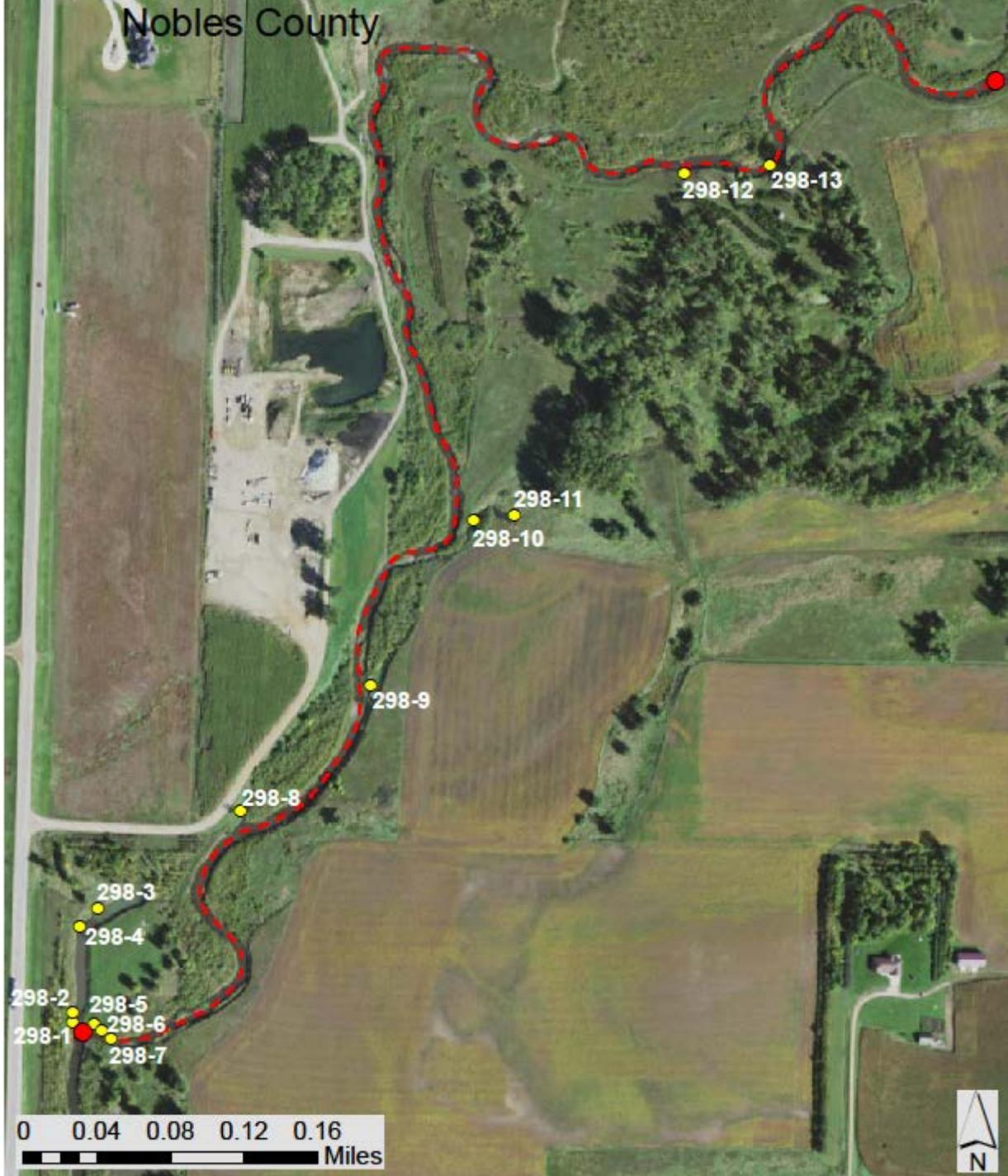
Map 17: Segment 297

Rock River
Pipestone County



Map 18: Segment 298

Kanaranzi Creek
Nobles County



Map 19: Segment 299

Elk Creek
Nobles County

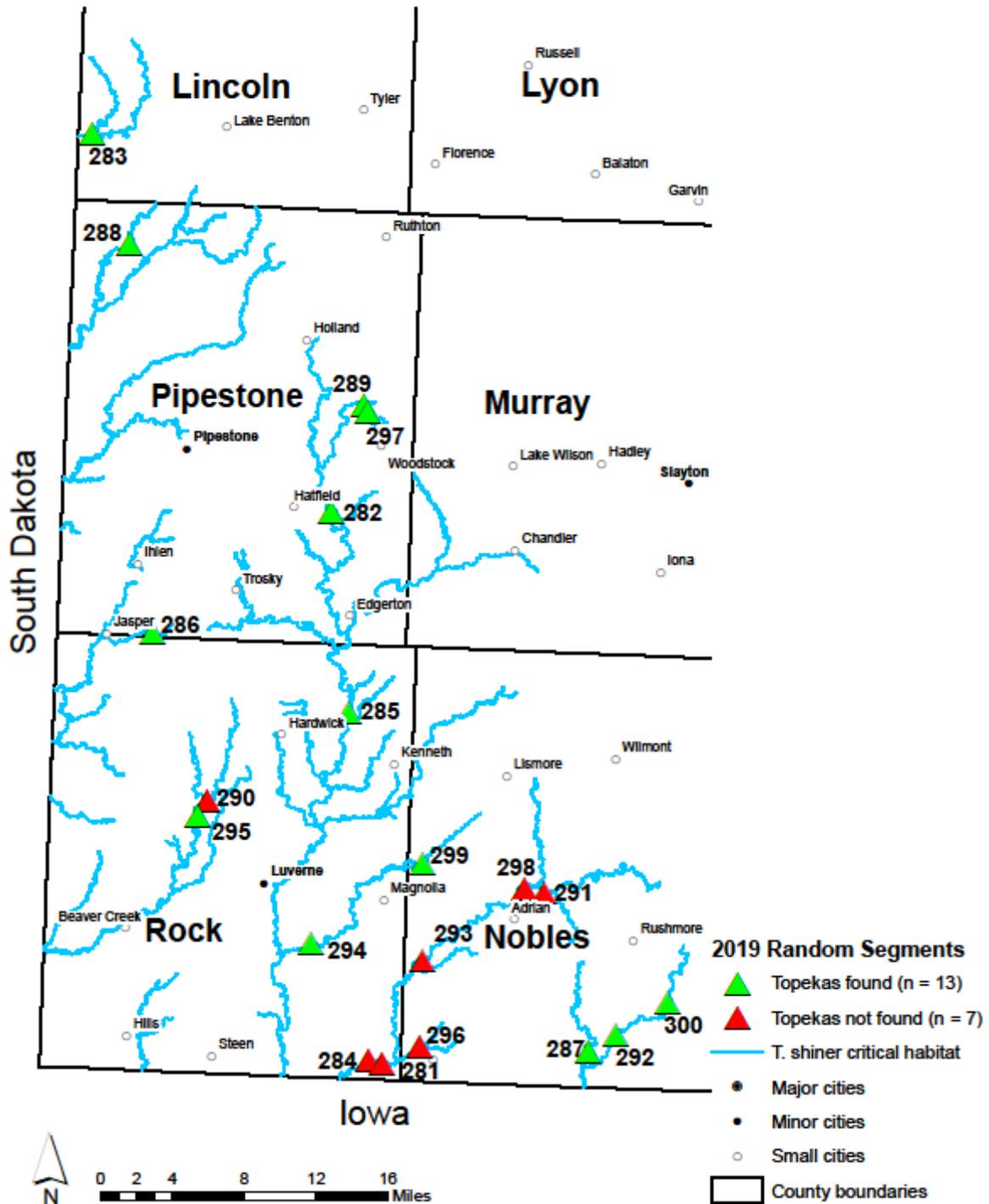


Map 20: Segment 300

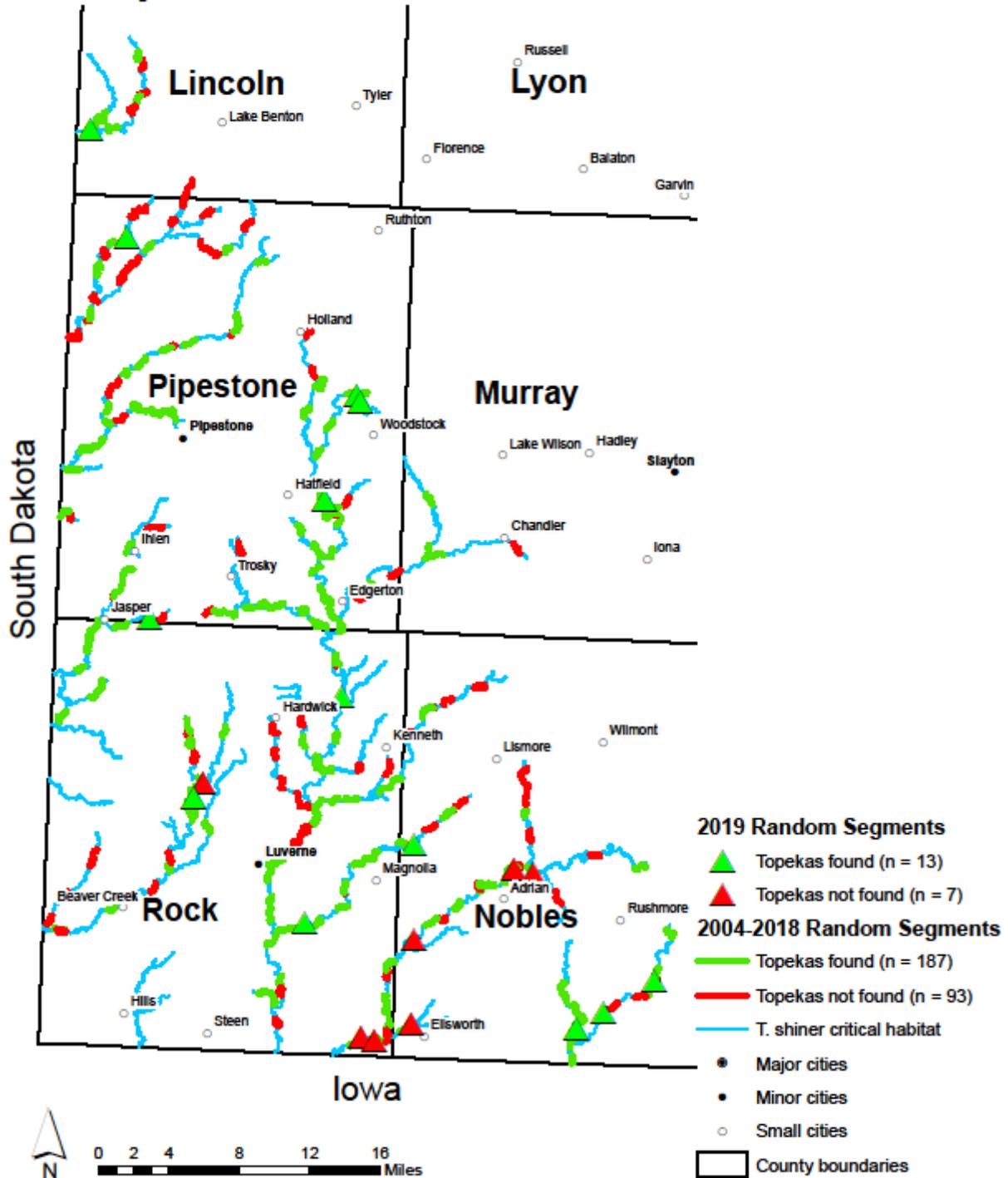
Little Rock River
Nobles County



Map 21: Overview of random segments 2019



Map 22: Overview of segments where Topeka shiners were found 2004-2019



APPENDIX B: Tables 1 & 2.

Table 1. 2019 Segments, sample sites, and Topeka shiner presence/absence.

Table 2. List of fish species collected at segments 281-300, 2019.

Table 1. 2019 Segments, sample sites, and Topeka Shiner presence/absence.

Segment	Stream	County	Township	Range	Section	Habitat Type	Site Number	Latitude	Longitude	Date	Comment
281	Norwegian Creek	Pipestone	101	43	30	main channel border	281-1	43.528611	-96.03361	2019-06-18	
						main channel border	281-2	43.528651	-96.033828		
						main channel border	281-3	43.528252	-96.036019		
						main channel	281-4	43.525859	-96.036837		
						main channel	281-5	43.525091	-96.037087		
						main channel border	281-6	43.524679	-96.03725		
						main channel	281-7	43.524148	-96.037563		
						main channel border	281-8	43.524105	-96.037822		
						main channel border	281-9	43.523807	-96.038725		
						main channel	281-10	43.523715	-96.039013		
						main channel border	281-11	43.523254	-96.040266		
						main channel border	281-12	43.523205	-96.040427		
						main channel	281-13	43.523152	-96.040584		

Small severely ditched and channelized stream. Mean stream width approximately 3-5m, mean depth 1m. Moderate to swift flows over small coarse gravel/sand substrate. Steep heavily eroded banks, areas with minimal erosion have graminoid spp. to the water's edge. No submergent macrophytes present. Little to no low-flow habitat present. *N topeka* not present.

Segment	Stream	County	Township	Range	Section	Habitat Type	Site Number	Latitude	Longitude	Date	Comment
282	Rock River	Pipestone	106	44	29	main channel border	282-1	43.960908	-96.156943	2019-06-13	TS location
<p><i>N. topeka</i> found in first seine haul in main channel boundary. Deep siltation over gravel substrate. Gradual gradient from bank to main channel. Mean stream width approximately 5-8m, depth <1.5m. No submergent aquatic macrophytes present. Banks severely eroded, graminoid spp. present right up to the water's edge. <i>N. topeka</i> present (n = 13, abundant).</p>											
283	Medary Creek	Lincoln	109	47	13	main channel border/pool	283-1	44.24775	-96.444337	2019-06-12	TS location
<p><i>N. topeka</i> found in first seine haul in main channel boundary/pool. Mean stream width approximately 4-5m, depth <1.5m. Moderate flows over small coarse gravel substrate in the main channel, deeply silt/muck in low-flow areas. Numerous low-flow habitat with emergent macrophytes present. <i>N. topeka</i> present (n = 3, present).</p>											
284	Kanaranzi Creek	Rock	101	44	24	main channel border	284-1	43.515049	-96.091771	2019-06-19	
						main channel border	284-2	43.515645	-96.091697		
						main channel border	284-3	43.51573	-96.091562		
						main channel border	284-4	43.516506	-96.089146		
						main channel border	284-5	43.514509	-96.093032		
						main channel border	284-6	43.513297	-96.092128		
						main channel border	284-7	43.512036	-96.094158		
						main channel border	284-8	43.511189	-96.094462		
						main channel	284-9	43.510719	-96.095686		
						main channel border	284-10	43.51233	-96.0922		

Large incised stream, mean stream width approximately 15-20m, mean depth approximately 1.5m with areas of water >2m. Water was turbid with moderate to swift flows. Substrate was sand over small coarse gravel. Heavily degraded and undercut banks. Little to no low-flow habitat available within the segment. No submergent macrophytes present. *N. topeka* not present.

Segment	Stream	County	Township	Range	Section	Habitat Type	Site Number	Latitude	Longitude	Date	Comment
285	Rock River	Rock	104	44	21	main channel border	285-1	43.789538	-96.124537	2019-06-13	TS location
<p><i>N. topeka</i> found in first seine haul in a large outside bend of the main channel border. Large incised stream, mean stream width approximately 10m, depths greater than 2m. Substrate was coarse gravel, with silt/muck over gravel near the banks. Heavily degraded banks with deep silt near margins. No submergent macrophytes present. <i>N. topeka</i> present (n = 5, common).</p>											

286	Unnamed Tributary to Split Rock Creek	Pipestone	105	46	34	main channel pool	286-1	43.85177	-96.347337	2019-06-13	
						main channel pool	286-2	43.851784	-96.347384		
						main channel border	286-3	43.852297	-96.348313		
						main channel border	286-4	43.852221	-96.348423		
						main channel border	286-5	43.852298	-96.34827		TS location

Small headwater stream, cold water, mean stream width approximately 3m, depth <1.5m. Submergent macrophytes present in the main channel. Substrate was small coarse gravel with silt/muck in low-flow areas. Four large low-flow and heavily silted areas present; heavily channelized. *N. topeka* found in the 5th seine haul in main channel boundary with minimal low-flow habitat present. *N. topeka* present (n = 9, present).

287	Little Rock Creek	Nobles	101	42	26	main channel boundary	287-1	43.52846	-95.846304	2019-06-18	TS location
<p><i>N. topeka</i> found in first seine haul in main channel boundary of impounded area (20x60m) downstream of the bridge. Impounded area <1m in depth, substrate was sand/silt over small coarse gravel. Heavily eroded banks. No submergent macrophytes present. Downstream of impounded area has a mean stream width approximately 5-8m with moderate to fast flows. Areas of low-flow habitat along main channel boundary present downstream of impounded area. <i>N. topeka</i> present (n = 21, abundant).</p>											

288	Willow Creek	Pipestone	108	46	17	off-channel pool	288-1	43.158146	-96.396097	2019-06-12	TS location
<p><i>N. topeka</i> found in first seine haul in side channel pool. Side channel pool had deep silt/muck and no submergent macrophytes present. Mean stream width approximately 3-4m in the main channel, depth <1.5m. Substrate in main channel is silt over small coarse gravel. Heavily channelized in areas. Good low-flow habitat throughout the segment. <i>N. topeka</i> present (n = 19, present).</p>											

Segment	Stream	County	Township	Range	Section	Habitat Type	Site Number	Latitude	Longitude	Date	Comment
289	Rock River	Pipestone	105	44	8	main channel pool	289-1	43.918937	-96.164548	2019-06-12	TS location
<p><i>N. topeka</i> found in first seine haul in main channel pool. A small horseshoe bend (<10m in length) with little to no flow; substrate was predominately silt. Mean stream width approximately 5-8m, mean depth <2m. Substrate in the main channel was small coarse gravel with large rocks scattered throughout. Main channel heavily channelized with steep sloping banks. Small hummocks with graminoid sp. present in the water in close proximity to the bank. <i>N. topeka</i> present (n = 11, abundant).</p>											
290	Unnamed Tributary to Beaver Creek	Pipestone	105	44	20,29	main channel border	290-1	43.719587	-96.279063	2019-06-13	
						side channel	290-2	43.719872	-96.278544		
						main channel border	290-3	43.721318	-96.278194		
						main channel border	290-4	43.721637	-96.278766		
						main channel border	290-5	43.721279	-96.279841		
						main channel border	290-6	43.721712	-96.28261		
						main channel border	290-7	43.721275	-96.279846		
						main channel border	290-8	43.722841	-96.283541		
						main channel border	290-9	43.723776	-96.2847		
						main channel border	290-10	43.724639	-96.284937		
						main channel border	290-11	43.723766	-96.287694		
<p>Moderate sized headwater stream, moderate to fast flows with stretches of slow deep pools. Mean stream width approximately 3-6m, average depth <2m. Substrate is coarse gravel, cobble, and large rocks. Substrate in margins are silt/muck over gravel. Filamentous algae present in low-flow areas. Minimal low-flow areas present. Uppers reaches of the segment fed by numerous springs. High fish abundance throughout the segment. <i>N. topeka</i> not present.</p>											

Segment	Stream	County	Township	Range	Section	Habitat Type	Site Number	Latitude	Longitude	Date	Comment
291	Kanmaranzi Creek, East Branch	Nobles	102	42	8	off-channel pool	291-1	43.65932	-95.904593	2019-06-19	
						off-channel pool	291-2	43.65931	-95.904608		
						off-channel pool	291-3	43.659336	-96.904858		
						off-channel pool	291-4	43.659351	-96.904937		
						main channel border	291-5	43.659176	-96.907603		
						main channel border	291-6	43.66023	-96.908066		
						off-channel pool	291-7	43.65913	-96.904288		
						main channel border	291-8	43.658056	-96.903481		
						main channel border	291-9	43.654912	-96.903469		
						main channel border	291-10	43.654239	-96.903093		

Moderate sized stream with moderate to fast flows. Mean stream width approximately 5-8m, average depth <1m. Substrate predominantly small coarse gravel/sand with silt present along the margins. Heavily eroded banks, especially in the stream bends. Minimal low-flow habitat present. Homemade wing dams present on the western portion of the segment; created low-flow habitat, but too deep to seine. Sampled two off-channel pools near the bridge crossing, warmer water temperature than the main channel, no submergent macrophytes present. *N. topeka* not present.

292	Little Rock River	Nobles	101	42	24	main channel pool	292-1	43.543134	-95.816504	2019-06-18	TS location
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N. topeka found in first seine haul in main channel pool just downstream of bridge. Impounded area had a mean stream width approximately 15m, and depths >2m. Substrate was sand/small coarse gravel with heavy siltation along the margins. Heavily eroded banks and actively grazed. No submergent aquatic macrophytes present. Main channel downstream of impoundment had a mean stream width approximately 5m, depth <1.5m. Approximately 5-7m in width, depth <3m, minimal flow, substrate was silt/sand. *N. topeka* present (n = 4, present).

293	Kanmaranzi Creek	Nobles	102	43	31	main channel border	293-1	43.597332	-96.033577	2019-06-19	
						main channel border	293-2	43.597156	-96.034586		

Segment	Stream	County	Township	Range	Section	Habitat Type	Site Number	Latitude	Longitude	Date	Comment
						main channel border	293-3	43.596876	-96.035073		
						main channel border	293-4	43.594005	-96.037144		
						main channel border	293-5	43.592366	-96.036994		
						main channel border	293-6	43.59099	-96.038198		
						main channel border	293-7	43.590163	-96.038832		
						main channel border	293-8	43.589884	-96.038698		
						main channel border	293-9	43.589642	-96.03957		
						main channel border	293-10	43.58964	-96.040591		

Medium to large heavily channelized stream with fast flows. Mean stream width approximately 10m, depth <2m. Substrate predominately sand with some small coarse gravel and heavily silted along the margins. No submergent aquatic macrophytes present. Banks severely eroded, areas of minimal erosion were lined with thick willow spp. Signs of recent flooding above the banks. Little to no low-flow habitat present. All sites samples were main channel boundary. *N. topeka* not present.

294	Elk Creek	Rock	102	44	30	main channel border/pool	294-1	43.60219	-96.163383	2019-06-14	
						main channel border	294-2	43.602141	-96.163323		
						main channel border	294-3	43.602334	-96.162579		
						main channel border	294-4	43.602291	-96.162661		TS location

Medium sized stream with moderate to fast flows. Banks are heavily eroded and deeply incised. Mean stream width approximately 5-8m, depth <2m. Substrate sand/small coarse gravel with deep silt along the margins. *N. topeka* caught in an off-channel pool (10x5m, depth >1.5m) which is connected at slightly higher flows. Off-channel pool is located near a large pile of concrete dumped to create a dam for trapping purposes, it is now causing bank erosion. Downstream of segment is heavily degraded due to overgrazing. *N. topeka* present (n = 3, present).

Segment	Stream	County	Township	Range	Section	Habitat Type	Site Number	Latitude	Longitude	Date	Comment
295	Beaver Creek	Rock	103	45,46	19,24,25	main channel pool	295-1	43.704379	-96.293872	2019-06-13	TS location
<p><i>N. topeka</i> found in first seine haul in main channel pool just upstream of bridge. Large pooled are both upstream and downstream of bridge (mean stream width approximately 20m, depths >2m). Substrate was silt/muck over coarse gravel with large rocks present throughout the pool. Heavily degraded banks, graminoid spp. hummocks sloughing into the stream. Mean stream width upstream of pool was approximately 5-6m and <1.5m in depth. <i>N. topeka</i> present (n= 42, abundant).</p>											

296	Kanaranzi Creek	Rock	101	44	26,35	main channel border	296-1	43.514487	-96.084758	2019-06-19	
						main channel border	296-2	43.513193	-96.083536		
						main channel border	296-3	43.514341	-96.082625		
						main channel border	296-4	43.513732	-96.080444		
						main channel border	296-5	43.513884	-96.080259		
						main channel border	296-6	43.513315	-96.079858		
						main channel border	296-7	43.513394	-96.078526		
						main channel border	296-8	43.514061	-96.078851		
						main channel border	296-9	43.51475	-96.080198		
						main channel border	296-10	43.515454	-96.078571		
						main channel border	296-11	43.515454	-96.078114		

Large incised stream with strong flows. Mean stream width approximately 10-15m, average depth 1m but areas of depth >2m. Substrate was sand over coarse gravel, with deep silt along margins. Heavily eroded and undercut banks. Little to no low-flow habitat available. No submergent aquatic macrophytes present. The entire segment is actively grazed. All sites samples were main channel boundary. *N. topeka* not present.

Segment	Stream	County	Township	Range	Section	Habitat Type	Site Number	Latitude	Longitude	Date	Comment
297	Rock River	Pipestone	107	44	27,34	side channel	297-1	43.756983	-96.168301	2019-06-12	
						side channel	297-2	43.501563	-95.849763		
<p>Large pooled area upstream and downstream of bridge, too deep to cross and sample. <i>N. topeka</i> found in side channel with moderate flows. Mean stream width of side channel approximately 2-3m, average depth 1m. Substrate was a mix of silt/muck over small coarse gravel. No submergent macrophytes present. Surveyed the margins between graminoid spp. hummocks. Heavily degraded banks. <i>N. topeka</i> present (n = 3, present).</p>											
298	Kanaranzi Creek	Nobles	102	42	7	off-channel pool	298-1	43.650943	-95.93254	2019-06-14	
						off-channel pool	298-2	43.541016	-95.932546		
						off-channel pool	298-3	43.651838	-95.932313		
						off-channel pool	298-4	43.651698	-95.9325		
						main channel border	298-5	43.650931	-95.932311		
						main channel border	298-6	43.650826	-95.932115		
						main channel border	298-7	43.650878	-95.932223		
						main channel border	298-8	43.652641	-95.930806		
						main channel border	298-9	43.653665	-95.929446		
						off-channel pool	298-10	43.654978	-95.928386		
						off-channel pool	298-11	43.655036	-95.927953		
						main channel border	298-12	43.657761	-95.926239		

Segment	Stream	County	Township	Range	Section	Habitat Type	Site Number	Latitude	Longitude	Date	Comment
						main channel border	298-13	43.657847	-95.925316		
<p>Large stream with fast flows. Mean stream width approximately 5-8m, up to 10m in spots, average depth <1.5m. Predominantly riffles, runs and glides with little low-flow habitat available. Substrate was sand/small coarse gravel. One large off-channel pool (12x100m, average depth <2m, silt/muck substrate) with abundant submergent macrophytes present. One <i>F. sciaticus</i> found in small spring fed off-channel pool (5x10m, average depth <1m). <i>N. topeka</i> not present.</p>											
299	Elk Creek	Nobles	103	43	31	main channel border	299-1	43.675194	-96.048298	2019-06-14	
						main channel border	299-2	43.675059	-96.049485		
						main channel border	299-3	43.676767	-96.049928		
						main channel border	299-4	43.677286	-96.050814		
						main channel border	299-5	43.677334	-96.05091		
						main channel border	299-6	43.675778	-96.046259		
						main channel pool	299-7	43.674682	-96.045496		
						side channel	299-8	43.674622	-96.043561		TS location
<p>Small headwater stream with moderate flows. Mean stream width approximately 1-2m, average depth <1m. Substrate was sand/small coarse gravel. Channelized in many areas, heavily degraded banks especially in the stream bends. <i>N. topeka</i> found in small side channel (1x10m, depth<1m) off a large main channel pool. Side channel was heavily silted with algae and submergent aquatic macrophytes present. <i>N. topeka</i> present (n = 3, present).</p>											
300	Little Rock River	Nobles	101	41	9	off-channel pool	300-1	43.565965	-95.75856	2019-06-18	
						off-channel pool	300-2	43.566041	-95.758378		TS location

Surveyed an off-channel oxbow (15x3m, depth <1m). Substrate was deep silt/muck. Oxbow was mostly stagnant, not connected on the upstream end but would be with slightly higher flows. Downstream end of the oxbow was flowing, but 2 drain tile pipes feed in just above the outflow. Oxbow was full of filamentous algae, but had no submergent aquatic macrophytes present. *N. topeka* found in second seine haul amongst numerous *P. promelas*, *C. commersonii*, and *S. atromaculatus*. Main channel mean width was approximately 4m, average depth <1m. Substrate was small coarse gravel/sand. Heavily degraded banks. Moderate to swift flows. *N. topeka* present (n = 1, present).

Table 2. List of fish species collected at segments 281-300, 2019.

Species	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	
<i>Ameiurus melas</i>	X					X					X					X					
<i>Campostoma anomalum</i>		X	X	X			X	X			X		X	X		X		X	X	X	
<i>Carpiodes cyprinusarpio</i>																X					
<i>Catostomus commersonii</i>	X	X	X	X			X				X		X	X	X		X	X	X	X	
<i>Chrosomus erythrogaster</i>											X										
<i>Culaea inconstans</i>	X	X	X	X		X		X		X			X	X		X		X		X	
<i>Cyprinella lutrensis</i>				X			X								X						
<i>Cyprinus carpio</i>															X						
<i>Esox lucius</i>						X															
<i>Etheostoma exile</i>	X		X	X																X	X
<i>Etheostoma nigrum</i>	X	X		X		X	X	X	X	X	X		X	X	X	X	X			X	
<i>Fundulus sciadicus</i>		X							X										X		
<i>Hybognathus hankinsoni</i>			X	X											X	X		X			
<i>Lepomis cyanellus</i>		X	X			X		X	X		X			X				X		X	
<i>Lepomis humilis</i>					X				X					X	X		X	X		X	
<i>Luxilus cornutus</i>	X		X	X	X		X			X	X	X	X	X	X	X	X			X	
<i>Micropterus dolomieu</i>												X									
<i>Notropis dorsalis</i>	X	X	X	X	X		X	X		X	X		X	X	X	X	X	X	X		
<i>Notropis stramineus</i>	X	X	X	X	X		X	X		X	X	X	X	X	X	X		X	X	X	
<i>Notropis topeka*</i>		X	X		X	X	X	X	X			X		X	X		X		X	X	
<i>Noturus gyrinus</i>			X			X															
<i>Percina maculata</i>							X			X				X			X				
<i>Pimephales notatus</i>	X	X	X	X	X	X	X	X			X		X	X		X	X	X			
<i>Pimephales promelas</i>	X		X		X	X	X	X		X	X		X	X	X	X	X	X	X	X	
<i>Rhinichthys obtusus</i>	X		X	X	X						X		X			X		X	X		
<i>Semotilus atromaculatus</i>	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X			X	X

APPENDIX C: Habitat and Voucher Photographs

Habitat photographs for segments in which no Topeka shiners were captured are representative of the habitat along the one-mile reach of stream. Habitat photographs from segments where Topeka shiners were present represent the specific site where they were collected. Voucher photographs are presented for each of the sites where Topeka shiners were collected.

Site 281, Norwegian Creek: no Topeka Shiners captured.



Site 282-1, Rock River: habitat photo.



Site 282-1, Rock River: voucher photo.



Site 283-1, Medary Creek: habitat photo.



Site 283-1, Medary Creek: voucher photo.



Site 284, Kanaranzi Creek: no Topeka Shiners captured.



Site 285-1, Rock River: habitat photo.



Site 285-1, Rock River: voucher photo.



Site 286-5, Unnamed Tributary to Split Rock Creek: habitat photo.



Site 286-5, Unnamed Tributary to Split Rock Creek: voucher photo.



Site 287-1, Little Rock Creek: habitat photo.



Site 287-1, Little Rock Creek: voucher photo.



Site 288-1, Willow Creek: habitat photo.



Site 288-1, Willow Creek: voucher photo.



Site 289-1, Rock River: habitat photo.



Site 289-1, Rock River: voucher photo.



Site 290, Rock River: no Topeka Shiners captured.



Site 291, Kanaranzi Creek: no Topeka Shiners captured.



Site 292-1, Little Rock River: habitat photo.



Site 292-1, Little Rock River: voucher photo.



Site 293, Kanaranzi Creek: no Topeka Shiners captured.



Site 294-4, Elk Creek: habitat photo.



Site 294-4, Elk Creek: voucher photo.



Site 295-1, Beaver Creek: habitat photo.



Site 295-1, Beaver Creek: voucher photo.



Site 296, Kanaranzi Creek: no Topeka Shiners captured.



Site 297-2, Rock River: habitat photo.



Site 297-2, Rock River: voucher photo.



Site 298, Kanaranzi Creek: no Topeka Shiners captured.



Site 299-8, Elk Creek: habitat photo.



Site 299-8, Elk Creek: voucher photo.



Site 300-2, Little Rock River: habitat photo.



Site 300-2, Little Rock River: voucher photo.

