FINAL REPORT

KICKAPOO CREEK RESTORATION PROJECT - PHASE 1

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Illinois Department of Natural Resources
FY 2006 to 2007 State Wildlife Grant Program
State of Illinois
Grant No. T-46-D-1

FY 2006 to 2007 State Wildlife Grant (SWG) Program
State of Illinois
Final Report (06/06/07 to 12/31/08)

GRANT NO.: T-46-D-1

GRANT TITLE: Kickapoo Creek Restoration Project - Phase 1

INTRODUCTION: The Bloomington-Normal area in McLean County in Central Illinois is experiencing rapid development rates. The majority of this development is occurring eastward. As Kickapoo Creek flows north-to-south along the eastern boundaries of this urban center, a large portion of this stream basin will imminently be developed in the near future. This is a serious situation as Kickapoo Creek is a listed "Biologically Significant Stream" with most segments attaining "Highly Valued Aquatic Resource" status. Kickapoo Creek is the gem of the Sangamon River Basin with regards to biological diversity with a current count of 51 fish species and 23 mussel species. Included in the aquatic assemblage of Kickapoo Creek are at least four mussel species in greatest need of conservation (slippershell-ST, creek heelsplitter, pondhorn, and rainbow-SE) and three fish species in greatest need of conservation (American brook lamprey, largescale stoneroller, and highfin carpsucker). Several sportfish are also found in Kickapoo Creek, including smallmouth bass, largemouth bass, channel catfish, flathead catfish, bluegill, and several other sunfish species.

In this first wave of urbanization, a group of six developers came together to build the largest subdivision in Bloomington-Normal history. Their plans call for 1,000 homes and a public school to be built on the banks of Kickapoo Creek. After reconsidering their original idea to dam the stream to impound 67 acres of water to form a shallow lake, they initiated the plan and partnerships to create one of the largest stream restoration projects in the state of Illinois to be the focal point of this development. The stream restoration project site is situated at the headwaters of the Kickapoo Creek basin and will provide biological protection and benefits near its source. Additionally, the project presented itself as a great opportunity to establish a working relationship with the city and developers. As expansion continues, this relationship can ensure that development is conducted in an ecologically sound manner to the extent possible.

Large scale stream restoration is a costly venture, and this project is being funded with federal grant money matched by the developers and the City of Bloomington. In addition to this State Wildlife Grant from the U.S. Fish and Wildlife Service (USFWS), federal funding for this project was also obtained from the USFWS National Fish Habitat Restoration Fund and the U.S. Environmental Protection Agency’s (USEPA) Section 319 Grant. When complete, an 88-acre park with a meandering stream and functioning floodplain corridor with wetlands, prairie, savanna, and forest components will be donated to the City of Bloomington to be maintained by their Parks & Recreation Department.

The pre-restoration conditions at the site were two channelized drainage ditches converging amidst agriculture land. An 88-acre park around these straight channels would have some inherent value. However, biological benefits and true environmental improvements would not be realized without the restoration work.

A monitoring and evaluation component has also been implemented in conjunction with this restoration project. Prior to construction activities, multiple years of fish population data were collected from the site in order to gage post-restoration data for comparison. Multiple sampling events were conducted and are planned during all stages of the work in addition to several years following completion of the project. The project was awarded a National NPS Monitoring Grant by the USEPA, which will allow the continuation of the monitoring activities initiated under this State Wildlife Grant.

This SWG was originally submitted as a three-year proposal for funding. The project was unsuccessful in obtaining SWG funding past this first year. The project will, however, continue as planned thanks to the funding provided by the USEPA.

SITE LOCATION: The restoration site is located on Kickapoo Creek of the Sangamon River Basin in McLean County in Central Illinois. The site lies approximately two miles east of Bloomington on Ireland Grove Road (1200 N). T23N R3E Sec. 9. Site maps are below.

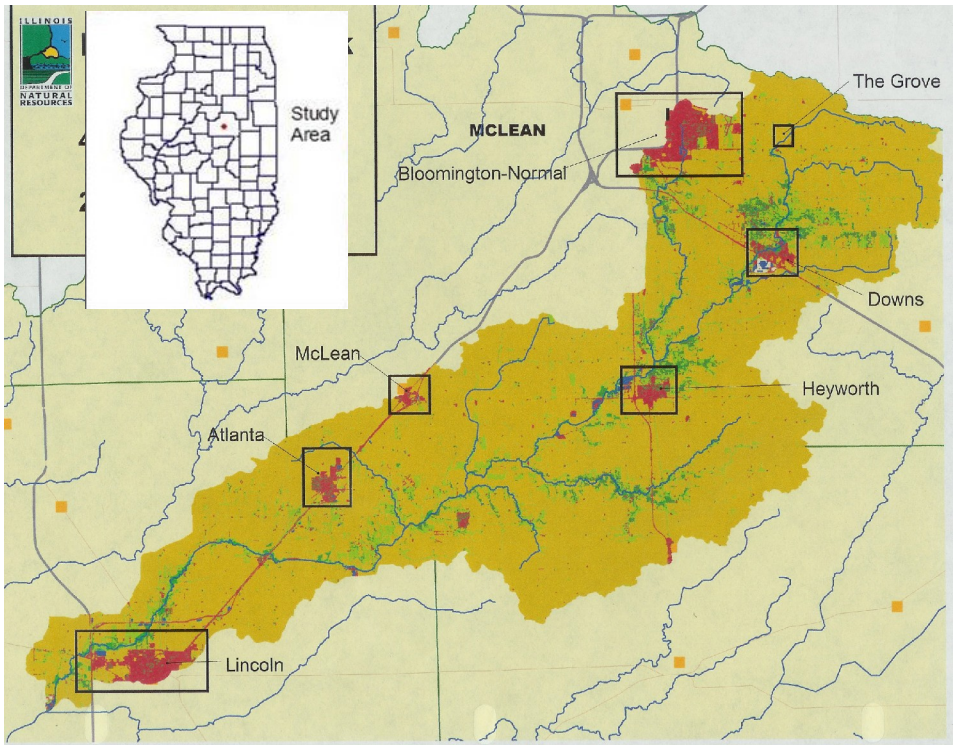


Figure 1. Location of the stream restoration site within the state of Illinois (inset) and within the Kickapoo Creek watershed (labeled as “The Grove” near the upper right hand corner).

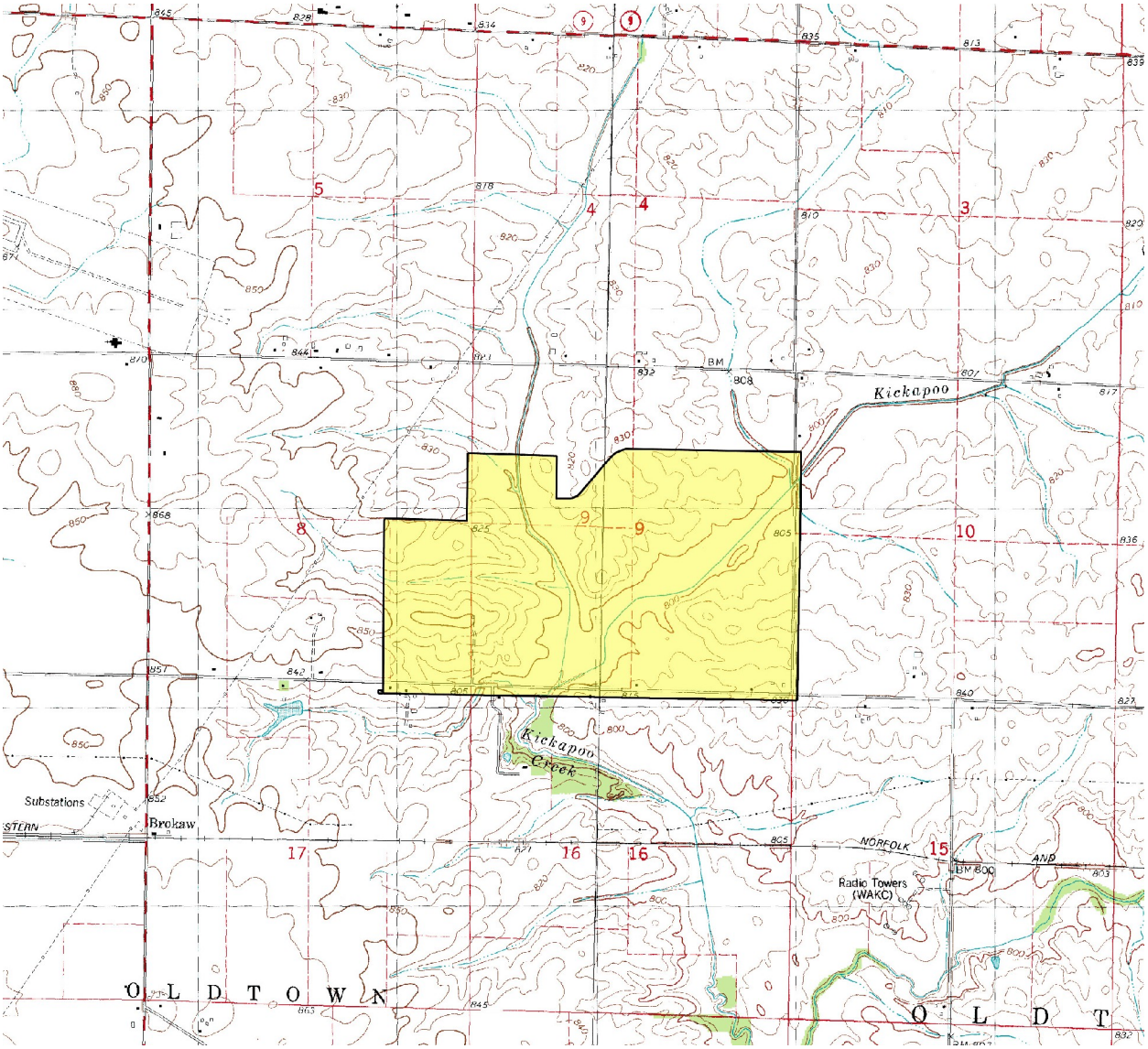


Figure 2. Topographic map showing Kickapoo Creek restoration project site in McLean County, Illinois. Yellow highlight identifies the site boundaries.

OBJECTIVES:

1. Coordinate efforts to ensure species in greatest need of conservation are given importance in the broader project. These efforts include consultation, correspondence, project oversight, meetings, and site visits (all four segments).

2. Re-meander and implement in-stream habitat at the Kickapoo Creek restoration project (approximately two miles of stream channel) (all four segments).

3. Construct wetlands within the 100-year floodplain (approximately twelve to twenty acres) (segments two, three, and four).

4. Monitor the fish population for pre-restoration to post-restoration evaluation and documentation of the project. Conduct a minimum of four fish population surveys per year for the duration of the project (all four segments).

JOB 1. Project coordination efforts

Project coordination efforts were conducted throughout the grant cycle, and actually began several years prior to the effective date of this grant and will continue for several years after this grant cycle. Coordination efforts within this grant cycle were abundant, with Trent Thomas (IDNR Streams Biologist) attending twenty-three meetings, both formal and onsite. 72 correspondences were logged for miscellaneous purposes throughout the grant cycle. Six data requests were completed and provided in support of the project. 34 site visits were conducted. Most of these visits were conducted on a daily basis during the time of the actual channel construction work. Upon completion of this grant cycle, the Personal Service budget of $5,000 had been greatly surpassed resulting in a $17,617.43 overmatch.

JOB 2. Re-meander and implement in-stream habitat at the Kickapoo Creek restoration project

Initiation of the implementation phase of the project fell well behind schedule. Delays resulted from coordination efforts among stakeholders and engineering plan approval by The City of Bloomington which was later resolved. A Grant Extension was applied for and approved April 17, 2008. This amendment moved the end date of the grant to December 31, 2008 to accommodate implementation work which was initiated during the month of August 2008.

Pre-restoration conditions at the site consisted of two channelized agricultural ditches with their confluence near the downstream limit of the project site. The existing stream channels were highly incised and overrun with reed canary grass. Aquatic habitat was featureless run habitat with little to no riffle or pool formation.

Figure 3. Pre-restoration conditions at the project site, showing channelized ditches and abundant reed canary grass.

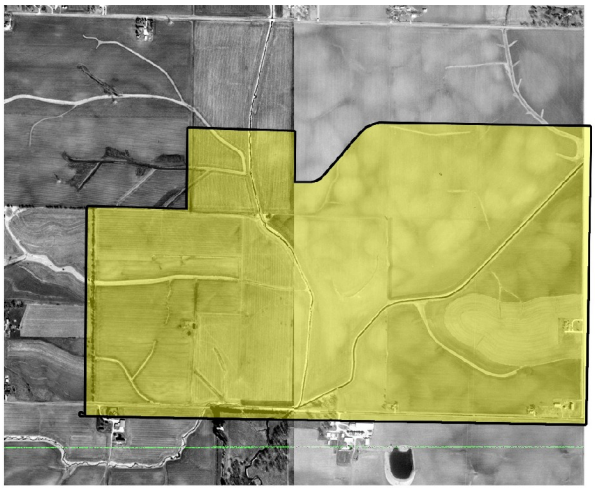


Figure 4. Aerial photograph showing the pre-restoration conditions at the site.

Landscape grading to lower the adjacent floodplain and form riparian wetlands was the first restoration work to begin. This was initiated in August of 2008. The next steps to follow included excavation of the re-meandered stream channels and placement of in-stream habitat.

Stream restoration work was conducted under the design and supervision of Don Roseboom and Dr. Chester Watson under a contract with Colorado State University. Following a sediment transport study for the project area, these two stream restoration experts worked closely with the local Farnsworth Group personnel to design and engineer the channel width, height, and meander curves for optimal movement of sediment and in-stream habitat development.

Figure 5. An example of suspended sediment samples collected for the Sediment Transport Study.

Figure 6. Collecting streambed material for the Sediment Transport Study.

Appendix A Stream Assessment of Upper Kickapoo Creek

INTRODUCTION

Stream assessments determine sites and causes of geotechnical channel instability, areas of sediment deposition, and watershed sources of greatest potential erosion.

1. Bank erosion at each meander in the ditch since an unstable moraine gravel and sand layer exists at the base level elevation of the streambed. As a source of sediment, channel erosion is only limited by the small number of meanders in the channelized ditch. Tension cracks are present in the floodplain above eroding meanders. Field waterways are not eroding.

2. Gravel and sand bars with limited amounts of soil are found over 80 percent of the channel length in the East Branch. The streambed and banks are heavily colonized with Reed Canary grass.

3. Silt and clay particles were the major portion of the suspended sediment load, which was localized in watershed areas of high runoff. Where either agriculture or construction exposed bare soils, those high runoff areas would be major sources of suspended sediments to Kickapoo Creek.

Figure 7. An excerpt from the Sediment Transport Study conducted by Colorado State.

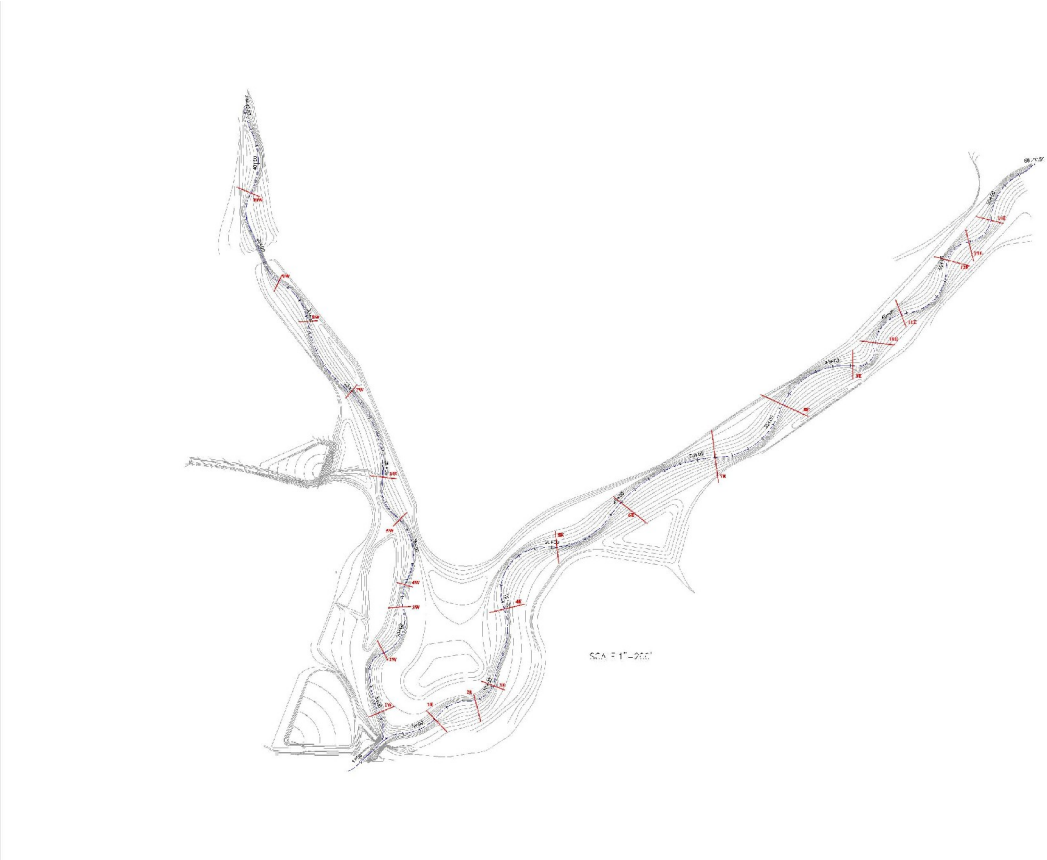


Figure 8. The resulting project schematics showing gradual stream channel meanders and position of Newbury weirs (constructed riffles) in red.

In the first phase of the restoration project, approximately 3000 linear feet of stream channel was reconstructed with meanders as designed above. Seven Newbury weirs, or constructed riffles, were placed within this reach. The Newbury weirs were designed to provide riffle habitat and create a scour for pool habitat off their downstream ends. The inside stream banks were built with gradual slopes to allow for the establishment of aquatic vegetation for further habitat benefits.

Much of the new channel construction was done “in-the-dry” to reduce massive sediment loading to the downstream reaches of Kickapoo Creek. This also allowed for fish salvage as portions of the existing channel were isolated and de-watered prior to redirecting stream flow to the newly constructed channel.

The following figures document the steps of the reconstructed channels and Newbury weir placement:

Figure 9. The new channel was constructed "in-the-dry" adjacent to the existing channel (seen in the upper left hand corner of this photo. Water within the excavation is groundwater seepage, which is a contributing factor to the high quality of this stream system.

Figure 10. Fabric was laid in the base of the excavated new channel and covered with a sand and gravel mix.

Figure 11. Outside bends were heavily armored with rip rap to maintain the path and form of the new channel.

Figure 12. Peak stones were placed to secure the placement and integrity of the Newbury weirs.

Figure 13. The peak stones set the height of the Newbury weirs. This was checked carefully with GPS equipment, as riffle height is critical to the function of the weir.

Figure 14. This photograph shows a view of the newly constructed stream channel prior to diversion of water. The armored banks can be seen in the background with one of the Newbury weirs in the foreground. The Newbury weirs were topped with a CA6 sand and gravel mix to seal the rock crevices and provide a more natural substrate type for ecological benefits.

Figure 15. This view shows the newly constructed channel immediately following introduction of stream flow. The rip rap placed in the outside bends has been covered with soil to allow the establishment of vegetation. The water is in its initial stages of carving its path through the CA6 mix over Newbury weir.

Figure 16. This view is a close-up of one of the Newbury weirs, showing how the CA6 mix allows the weir to closely mimic a natural riffle just days after construction.

Figure 17. This is an overview of the completed construction work on the west branch of Phase 1**.** One of the constructed wetlands is also visible in the background to the left of the stream.

Figure 18. The project area was seeded under the direction of Bryan Cross of Kaskaskia Engineering, and the stream banks were blanketed for protection against erosion.

JOB 3. Construct wetlands within the 100-year floodplain

The first restoration activities at the project site included lowering the floodplain and shaping the constructed wetland basins of Phase 1. Pre-restoration conditions at the site consisted of incised and straightened drainage ditches with a disconnected floodplain that was planted in agricultural row crops and no longer functioned naturally.

Figure 19. Lowering the floodplain to re-establish a natural flood regime and create wetland habitat within the Phase 1 reach of the restoration project.

By lowering the floodplain, a natural flood regime was returned to this reach of Kickapoo Creek. This has resulted in an increase in flood water storage capacity and a decrease in peak discharge levels during flood events, as shown in the before-and-after hydrologic graphs provided by the U.S. Geological Service (USGS) below.

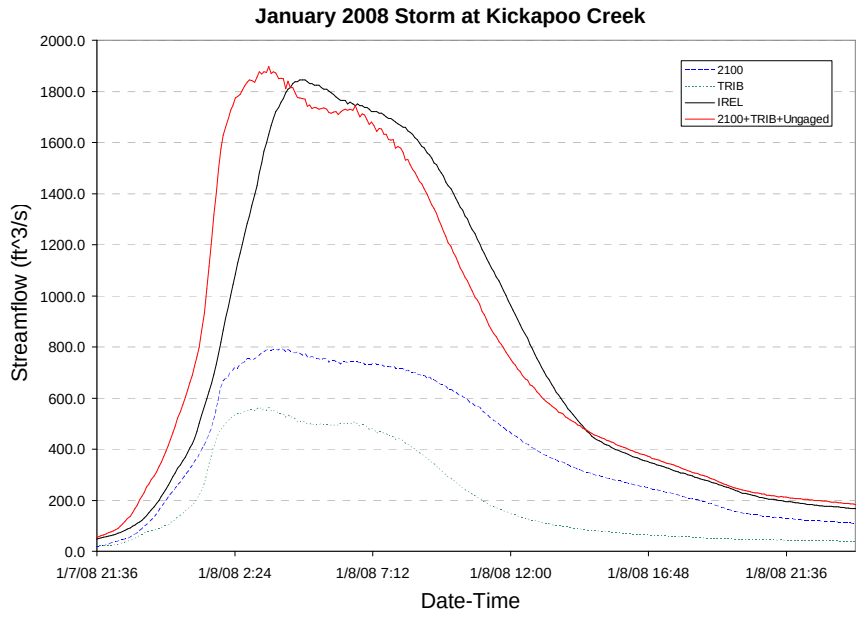


Figure 20. This graph shows a storm event prior to lowering the floodplain at the restoration site. The red line indicates inflow into the project reach obtained from upstream gages, and the black line indicates outflow from the project reach at the downstream gage on Ireland Grove Road bridge. Note the similarity between the two curves.

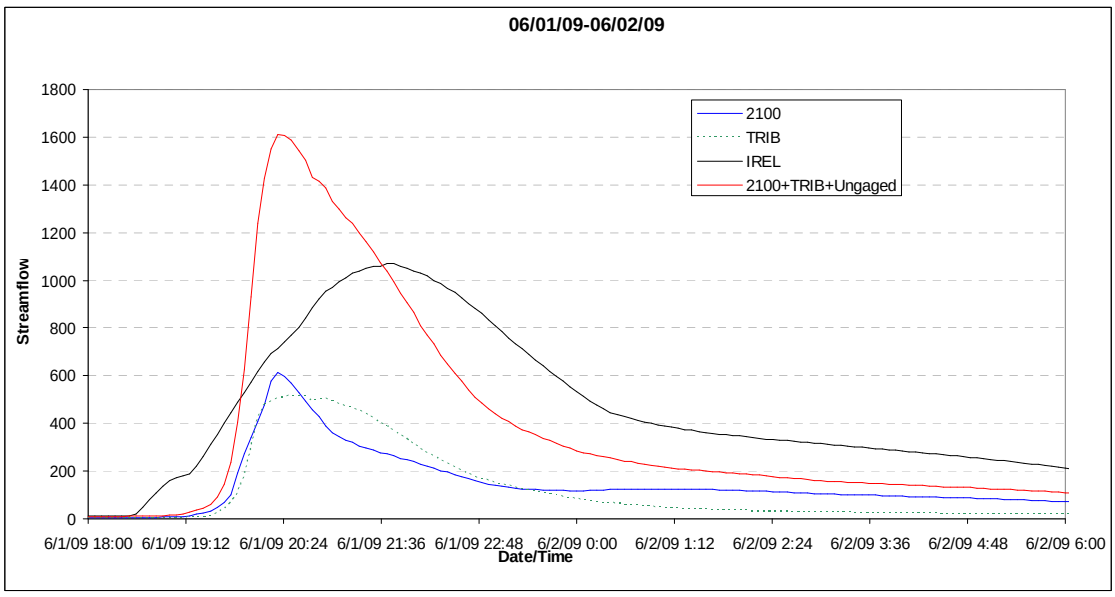


Figure 21. This graph shows a storm event following the excavation of the floodplain. Note the differences between the inflow (red line) and outflow (black line) curves. The restoration work has significantly lowered the peak discharge and extended the release of flood waters.

Wetland habitat has also been provided within Phase 1 of the project. A 2.1-acre wetland was constructed along the west side of the west branch of the project reach. This wetland is fed by runoff from the housing development and periodic overflow from the stream. A 1.3-acre central wetland was also constructed between the two branches of the stream. This wetland has connections to a groundwater source that will maintain wet soil and minimal water levels. A retention basin in the southwest corner of the restoration area will also provide some wetland area, but this will be variable and the extent is yet to be determined. The inside bends of the re-meandered stream channel were constructed with very gradual slopes (about 10 to 1), which will also provide significant wetland area as they become established over time with a number of wetland plant species. The wetland areas were seeded with over 30 species of wetland plants under the direction of Bryan Cross of Kaskaskia Engineering, and live plantings of these areas have also continued past the cycle of this grant. Establishment of wetland habitat will significantly increase biological diversity among the communities of vegetation, insects, and animals that occupy the Kickapoo Creek ecological area.

Figure 22. The 2.1-acre west wetland prior to vegetation growth.

Figure 23. The 1.3-acre central wetland following minimal growth of vegetation. Note the wet areas that will remain relatively permanent due to groundwater seepage.

The wetland areas are designed to intercept run-off waters from the housing development prior to its introduction to the stream system. This will help reduce the flashy effect typically observed in urban settings. The wetlands are also intended to process excess nutrients and intercept sediment and other pollutants before they enter the stream. USGS will be monitoring the effectiveness of the wetland nutrient removal under the funding of the USEPA's National NPS Monitoring Grant.

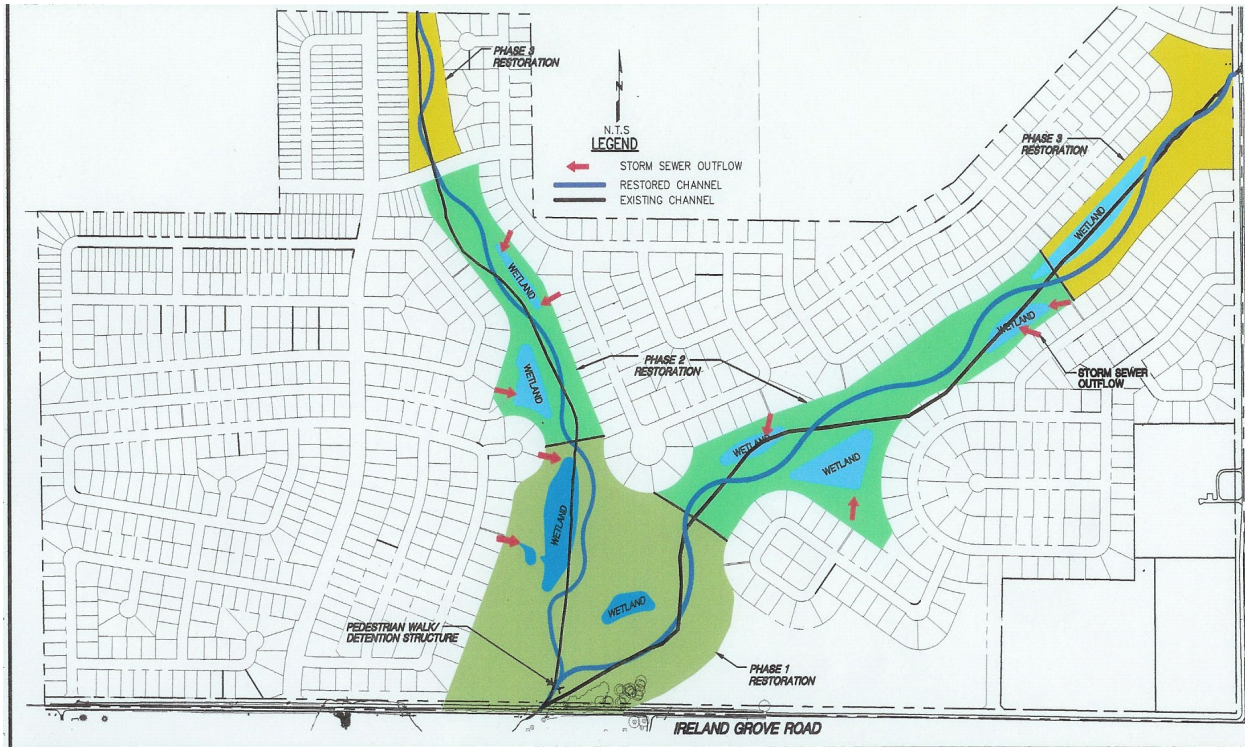


Figure 24. The 2008 rendition of the Final Project Design. Phase 1 is shown in olive green at the downstream limit of the project site. Note the meanders in the restored stream channel shown in blue and the several wetlands dispersed throughout the project area also shown in blue. Red arrows indicate the flow patterns for runoff from the development, which will include over 1,000 homes and a school. The passive restoration area will be 88 acres when completed.

JOB 4. Fish population monitoring for evaluation and documentation of the project

Fish population monitoring efforts have been successfully implemented as scheduled. The monitoring efforts have been designed to include two sites within the restoration reach with a control site upstream of the project on the west branch and two sites within the restoration reach with a control site upstream of the project on the east branch, for a total of six sampling sites. These six sites are scheduled to be sampled twice per year in late June and early September for the duration of the project and several years following completion of the project. In addition to these six core sites, a sampling reach immediately downstream of the project site was surveyed in June 2007.

All sites are 300 feet in length. The sampling reach is isolated with block nets and sampled with a single upstream pass with the electrofishing gear following Illinois Department of Natural Resources standardized sampling protocol. The two lowermost sampling sites (EIE-18 and EIEM-01) and the site immediately downstream of the project site (EIE-22) are being sampled

with a 30-foot electric seine powered by a 2000-watt 2-phase AC generator. The four remaining upstream sites (EIE-19, EIE-20, EIEM-02, and EIEM-03) are being sampled with DC battery-powered backpack electrofishers. Care has been taken to conduct sampling events during normal to low flow conditions.

To date, the six core sites have been surveyed in June 2006 (prior to grant cycle), June 2007 plus additional downstream site, September 2007, June 2008, and September 2008. All samples to this point are pre-restoration baseline samples, except the Fall samples of EIE-18 and EIEM-01 which were sampled just days after the Phase 1 channel construction work. Preserved fish have been processed and data entry is complete through the 2008 sampling events.

Additional data on water quality, habitat measures, and macroinvertebrates are also being collected by Illinois Environmental Protection Agency staff on the three east branch sites (EIE-18, 19, and 20) that will bolster information gained from the fisheries data collection effort. These sites were sampled by IEPA in September 2007 and 2008 and are scheduled to be sampled annually for the duration of the project evaluation period.

Figure 25. The two downstream treatment sites (EIE-18 and EIEM-01) are sampled using an electric seine powered by an AC generator, as shown here during a pre-restoration sampling event.

Figure 26. The two upstream treatment sites (EIE-19 and EIEM-02) and the two upstream control sites (EIE-20 and EIEM-03) are sampled using DC battery-powered backpack electrofishers, as shown here during a pre-restoration sampling event.

Figure 27. A post-restoration sampling event on the downstream treatment site on the west branch (EIEM-01). This sample was conducted just days following completion of the stream channel construction work in 2008. Note the use of the electric seine and blocknets to isolate the sampling reach.

Figure 28. Striped shiners in breeding condition collected during the surveys at restoration site.

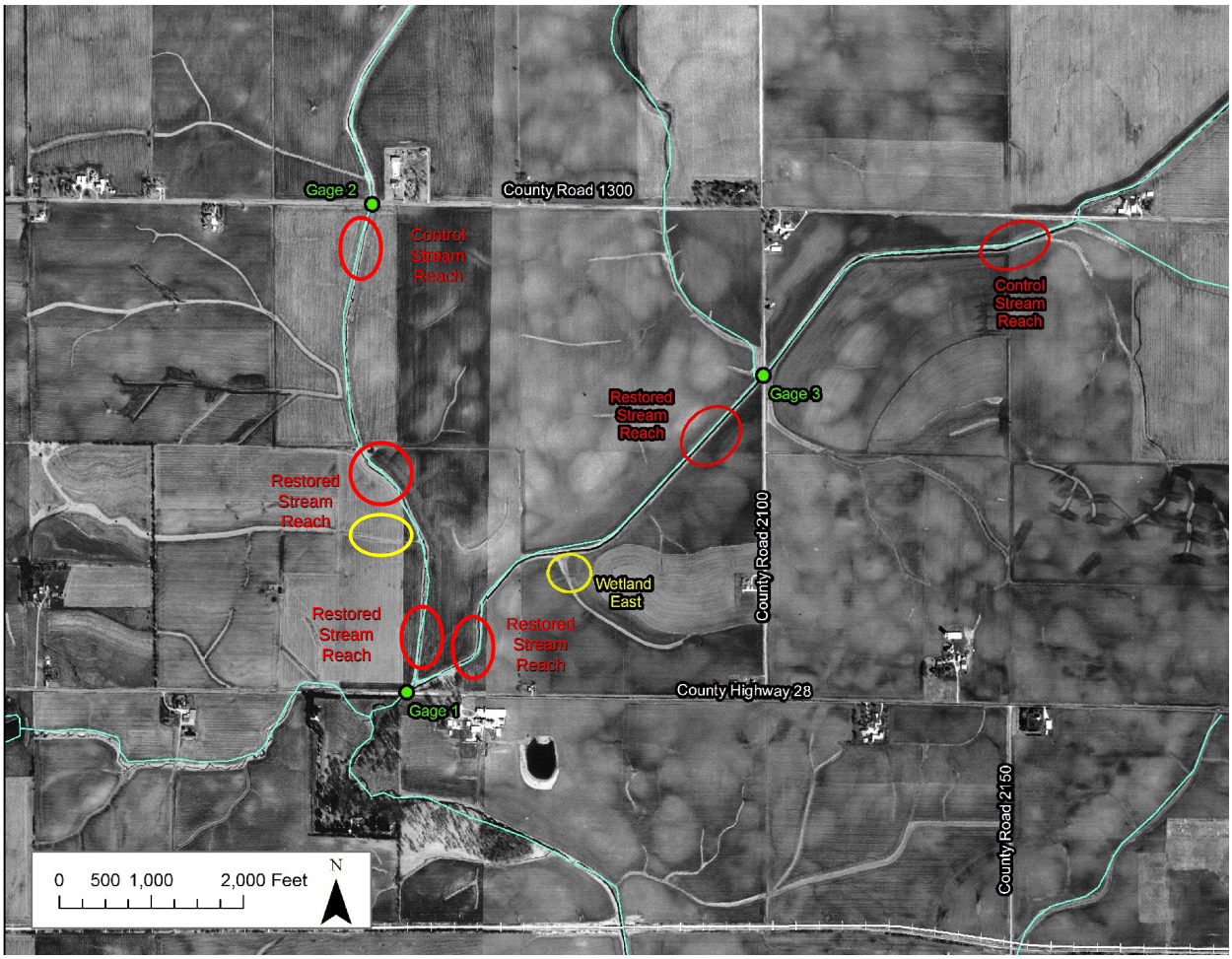


Figure 29. Overview of the monitoring design for the stream restoration project: red ovals indicate the six fish sampling stations; yellow ovals indicate the two USGS wetland nutrient monitoring stations; green dots indicate the three USGS stream gages that monitor inflow and outflow at the project site.

Following are summary tables and graphs of the fisheries data to date:

Table 1. East Branch Downstream Treatment (EIE-18) Fisheries Data

Common name	Scientific name	Total of all sites	ALL 12405 20-Jun-2006 EIE-18 Kickapoo Creek E. Br. D.S. Treatment	ALL 12451 26-Jun-2007 EIE-18 Kickapoo Creek E. Br. D.S. Treatment	ALL 12450 4-Sep-2007 EIE-18 Kickapoo Creek E. Br. D.S. Treatment	ALL 12462 23-Jun-2008 EIE-18 Kickapoo Creek E. Br. D.S. Treatment	ALL 12468 1-Oct-2008 EIE-18 Kickapoo Creek E. Br. D.S. Treatment
Gizzard shad	Dorosoma cepedianum	11					11
Carp	Cyprinus carpio	14		6			
Creek chub	Semotilus atromaculatus	1128	32	25	110	17	2
Hornyhead chub	Nocomis biguttatus	715	58	18	56	9	2
Hornyhead chub x Striped shiner hybrid	Nocomis biguttatus x Luxilus chrysocephalus	2					
Central stoneroller	Campostoma anomalum	1784	55	65	243	26	5
Largescale stoneroller	Campostoma oligolepis	12					1
Striped shiner	Luxilus chrysocephalus	1835	79	172	371	54	12
Redfin shiner	Lythrurus umbratilus	82	7	22	8	9	1
Red shiner	Cyprinella lutrensis	18	4	1			1
Bluntnose minnow	Pimephales notatus	1260	94	178	474	24	10
Bigmouth shiner	Notropis dorsalis	64		1	8	3	7
Sand shiner	Notropis ludibundus	244	7	12	48	10	26
White sucker	Catostomus commersoni	333	20	14	56	4	22
Northern hog sucker	Hypentelium nigricans	19			3	1	1
Golden redhorse	Moxostoma erythrurum	8		4		2	1
Yellow bullhead	Ameiurus natalis	43	3	2	3	1	
Blackstripe topminnow	Fundulus notatus	6			3	2	
Rock bass	Ambloplites rupestris	42	3	3	6	6	
Largemouth bass	Micropterus salmoides	15		1			5
Green sunfish	Lepomis cyanellus	283	2	18	26	10	18
Bluegill	Lepomis macrochirus	21	1	1	2	1	4
Blackside darter	Percina maculata	13		1	2		
Johnny darter	Etheostoma nigrum	371	6	17	7	7	
Total fish		8323	371	561	1426	186	129
Total species			14	19	17	17	17
Electrode minutes		795.6	18	24	36	16.8	19.2
Seine hauls		0					
Kilograms of fish		106.268	1.99	15.787	9.865	2.053	1.798
Native fish species		22	14	18	17	17	17
Native minnow species		10	8	9	8	8	10
Native sucker species		3	1	2	2	3	3
Native sunfish species		4	3	4	3	3	3
Benthic invertivore species		5	1	4	4	4	3
Intolerant species		2	1	1	2	2	2
Prop. specialist benthic invertivores		0.05	0.02	0.04	0.01	0.05	0.02
Prop. genenerallist feeders		0.64	0.67	0.81	0.78	0.72	0.88
Prop. mineral-substrate spawners		0.54	0.54	0.51	0.48	0.58	0.18
Prop. tolerant species		0.32	0.43	0.39	0.29	0.29	0.29
Extrapolated IBI			37	44	44	49	41
Accumulated days from first sampling event			2	373	443	736	836

Table 2. East Branch Upstream Treatment (EIE-19) Fisheries Data

Common name	Scientific name	Total of all sites	ALL 12406 19-Jun-2006 EIE-19 Kickapoo Creek E. Br. U.S. Treatment	ALL 12452 25-Jun-2007 EIE-19 Kickapoo Creek E. Br. U.S. Treatment	ALL 12458 4-Sep-2007 EIE-19 Kickapoo Creek E. Br. U.S. Treatment	ALL 12463 23-Jun-2008 EIE-19 Kickapoo Creek E. Br. U.S. Treatment	ALL 12469 1-Oct-2008 EIE-19 Kickapoo Creek E. Br. U.S. Treatment
Gizzard shad	Dorosoma cepedianum	11					
Carp	Cyprinus carpio	14					
Creek chub	Semotilus atromaculatus	1128	66	42	40	35	11
Hornyhead chub	Nocomis biguttatus	715	21	37	61	45	32
Hornyhead chub x Striped shiner hybrid	Nocomis biguttatus x Luxilus chrysocephalus	2			2		
Central stoneroller	Campostoma anomalum	1784	30	142	180	17	63
Largescale stoneroller	Campostoma oligolepis	12					5
Striped shiner	Luxilus chrysocephalus	1835	106	80	106	144	59
Redfin shiner	Lythrurus umbratilus	82	6	4		1	1
Red shiner	Cyprinella lutrensis	18				1	1
Bluntnose minnow	Pimephales notatus	1260	10	30	42	13	21
Bigmouth shiner	Notropis dorsalis	64			1		
Sand shiner	Notropis ludibundus	244			2	5	3
White sucker	Catostomus commersoni	333	5	23	11	24	15
Northern hog sucker	Hypentelium nigricans	19					
Golden redhorse	Moxostoma erythrurum	8					
Yellow bullhead	Ameiurus natalis	43		6	1	3	6
Blackstripe topminnow	Fundulus notatus	6				1	
Rock bass	Ambloplites rupestris	42	1	2	3	6	
Largemouth bass	Micropterus salmoides	15					
Green sunfish	Lepomis cyanellus	283	2	18	20	7	2
Bluegill	Lepomis macrochirus	21					
Blackside darter	Percina maculata	13		1			
Johnny darter	Etheostoma nigrum	371	5	9	24	2	11
Total fish		8323	252	394	493	304	230
Total species			10	12	12	14	13
Electrode minutes		795.6	35	44	34	32.8	43.9
Seine hauls		0					
Kilograms of fish		106.268	1.484	5.161	4.311	4.656	3.646
Native fish species		22	10	12	12	14	13
Native minnow species		10	6	6	7	8	9
Native sucker species		3	1	1	1	1	1
Native sunfish species		4	2	2	2	2	1
Benthic invertivore species		5	1	2	2	1	1
Intolerant species		2	1	1	1	1	1
Prop. specialist benthic invertivores		0.05	0.02	0.03	0.05	0.01	0.05
Prop. geneneralist feeders		0.64	0.77	0.52	0.45	0.77	0.52
Prop. mineral-substrate spawners		0.54	0.65	0.68	0.71	0.7	0.7
Prop. tolerant species		0.32	0.4	0.42	0.42	0.43	0.46
Extrapolated IBI			33	36	38	35	35
Accumulated days from first sampling event			1	372	443	736	836

Table 3. East Branch Upstream Control (EIE-20) Fisheries Data

Common name	Scientific name	Total of all sites	ALL 12407 19-Jun-2006 EIE-20 Kickapoo Creek E. Br. U.S. Control	ALL 12453 26-Jun-2007 EIE-20 Kickapoo Creek E. Br. U.S. Control	ALL 12459 4-Sep-2007 EIE-20 Kickapoo Creek E. Br. U.S. Control	ALL 12464 23-Jun-2008 EIE-20 Kickapoo Creek E. Br. U.S. Control	ALL 12470 30-Sep-2008 EIE-20 Kickapoo Creek E. Br. U.S. Control
Gizzard shad	Dorosoma cepedianum	11					
Carp	Cyprinus carpio	14					
Creek chub	Semotilus atromaculatus	1128	45	37	26	40	134
Hornyhead chub	Nocomis biguttatus	715	12	13	20	12	111
Hornyhead chub x Striped shiner hybrid	Nocomis biguttatus x Luxilus chrysocephalus	2					
Central stoneroller	Campostoma anomalum	1784	47	23	47	28	259
Largescale stoneroller	Campostoma oligolepis	12					4
Striped shiner	Luxilus chrysocephalus	1835	40	27	14	29	28
Redfin shiner	Lythrurus umbratilus	82					
Red shiner	Cyprinella lutrensis	18					
Bluntnose minnow	Pimephales notatus	1260		5	4	2	16
Bigmouth shiner	Notropis dorsalis	64	1				
Sand shiner	Notropis ludibundus	244					1
White sucker	Catostomus commersoni	333	3	5	9	8	15
Northern hog sucker	Hypentelium nigricans	19					
Golden redhorse	Moxostoma erythrurum	8					
Yellow bullhead	Ameiurus natalis	43	1				
Blackstripe topminnow	Fundulus notatus	6					
Rock bass	Ambloplites rupestris	42					
Largemouth bass	Micropterus salmoides	15					3
Green sunfish	Lepomis cyanellus	283		1		3	2
Bluegill	Lepomis macrochirus	21					
Blackside darter	Percina maculata	13		1	2		1
Johnny darter	Etheostoma nigrum	371	43	9	9	9	65
Total fish		8323	192	121	131	131	639
Total species			8	9	8	8	12
Electrode minutes		795.6	27	29	17	28.2	37.1
Seine hauls		0					
Kilograms of fish		106.268	0.61	1.349	1.087	2.078	4.996
Native fish species		22	8	9	8	8	12
Native minnow species		10	5	5	5	5	7
Native sucker species		3	1	1	1	1	1
Native sunfish species		4	0	1	0	1	2
Benthic invertivore species		5	2	2	2	1	2
Intolerant species		2	1	1	1	1	1
Prop. specialist benthic invertivores		0.05	0.22	0.08	0.08	0.07	0.1
Prop. geneneralist feeders		0.64	0.47	0.62	0.4	0.63	0.31
Prop. mineral-substrate spawners		0.54	0.52	0.53	0.63	0.53	0.63
Prop. tolerant species		0.32	0.38	0.44	0.38	0.5	0.33
Extrapolated IBI			35	34	33	32	40
Accumulated days from first sampling event			1	373	443	736	835

Table 4. West Branch Downstream Treatment (EIEM-01) Fisheries Data

Common name	Scientific name	Total of all sites	ALL 12408 20-Jun-2006 EIEM-01 Kickapoo Creek UT W. Br. D.S. Treatment	ALL 12454 26-Jun-2007 EIEM-01 Kickapoo Creek U.T. W. Br. D.S. Treatment	DRY 5-Sep-2007 EIEM-01 Kickapoo Creek U.T. W. Br. D.S. Treatment	ALL 12465 23-Jun-2008 EIEM-01 Kickapoo Creek U.T. W. Br. D.S. Treatment	ALL 12471 1-Oct-2008 EIEM-01 Kickapoo Creek U.T. W. Br. D.S. Treatment
Gizzard shad	Dorosoma cepedianum	11					
Carp	Cyprinus carpio	14	2				
Creek chub	Semotilus atromaculatus	1128	33	18		29	5
Hornyhead chub	Nocomis biguttatus	715	15	5		9	6
Hornyhead chub x Striped shiner hybrid	Nocomis biguttatus x Luxilus chrysocephalus	2					
Central stoneroller	Campostoma anomalum	1784	17	16		6	56
Largescale stoneroller	Campostoma oligolepis	12		1			1
Striped shiner	Luxilus chrysocephalus	1835	88	42		22	30
Redfin shiner	Lythrurus umbratilus	82		2			
Red shiner	Cyprinella lutrensis	18					2
Bluntnose minnow	Pimephales notatus	1260	28	47		10	12
Bigmouth shiner	Notropis dorsalis	64	14	5		3	2
Sand shiner	Notropis ludibundus	244	7	7		4	26
White sucker	Catostomus commersoni	333	5	15		7	25
Northern hog sucker	Hypentelium nigricans	19					
Golden redhorse	Moxostoma erythrurum	8					
Yellow bullhead	Ameiurus natalis	43		2			
Blackstripe topminnow	Fundulus notatus	6					
Rock bass	Ambloplites rupestris	42		2		2	
Largemouth bass	Micropterus salmoides	15					3
Green sunfish	Lepomis cyanellus	283	3	9		21	47
Bluegill	Lepomis macrochirus	21	5			2	5
Blackside darter	Percina maculata	13	1				
Johnny darter	Etheostoma nigrum	371	4	11		12	1
Total fish		8323	222	182		127	221
Total species			13	14		12	14
Electrode minutes		795.6	14	19		18.7	12.8
Seine hauls		0					
Kilograms of fish		106.268	4.164	2.042		1.019	3.311
Native fish species		22	12	14		12	14
Native minnow species		10	7	9		7	9
Native sucker species		3	1	1		1	1
Native sunfish species		4	2	2		3	3
Benthic invertivore species		5	3	2		2	2
Intolerant species		2	1	1		1	1
Prop. specialist benthic invertivores		0.05	0.02	0.06		0.09	0
Prop. geneneralist feeders		0.64	0.83	0.81		0.77	0.7
Prop. mineral-substrate spawners		0.54	0.55	0.37		0.31	0.42
Prop. tolerant species		0.32	0.42	0.36		0.33	0.36
Extrapolated IBI			35	39		40	39
Accumulated days from first sampling event			2	373	444	736	836

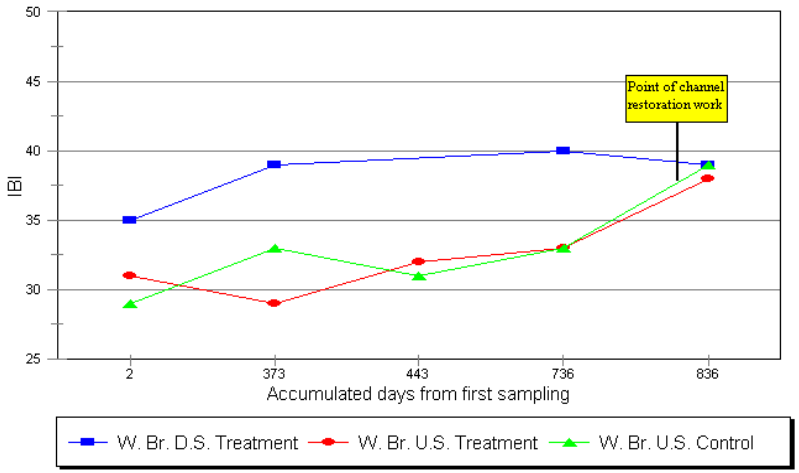
Table 5. West Branch Upstream Treatment (EIEM-02) Fisheries Data

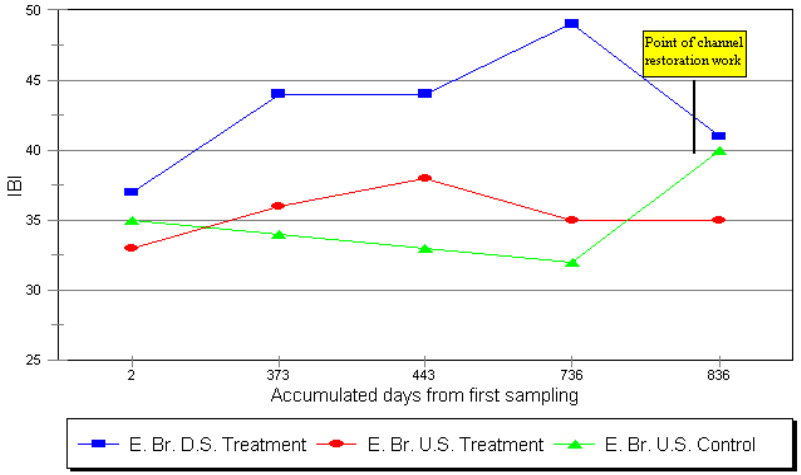
Common name	Scientific name	Total of all sites	ALL 12409 20-Jun-2006 EIEM-02 Kickapoo Creek UT W. Br. U.S. Treatment	ALL 12455 26-Jun-2007 EIEM-02 Kickapoo Creek U.T. W. Br. U.S. Treatment	ALL 12460 5-Sep-2007 EIEM-02 Kickapoo Creek U.T. W. Br. U.S. Treatment	ALL 12466 23-Jun-2008 EIEM-02 Kickapoo Creek U.T. W. Br. U.S. Treatment	ALL 12472 30-Sep-2008 EIEM-02 Kickapoo Creek U.T. W. Br. U.S. Treatment
Gizzard shad	Dorosoma cepedianum	11					
Carp	Cyprinus carpio	14					
Creek chub	Semotilus atromaculatus	1128	19	92	43	44	64
Hornyhead chub	Nocomis biguttatus	715	9	31	6	17	4
Hornyhead chub x Striped shiner hybrid	Nocomis biguttatus x Luxilus chrysocephalus	2					
Central stoneroller	Campostoma anomalum	1784	23	61	28	28	15
Largescale stoneroller	Campostoma oligolepis	12					
Striped shiner	Luxilus chrysocephalus	1835	9	62	20	19	7
Redfin shiner	Lythrurus umbratilus	82			1		
Red shiner	Cyprinella lutrensis	18					
Bluntnose minnow	Pimephales notatus	1260	2	15	8	6	9
Bigmouth shiner	Notropis dorsalis	64			3		1
Sand shiner	Notropis ludibundus	244		1			
White sucker	Catostomus commersoni	333	3	4		11	3
Northern hog sucker	Hypentelium nigricans	19					
Golden redhorse	Moxostoma erythrurum	8					
Yellow bullhead	Ameiurus natalis	43		1	2	1	
Blackstripe topminnow	Fundulus notatus	6					
Rock bass	Ambloplites rupestris	42					
Largemouth bass	Micropterus salmoides	15					2
Green sunfish	Lepomis cyanellus	283			1	3	18
Bluegill	Lepomis macrochirus	21					
Blackside darter	Percina maculata	13					
Johnny darter	Etheostoma nigrum	371	6	13	2	11	17
Total fish		8323	71	280	114	140	140
Total species			7	9	10	9	10
Electrode minutes		795.6	14	39	33	30	33.1
Seine hauls		0					
Kilograms of fish		106.268	0.586	2.688	0.54	2.074	1.184
Native fish species		22	7	9	10	9	10
Native minnow species		10	5	6	7	5	6
Native sucker species		3	1	1	0	1	1
Native sunfish species		4	0	0	1	1	2
Benthic invertivore species		5	1	1	2	1	2
Intolerant species		2	1	1	1	1	1
Prop. specialist benthic invertivores		0.05	0.08	0.05	0.02	0.08	0.12
Prop. geneneralist feeders		0.64	0.46	0.62	0.68	0.6	0.73
Prop. mineral-substrate spawners		0.54	0.58	0.55	0.48	0.46	0.19
Prop. tolerant species		0.32	0.43	0.44	0.4	0.56	0.4
Extrapolated IBI			31	29	32	33	38
Accumulated days from first sampling event			2	373	444	736	835

Table 6. West Branch Upstream Control (EIEM-03) Fisheries Data

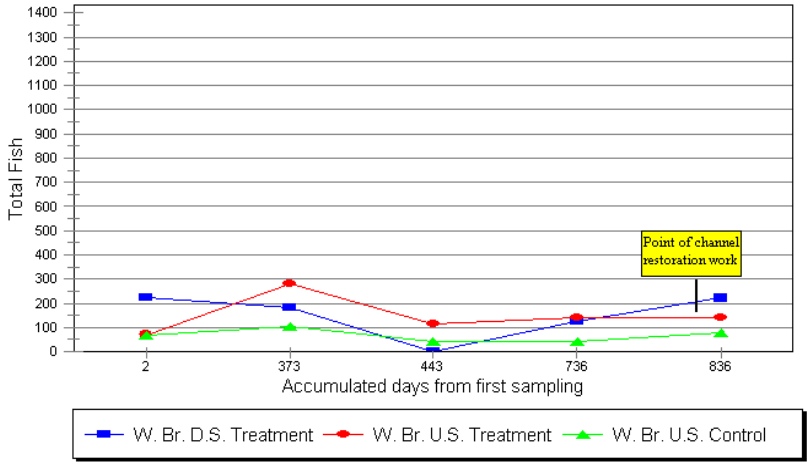
Common name	Scientific name	Total of all sites	ALL 12410 19-Jun-2006 EIEM-03 Kickapoo Creek UT W. Br. U.S. Control	ALL 12456 25-Jun-2007 EIEM-03 Kickapoo Creek U.T. W. Br. U.S. Control	ALL 12461 5-Sep-2007 EIEM-03 Kickapoo Creek U.T. W. Br. U.S. Control	ALL 12467 23-Jun-2008 EIEM-03 Kickapoo Creek U.T. W. Br. U.S. Control	ALL 12473 23-Sep-2008 EIEM-03 Kickapoo Creek U.T. W. Br. U.S. Control
Gizzard shad	Dorosoma cepedianum	11					
Carp	Cyprinus carpio	14					
Creek chub	Semotilus atromaculatus	1128	26	19	12	13	23
Hornyhead chub	Nocomis biguttatus	715	3	12	7	1	2
Hornyhead chub x Striped shiner hybrid	Nocomis biguttatus x Luxilus chrysocephalus	2					
Central stoneroller	Campostoma anomalum	1784	22	13	1	4	18
Largescale stoneroller	Campostoma oligolepis	12					
Striped shiner	Luxilus chrysocephalus	1835	13	20	4	3	5
Redfin shiner	Lythrurus umbratilus	82					
Red shiner	Cyprinella lutrensis	18	1				
Bluntnose minnow	Pimephales notatus	1260	1	20	4	9	4
Bigmouth shiner	Notropis dorsalis	64		2			1
Sand shiner	Notropis ludibundus	244					
White sucker	Catostomus commersoni	333				1	1
Northern hog sucker	Hypentelium nigricans	19					
Golden redhorse	Moxostoma erythrurum	8					
Yellow bullhead	Ameiurus natalis	43		1			2
Blackstripe topminnow	Fundulus notatus	6					
Rock bass	Ambloplites rupestris	42					
Largemouth bass	Micropterus salmoides	15					1
Green sunfish	Lepomis cyanellus	283	1			4	9
Bluegill	Lepomis macrochirus	21					
Blackside darter	Percina maculata	13					
Johnny darter	Etheostoma nigrum	371	2	17	13	7	13
Total fish		8323	69	104	41	42	79
Total species			8	8	6	8	11
Electrode minutes		795.6	20	21	21	16	30
Seine hauls		0					
Kilograms of fish		106.268	0.561	0.809	0.081	0.349	0.975
Native fish species		22	8	8	6	8	11
Native minnow species		10	6	6	5	5	6
Native sucker species		3	0	0	0	1	1
Native sunfish species		4	1	0	0	1	2
Benthic invertivore species		5	1	2	1	1	2
Intolerant species		2	1	1	1	1	1
Prop. specialist benthic invertivores		0.05	0.03	0.16	0.32	0.17	0.16
Prop. geneneralist feeders		0.64	0.61	0.6	0.49	0.71	0.57
Prop. mineral-substrate spawners		0.54	0.55	0.43	0.29	0.19	0.32
Prop. tolerant species		0.32	0.5	0.38	0.33	0.5	0.45
Extrapolated IBI			29	33	31	33	39
Accumulated days from first sampling event			1	372	444	736	827

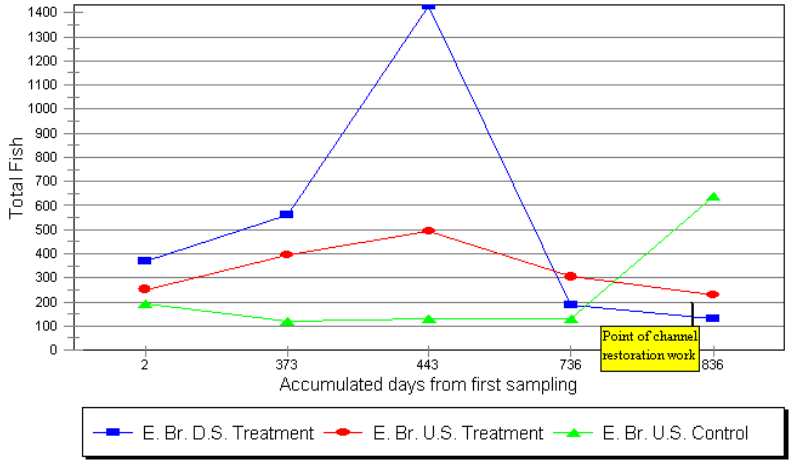
Table 7. Downstream Reference (EIE-22) Fisheries Data			
Common name	Scientific name	Total of	ALL 12457
		all sites	25-Jun-2007
			EIE-22
			Kickapoo Creek
Gizzard shad	Dorosoma cepedianum	11	
Carp	Cyprinus carpio	14	6
Creek chub	Semotilus atromaculatus	1128	26
Hornyhead chub	Nocomis biguttatus	715	81
Hornyhead chub x Striped shiner hybrid	Nocomis biguttatus x Luxilus chrysocephalus	2	
Central stoneroller	Campostoma anomalum	1784	246
Largescale stoneroller	Campostoma oligolepis	12	
Striped shiner	Luxilus chrysocephalus	1835	170
Redfin shiner	Lythrurus umbratilus	82	20
Red shiner	Cyprinella lutrensis	18	7
Bluntnose minnow	Pimephales notatus	1260	162
Bigmouth shiner	Notropis dorsalis	64	12
Sand shiner	Notropis ludibundus	244	85
White sucker	Catostomus commersoni	333	24
Northern hog sucker	Hypentelium nigricans	19	14
Golden redhorse	Moxostoma erythrurum	8	1
Yellow bullhead	Ameiurus natalis	43	8
Blackstripe topminnow	Fundulus notatus	6	
Rock bass	Ambloplites rupestris	42	8
Largemouth bass	Micropterus salmoides	15	
Green sunfish	Lepomis cyanellus	283	38
Bluegill	Lepomis macrochirus	21	
Blackside darter	Percina maculata	13	4
Johnny darter	Etheostoma nigrum	371	19
Total fish		8323	931
Total species			18
Electrode minutes		795.6	32
Seine hauls		0	
Kilograms of fish		106.268	25.014
Native fish species		22	17
Native minnow species		10	9
Native sucker species		3	3
Native sunfish species		4	2
Benthic invertivore species		5	5
Intolerant species		2	2
Prop. specialist benthic invertivores		0.05	0.04
Prop. geneneralist feeders		0.64	0.6
Prop. mineral-substrate spawners		0.54	0.58
Prop. tolerant species		0.32	0.41
Extrapolated IBI			47
Accumulated days from first sampling event			372



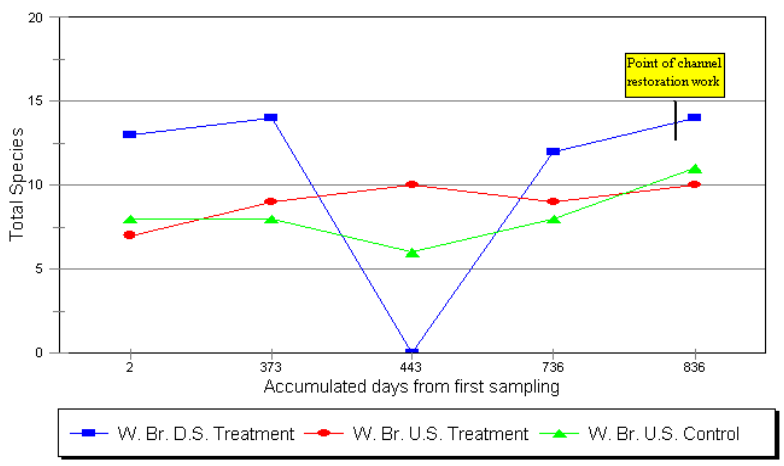


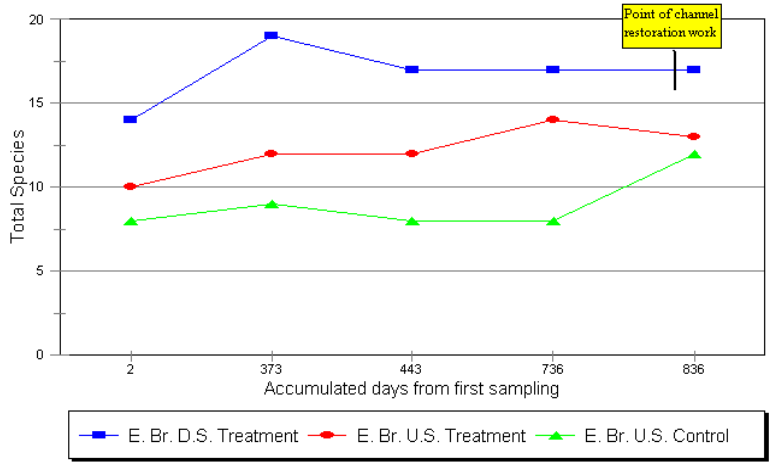
Figures 30-31: Index of Biotic Integrity (West Branch - left and East Branch - right). The downstream treatment sites on both branches are the only two sites that have undergone restoration work. The upstream treatment sites are still pre-restoration samples. Note that the IBI decreased slightly on both downstream treatment sites in samples conducted in the days immediately following in-stream channel work as one would expect. Three of the four upstream sampling sites showed increases in the last round of sampling, possibly due to an atypically wet year that increased base flows making upstream reaches more accessible than normal years. It may be possible that the in-stream work may have pushed fish further upstream than usual also.



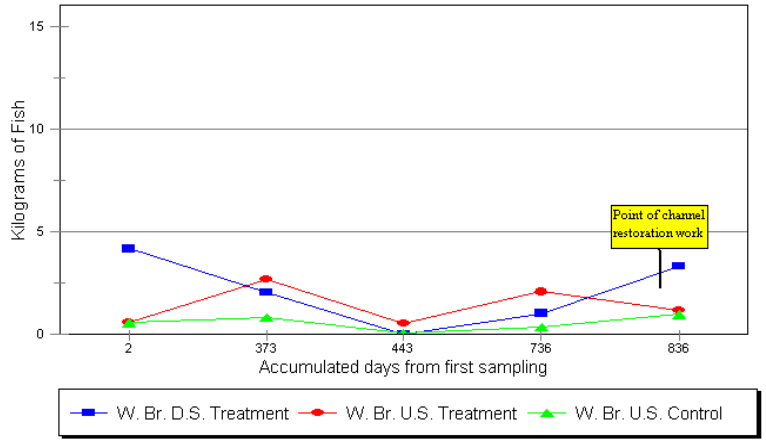


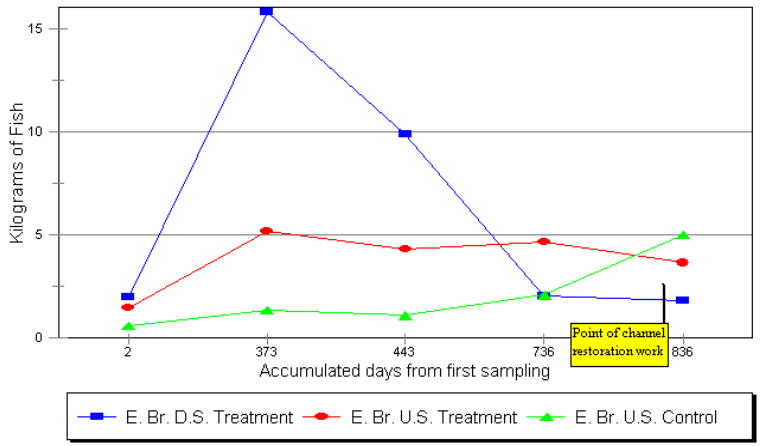
Figures 32-33: Total Fish (West Branch - left and East Branch - right). Total fish numbers collected is highly variable in the samples, more so in the East Branch than the West Branch. The zero collection from the West Branch Downstream Treatment site was due to the channel going dry as a result of groundwater pumping during sewer infrastructure work**.** This will be reflected in all of the data for this site. Total fish collected from the West Branch Downstream Treatment site increased immediately following the in-stream work, this may be due to the significantly higher volume of water in the new channel compared to the pre-restoration channel in the west branch. Total fish collected from the East Branch Downstream Treatment site decreased immediately following the in-stream work as expected. This should rebound over time, as the new channel matures.



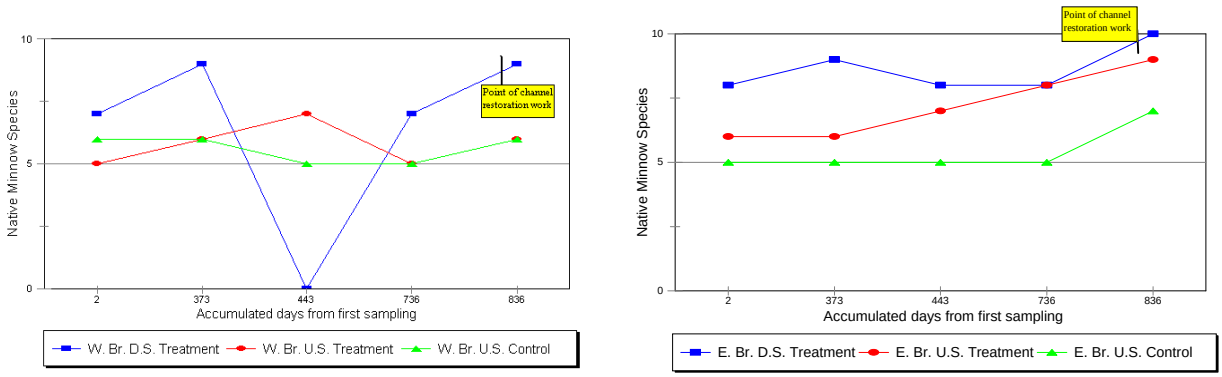


Figures 34-35: Total Species (West Branch - left and East Branch - right). Total species collected from each of the samples has remained fairly constant, except when the channel went dry the west branch. Total species was also not impacted during the in-stream work on both branches.

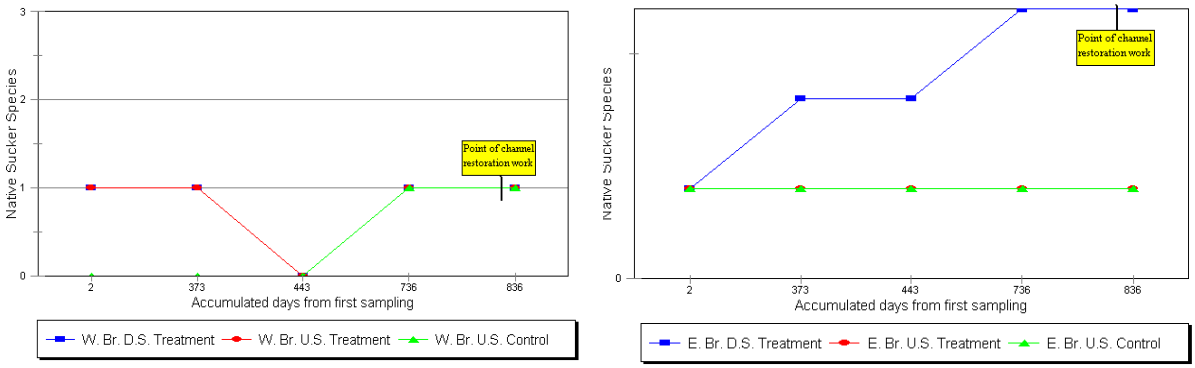




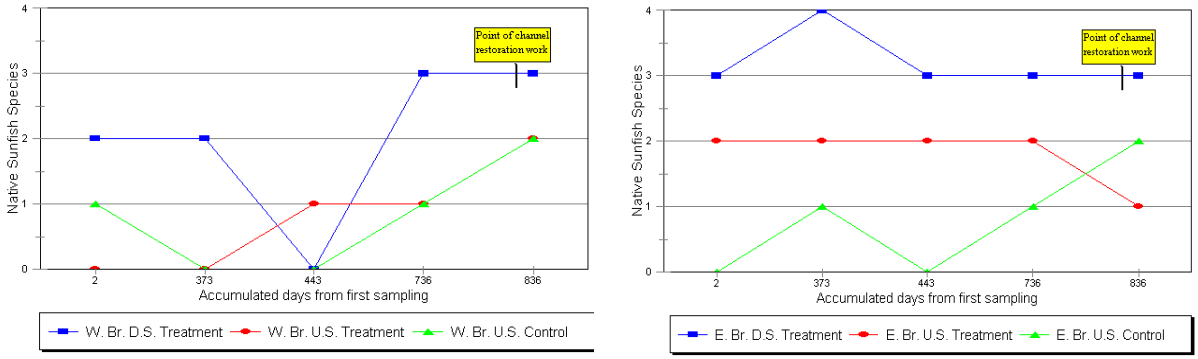
Figures 36-37: Fish Biomass (West Branch - left and East Branch - right). Fish biomass follows the same trends seen in Figures 32-33 for Total Fish collected. This data is also highly variable among the samples. An increase in biomass was observed at the West Branch Downstream Treatment site immediately following in-stream work. This is again presumed to be due to the increased volume of water available in the new channel as compared to the pre-restoration channel.



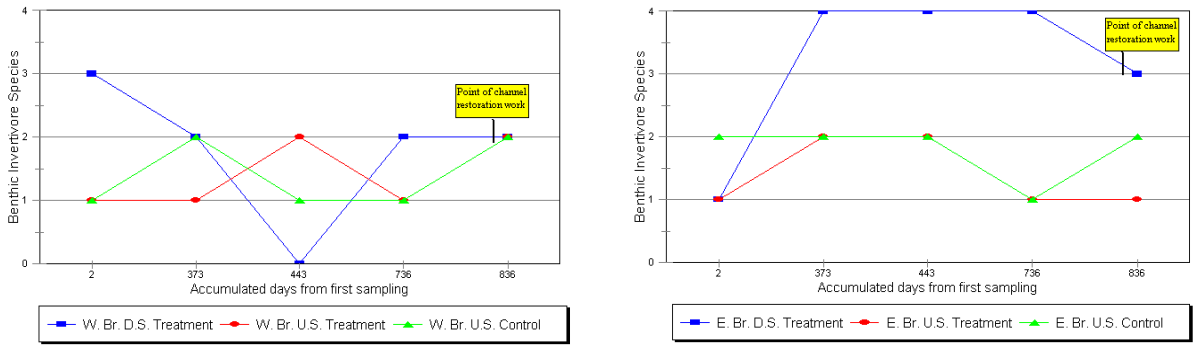
Figures 38-39: Native Minnow Species (West Branch - left and East Branch - right). All sites are showing stable to increasing trends in the number of Native Minnow Species, even during the channel construction work.



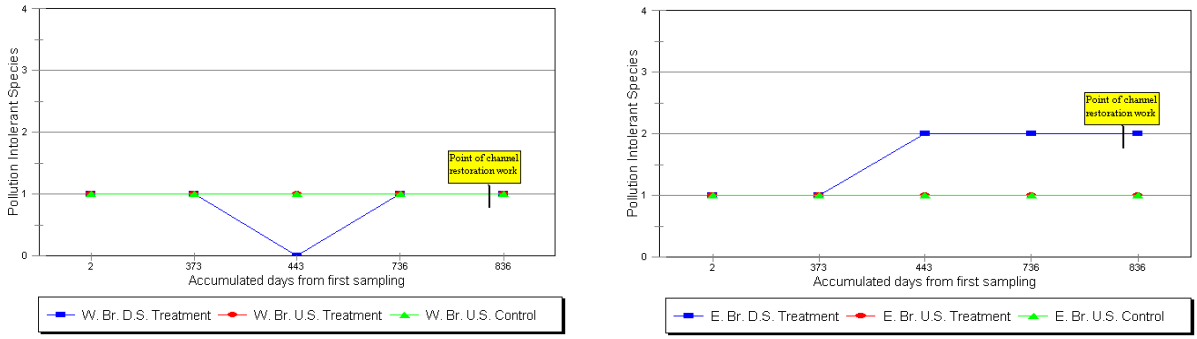
Figures 40-41: Native Sucker Species (West Branch - left and East Branch - right). Most samples are containing a single Sucker species, as most suckers do not normally venture too far into the headwaters that often. The East Branch Downstream Treatment site is the exception, as its higher volume of water attracts a couple more Sucker species from the downstream reaches.



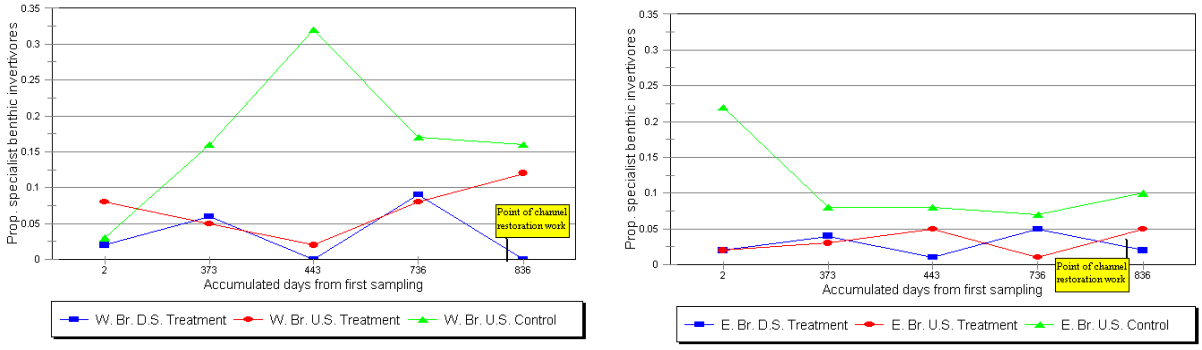
Figures 42-43: Native Sunfish Species (West Branch - left and East Branch - right). The west branch sites appear to be showing modestly increasing trends in the number of Sunfish species present. The east branch sites are showing little change in Sunfish numbers.



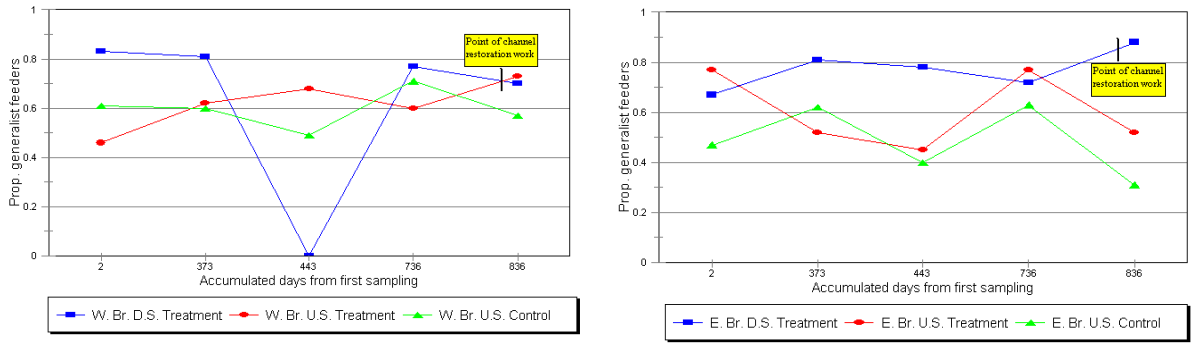
Figures 44-45: Benthic Invertivore Species (West Branch - left and East Branch - right). All the samples appear to be fluctuating by plus or minus one species of Benthic Invertivore.



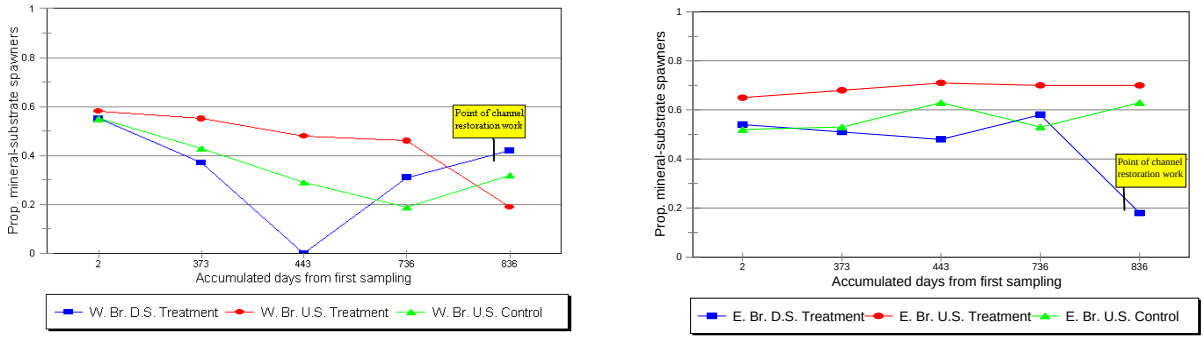
Figures 46-47: Pollution Intolerant Species (West Branch - left and East Branch - right). All samples have been relatively stable in the number of Pollution Intolerant Species present.



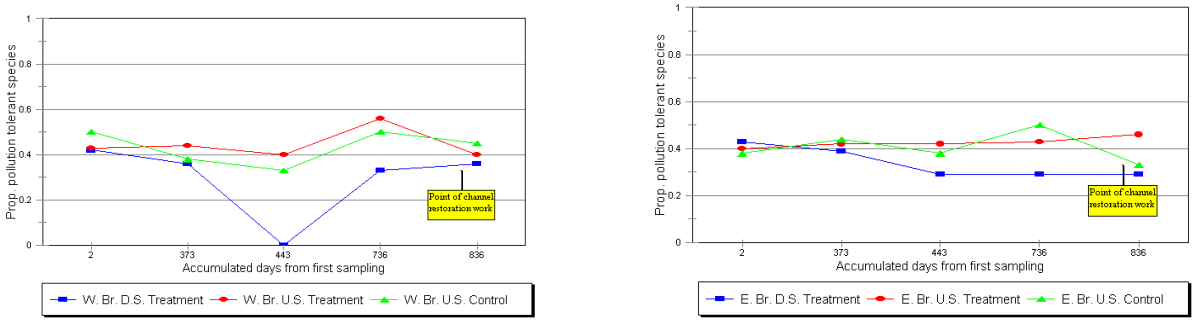
Figures 48-49: Proportion as Specialist Benthic Invertivore Species (West Branch - left and East Branch - right). Proportion as Specialist Benthic Invertivore Species is relatively stable, other than the Upstream Control samples that occasionally contain an unusually high proportion of johnny darters.



Figures 50-51: Proportion as Generalist Feeders (West Branch - left and East Branch - right). For this metric, the lower the proportion the better. Proportions appear relatively stable, except where the East Branch Treatment site increased in proportion immediately following the in-stream work while the upstream sites on the east branch both decreased in Proportion as Generalist Feeders.



Figures 52-53: Proportion as Mineral-Substrate Spawners (West Branch - left and East Branch - right). These species have reproductive strategies that require a clean gravel substrate, so they are good indicators of habitat quality. The upstream sites on the west branch are showing gradual decreasing trends, while the West Branch Downstream Treatment site showed an increase immediately following the in-stream construction work. In contrast, the East Branch Downstream Treatment site showed a harsh decrease following the in-stream work.



Figures 54-55: Proportion as Pollution Tolerant Species (West Branch - left and East Branch - right). Proportion of Pollution Tolerant Species appears to be stable among the sites.

STATE WILDLIFE GRANT BUDGET (for Phase 1 of project):

	Total Budget	DNR Actual	Bloomington Actual	Total Expenditures
Pers Serv-1100	$ 5,000.00	$ 18,225.43	$ 0.00	$ 18,225.43
Contractual-1200	$ 243,862.00	$ 80.71	$ 243,862.00	$ 243,942.71
Travel - 1290	$ 0.00	$ 0.00	$ 0.00	$ 0.00
Commodities-1300	$ 4,900.00	$ 0.00	$ 0.00	$ 6.42
Equipment-1500	$ 0.00	$ 0.22	$ 0.00	$ 0.00
Telecom-1700	$ 0.00	$ 0.00	$ 0.00	$ 0.22
Op of Auto -1800	$ 0.00	$ 4,963.00	$ 0.00	$ 0.00
Lump Sum-1900	$ 0.00	$ 23,275.78	$ 0.00	$ 4,963.00
Subtotal	$ 253,762.00	$ 46,545.14	$ 243,862.00	$ 267,137.78
Indirect Costs	$ 0.00	$ 0.00	$ 0.00	$ 4,241.65
TOTAL	$ 253,762.00	$ 46,545.14	$ 243,862.00	$ 271,379.43
% Complete	100.00%			

RELATED GRANTS/FUNDING:

USEPA National Watershed Monitoring Program funding has been procured for monitoring of the project. This funding is for a minimum of four years and is expected to be extended up to ten years.

USEPA Section 319 funds have also been procured for the project.

USFWS National Fish Habitat Restoration Funds were also procured for in-stream habitat costs.

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