# Chapter 4 Watershed Assessments and Techniques

## Tailored Integrated Stream Watershed Assessment

In addition to using water chemistry testing techniques in the water resources study, in field surveys prove to be very important in characterizing the health of a riverine eco-system. The Tailored Integrated Stream Watershed Assessment (TISWA) is a screening tool that combines varying degrees of existing estimated and observed data. The purpose is to rank sub-watersheds of a watershed in order to determine areas, which have higher pollution potential. Using this study, there can be a focus on a particular area of a watershed with a scientific basis for choosing these locations, or target areas, for best management practice implementation. In conjunction with other factors such as highly erodible soils, water quality sampling results, and loading estimates, areas associated with poorer water quality can be addressed first in the most economical and environmentally beneficial way.

In the fall of October 1999 a TISWA survey was conducted in the LCR watershed. The month of October was chosen to correctly document the amount of conservation tillage. Staff from the BNC Water Board and Brown Water Planning conducted the survey. Before the actual field survey was conducted relevant information was gathered from maps and GIS systems to determine survey locations and back round information of the area. A map is included in chapter 5 that shows the results of the 1999 TISWA survey. The map indicates the location of each TISWA point and impairment rating for that location.

Three to four locations were identified in each of the 12 sub-watersheds. The survey points were conducted on tributaries and the main stem of the LCR. TISWA Survey locations were located where a tributary or the main-stem of the Little Cottonwood river traversed a public roadway. Again, the conditions of the site only reflect the vicinity within viewing distance of the observer. Conditions of sampling point using the below criteria are subjective.

Impairment ratings were determined from the total range of scores within each category. An example of a field worksheet used for scoring can be found in Appendix I. Using the TISWA survey questions, the study addressed four categories:

**1)** The land use and landscape. Depending on the percentages of land use/land cover at the site location, the potential for contaminants to be carried to specified creeks can be determined.

**2)** Pollutant Sources. This section relates to the number and condition of feedlots, point source facilities and septic systems.

**3)** Riparian zone and Channel Morphology. This section attempts to document the general condition of the riparian zone.

**4)** Biotic and Abiotic Indicators. This section estimates the overall biological and biochemical condition of the subwatershed.

# Watershed Modeling Techniques

## Geographic Information System

Minnesota State University Water Resources Center, Mankato (MSUWRC) has provided technical assistance with the creation of a Geographic Information System (GIS) database for much of MN River basin including that of the LCR watershed. An extensive database based on existing and newly gathered information through inventories of feedlots, land use, drained wetlands, etc. The information provided by MSUWRC is an important tool to assist in the selection of priority management areas, watershed modeling, on land water quality improvements, and general communication of projects through maps.

Data used for this study was created by the MSUWRC, which employs strict quality control assurance procedures. Some data layers however were not created by MSYWRC and were created by BNCWQB staff. Similar control procedures however were also used to ensure reliable, accurate and up to date information.

# Soil Erosion Potential Model

Soil erosion is frequently associated with sediment and phosphorus transport to surface water bodies. Identifying the extent and location of area with high erosion within a watershed will help managers pinpoint areas where best management practices should be implemented such as filter strips, or conservation tillage. Maps 8, 9, and 10 depict modeled soil erosion in the LCR watershed.

The soil erosion potential model was calculated using the Revised Universal Soil Loss Equation(RUSLE) for sheet and rill erosion predications. The RUSLE equation is:

A= R Factor * K Factor * LS Factor * C Factor * P Factor

Corn and soybean rotation found in medium residue was assumed to be the cropping factor for all fields.

**Methodology**

The clipped land use, and soils for the watershed were unioned in Arc View to produce a coverage which combined attributes of all three. Once the coverage was cleaned for “ghost” polygons the RUSLE equation was used to calculate erosion rates for each unioned polygon. The A values were then classified into 5 soil loss categories. P factor or conservation factor was given a value of 1. It was assumed special conservation practices such as conservation tillage, strip cropping or other practices were not present. Although there are many areas where conservation is incorporate on cultivated land, P factor was not considered in this analysis since detailed locations at the time were not readily available. Below is a short description of each factor and the values used for the watershed.

To quantify the number of acres within each category by minorshed, the 5 reclassified RUSLE categories were queried and converted to shapefiles. The minor5 field was selected and a summary of the acres was produced for each minorshed per five RUSLE categories.

To determine the proximity of potential soil erosion rates to water ways, each individual soil rate shapefile was selected. Select by theme was then used. Select active features that are within distance of the selected features of Little Cottonwood River and tributaries. A selection distance of 200 feet was used in this analysis. The command selects all erosion categories within 200 feet of a waterway. Acres were then summed for each soil erosion category.

**R Factor (Rainfall and Runoff)**

- Incorporates the rainfall frequencies of geographic areas. RUSLE contains expanded and more precise information for locations across the United States. R factor has the ability to calculate the effect that ponded or puddled water has on raindrop erosion

- Values used for analysis

  120 Blue Earth and Cottonwood Counties

  121 Brown County

**K Factor (Soil Erodiblity)**

- more significant erodibility data from around the world such as the soil type, the diameter of soil particles, and the presence of rock fragments. Adjusted to account for soils in South-Central Minnesota.

- K values assigned by specified soil unit and adjusted for RUSLE zone 100B/C

| | |
|---|---|
| .17 adjusted to .15 | .28 adjusted to .26 |
| .32 adjusted to .30 | .20 adjusted to .17 |
| .37 adjusted to .35 | ..24 adjusted to .22 |
| .43 adjusted to .40 | .20 adjusted to .17 |
| .24 adjusted to .22 | |

**LS Factor (Slope Length and Steepness)**

- Known value found in the Soil Survey

- possesses the ability to predict soil loss on complex slopes

- can apply different functions based on the relative amounts of rill and interrill erosion.

**C Factor ( Cover and Management)**

| | |
|---|---|
| .16 cultivated land | 0.0 shallow or seasonal wetlands (types 1, 2, 3 )=.003 |
| .02 grassland/CRP | .45 gravel pits and open mines |
| .003 forested | .15 farmsteads and other rural developments |
| .26 Urban and industrial | 0.0 lakes and deeper water wetlands |

**P Factor (Support Practice)**

1.0 Assumed no special practices on any cultivated land (constant of 1.0)

### Slopes, Elevations, Hill shading

All coverages were created using USGS 30 meter resolution Digital Elevation Models (DEM). DEMs were obtained from MDNR as GRIDS. The GRIDS were transformed using ArcInfo Import 7 to allow for ArcView Spatial Analyst readability. DEMS were then added to the view as GRIDS. DEMs from Cottonwood, Brown and Blue Earth Counties were clipped to the watershed boundary using USGS spatial Analysis extension. X tools extension was then used to convert the shape file boundary into a graphic before clipping the DEM. The merge command in the USGS spatial analysis extension was used to combine the three individual clipped DEMS into one DEM.

Spatial Analyst Extension within ArcView 3.2 was then used to perform calculations, reclassifications and analysis to construct slope as percentage and hill shading within the watershed.

## Historical Fishery Assessment- MN DNR

According to the Department of Natural Resources, presently no fisheries management plans exist for this river. Ecological classification for the upper reach (miles 78.7-56.0) is warm water feeder, midreach (miles 56.0-18.0) is warm water game fish or marginal trout and the lower reach (mile 18.0-0) is classed coldwater feeder suitable for marginal trout waters.

In 1986 the DNR fisheries unit conducted a first ever survey of the Little Cottonwood River. The reason for the fisheries survey was to inventory general fish populations and stream properties for management purposes. This survey identified suitable natural reproduction of several game fish species in this river. A copy of the original report can be found in section N of the Appendix. A brief summary of the 1986 survey is described below. Also included in the appendix is a letter dated from 1961 from a fisherman describing the trout angling potential in the lower reaches of the river.

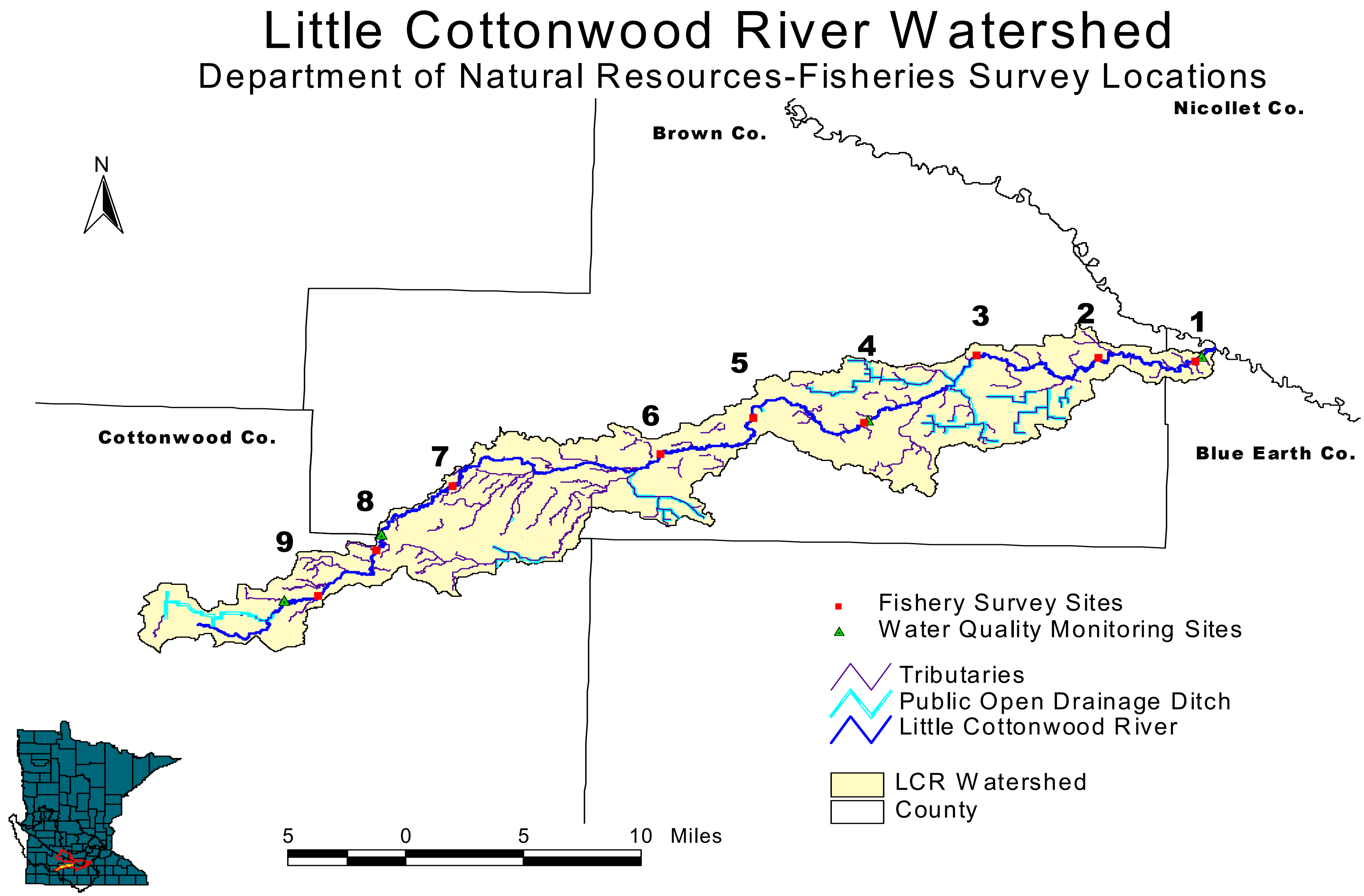
Nine stations on the main stem of the river were selected for the 1986 survey.[1]. At each site biological and physical characteristics were documented. A backpack electro-fishing device was used to temporarily stun the fish. Larger fish species were weighed and

[1] Note: In 1986 the sites were labeled 9-1 starting from the mouth. However in 2000, the sites were re-labeled by the DNR in the opposite order. The map and tables in this diagnostic report reflect those changes. They are not reflected in the original 1986 survey report found in the Appendix

identified in the field, while smaller fish species were taken back for identification and further study.

*Location of sites (Miles from mouth)*

| | | | | |
|---|---|---|---|---|
| Site 1= 1.7 | Site 3= 18 | Site 5= 36.6 | Site 7= 59.1 | Site 9= 74.2 |
| Site 2= 8.8 | Site 4= 27.6 | Site 6= 45.2 | Site 8= 67. | |


Little Cottonwood River Watershed
Department of Natural Resources-Fisheries Survey Locations
Nicollet Co.
Brown Co.
Cottonwood Co.
Blue Earth Co.
N
1
2
3
4
5
6
7
8
9
Fishery Survey Sites
Water Quality Monitoring Sites
Tributaries
Public Open Drainage Ditch
Little Cottonwood River
LCR Watershed
County
5 0 5 10 Miles

The main limiting factors for game fish survival as discussed in the 1986 survey were listed as:

- Non-point sources of pollution from agricultural chemicals, sediments (unstable banks and field runoff), and waste from pastures and feedlots.
- Also of special concern were quantity issues. Highly fluctuating water levels (seasonal low flows) likely hinder the production of game fish.
- Heavily pastured reaches and high carp populations were also listed as special concerns.

In general, the 1986 fishery assessment concluded non-game and minnow dominate the species structure of the river. Game fish such as walleye, northern pike, channel catfish and smallmouth bass are all present in the lower and middle reaches (mi. 56-0) and populations/movement are most likely influenced by the MN River.

Two of the most critical fish management problems included, seasonal low flows and poor land use practices within the watershed.

Summary report of 1986 survey by fisheries technician Duane Williams:

> "The upstream reach (mile 78.7-56.0) of the LCR is not channelized like many upstream reaches in southern MN. Dominant fish species found were creek chub and blacknose dace. The middle reach (mile 56.0-18.0) and lower reach (mile 18.0-0) flow through wooded valley and are suitable for game fish. Northern pike is the dominant game fish in the river.
>
> In the lower reach, walleye and channel catfish are found and their populations are probably influenced by fish movement from the MN River. A remnant small mouth bass population is surviving the agricultural use of the watershed. This small mouth bass population should be of special concern to the area."[2]

**Table 22**

**MNDNR 1986 Fish Survey**

| **Invertebrates Present[1]** | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 | Site 7 | Site 8 | Site 9 |
|---|---|---|---|---|---|---|---|---|---|
| Mayflies (Ephemeroptera) | X | X | X | X | X | X | X | X | X |
| Stoneflies (Plecoptera | X | X | X | | | | X | X | |
| Caddisflys (Trichoptera) | X | X | X | X | X | | X | | X |
| True bugs (Hemitera) | X | | X | | | X | | | |
| Crayfishes (Decapoda) | X | X | X | | X | | X | X | X |
| Flies and midges (Diptera) | | | | X | | X | | X | X |
| Clams (Pelecypoda) | X | X | X | X | | | X | | X |
| Snails (Gastropoda) | X | X | X | X | X | | X | | |

**[1] Macro invertebrates which were present or absent during survey**

[2] Minnesota Department of Natural Resources, Stream Survey Report, 1986, NA-01475-01

## Table 23

**MNDNR 1986 Fish Survey**

| Fish Species Present[2] | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 | Site 7 | Site 8 | Site 9 |
|---|---|---|---|---|---|---|---|---|---|
| Bigmouth buffalo | | | | 1 | | | | | |
| Bigmouth shiner | | | | | | | | 1 | |
| Black bullhead | 2 | 6 | 1 | | 20 | 3 | | | |
| Blacknose dace | 3 | | | | | | | 17 | |
| Blackside darter | | 1 | 5 | | | | | | |
| Bluntnose minnow | | 2 | 14 | 5 | | 2 | | | |
| Carp | 5 | 8 | | 5 | 2 | 11 | | | |
| Central stoneroller | | | 1 | | | | | 1 | |
| Channel catfish | | | 1 | 1 | | | | | |
| Common shiner | | | 27 | 6 | 1 | 1 | | | |
| Creek chub | | | 1 | | 1 | 3 | | 28 | 3 |
| Fathead minnow | 2 | | | 1 | | | | 1 | |
| Golden redhorse | | 1 | 4 | | | | | | |
| Green sunfish | | | 20 | 5 | 6 | | | | |
| Hornyhead chub | | | 22 | | | | | 2 | |
| Johnny darter | | | | | | | | 3 | |
| Log perch | | 2 | | | | | | | |
| Northern hogsucker | 6 | 8 | 6 | | | | | | |
| Northern pike | 1 | | 2 | 5 | 1 | 5 | | | |
| Orange spotted sunfish | | 1 | 1 | | 4 | | | | |
| Quillback | | 27 | | | | | | | |
| Redhorse | | 2 | | | | | | 1 | |
| Rock bass | 1 | | | | | | | | |
| Sand shiner | 2 | | | | | | | | |
| Shorthead redhorse | 12 | 9 | 7 | | | | | | |
| Slenderhead darter | | | 10 | | | | | | |
| Smallmouth bass | | 1 | | | | | | | |
| Spotfin Shiner | 3 | | 38 | 5 | | | | | |
| Stonecat | 2 | 8 | 20 | | | | | | |
| Tadpole madtom | | | | | 2 | | | | |
| Walleye | 1 | | 2 | | | | | | |
| White sucker | | | 2 | 3 | 8 | 4 | | 7 | 1 |
| Yellow bullhead | | | | 1 | | | | | |
| **Total** | **40** | **76** | **183** | **38** | **45** | **29** | **0** | **61** | **4** |

[2] Type and quantity of species sampled during stream shocking survey

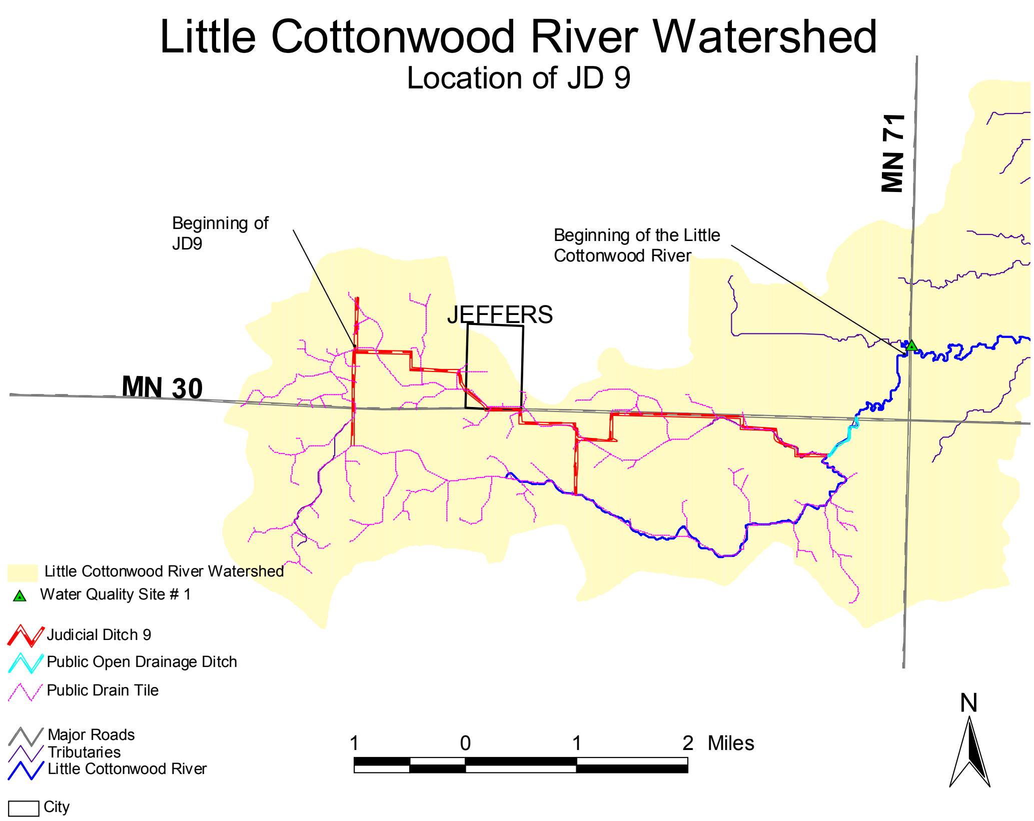
## Updated Fisheries Survey

In August of 2000 staff from DNR Fisheries-Waterville and Brown Nicollet Cottonwood Water Quality Board (BNC) staff conducted a fisheries survey on the Little Cottonwood River Watershed as part of the phase I diagnostic study work plan. The survey was conducted in the same manner as the 1986 survey.

Results of the 2000 survey can be seen in the in the results section, chapter 5.

## Judicial Ditch 9

In 1997, Cottonwood County and installed a Public Open drainage system in the far upper reaches of the LCR watershed as petitioned by landowners to improve the overall drainage for the production of row crops. Map 16 shows the location of the ditch relative to the Little Cottonwood. A 30" public subsurface tile system was replaced with an open drainage ditch system to increase the removal of water from subsurface drainage. In the summer of 1997 public drain tile was replaced with 7.2 miles of open drainage. The open ditch system was designed with 2:1 side slopes and 4- 6 feet wide bottoms. Depths of the ditch range from 20 feet in the upper reaches to 30 or more feet as it connects with the main stem of the Little Cottonwood River. The ditch was designed by Bolton and Menk engineering of Mankato.




**Map 16:** Location of drainage improvement.

Despite the possible success in terms of drainage improvement, changes in water quality and quantity have been documented since its construction. Some of those changes, such as river channel adjustments and suspended sediment/nutrient levels, were documented during the phase I diagnostic study. The results of the water quality and channel assessments can be found in chapter 5 of this report.