# Chapter 6 Conclusions & Goals

## Little Cottonwood River Diagnostic Study

The primary scope of the Little Cottonwood River diagnostic study was to measure the movement of sediments and associated pollutants between river reaches and document factors affecting their transport to the river. Examination of the relationship between land use and water quality was the primary method for documenting such factors. The second main goal of the LCR diagnostic study was to determine realistic goals to meet both the Little Cottonwood and Minnesota River and ultimately how and where to implement cost effective practices which would help ascertain those goals.

Water quality and quantity monitoring over a variety of flows and seasons provided information about both spatial and temporal variability in water quality during the three-year study. Like many other watersheds in the southern portion of the Minnesota River Basin, water quality in the LCR is impaired by non-point source pollutants. Sediments, nutrients, and bacteria are the three main pollutants of concern. All of these pollutants increase substantially during and after rain events within the entire watershed. The most significant levels occur during the early growing season, typically April through July. During this period levels increase far above recommended levels.

The upper portion of the watershed is a large source of nitrates and sediments. Most of the sediments are derived from a newly created drainage ditch (mainly eroding side slopes). High nitrates in this area are the result of commercially applied nitrogen leaching from the corn root zone into an extensive network of underground tile systems.

Nitrate concentrations and loads generally decrease downstream (middle portion of the watershed) as dilution and wetland processes become more prevalent. Fecal coliform bacteria levels, however are highest in this area (site 3). Higher numbers of feedlots within this area as well as open animal access to the river may help explain the higher levels compared to other parts of the watershed.

A majority of the sediment and nutrient load is delivered from areas of the watershed that have the highest growing season rainfall amounts. As we move down the Little Cottonwood River system and into the lower reaches, sediment and nutrient loads increase significantly. This area occurs between water quality monitoring sites 3 and 4 of the watershed. Steep slopes/river gradient in combination with higher rainfall/runoff rates considerably increases the overall sediment and nutrient load to the river. Targeting Best Management Practices within this area should be a priority during future implementation phases of the project.

# Conclusions:

### Hydrology

- Under certain conditions, the recent changes in drainage in the upper portion of the watershed, mainly ditching and tiling, have resulted in more water leaving the upper portion of the watershed at a faster rate.

- Wetland restoration, retention basins and/or culvert downsizing may be an important BMP for controlling peak water flows downstream.

### Sediment

- Sediment concentrations and loads were elevated at all four monitoring sites during runoff conditions.

- Most of the sediment load is delivered between sites 3 and 4. In 1999 sediment yields increased from 58 lbs/acre at site 3 to 710 lbs./acre at site 4.

### Phosphorus

- Phosphorus concentrations and loads were moderate for the entire watershed.

- Sediments and phosphorus are directly correlated. The majority of the total phosphorus and soluble phosphorus is derived during storm events.

### Nitrates

- Nitrates are elevated in much of the watershed up until the end of July. After July leaching is minimized due to crop uptake and little or no leaching because of high evapotranpiration rates during this part of the season. Highest loads and concentrations occur near the headwaters.

- Nitrate levels decrease near the middle of the watershed due to wetland processes. Levels increase again after site 3.

- Based on samples taken from storm events, much of the nitrate is reaching the river through a shallow subsurface pathway. This pathway is mainly through underground public and private tile systems.

### Pathogens

- Most of the elevated Fecal Coliform bacteria counts occur during runoff events, suggesting sources of bacteria from sources such as feedlots. High counts during low flow conditions did occur at times during the study suggesting point sources. Failing septic systems are considered the main point source.

- Highest Geometric means were found at site 3. Possible reasons include the high number of livestock facilities, some of which allow access to the river.

## Water Quality Goals

Factors used to derive attainable water quality goals for the Little Cottonwood River:

- Revised Universal Soil Loss Equation model
- FLUX Loading model
- Analysis of livestock manure contributions to the 1999 total phosphorus load from the watershed
- MN River and TMDL goals
- Red Top Farms Nitrogen Management Demonstration Site
- Current EPA water quality standards for surface and groundwater.

### Sediments

The 1998-2000 flow-weighted mean total suspended solids (TSS) concentration at the mouth of the Little Cottonwood is 203 mg/l (Table 40). Based on eco-region reference values, as well as the turbidity standard for the Little Cottonwood (which can be roughly equated to TSS), a flow-weighted mean concentration in the 50-100 mg/l range would be desirable. This may not be a feasible goal, however, in a three-year project. The soil erosion potential model, summarized in Tables 10 & 11, provides some sense for what might be feasible. Table 11 contains modeled erosion rates on lands within 200 ft. of any waterway. If soil erosion on all of this land were cut in half, it would amount to an estimated 16.7 million pounds of soil per year. Assuming that 10% of this eroded soil reaches the Little Cottonwood River, sedimentation would be reduced by 1.67 million pounds per year. Using similar assumptions, cutting soil erosion in half on an additional 1500 acres of land (proposed CREP enrollment acres during phase II) could result in a sedimentation reduction of 3 million pounds, for a total of 4.67 million pounds. This 4.67 million pounds represents about 16% of total suspended sediment that left the watershed in 1999, and about 40% in 1998 and 2000. **Based on these figures, a load reduction goal of about 25% is aggressive, yet reasonable. This translates to a flow-weighted mean concentration goal of about 150 mg/l or 115 lbs/acre.**[1]

### Phosphorus

Based on ecoregion reference values, as well as comparisons with other watersheds and the Minnesota River, total phosphorus concentrations and yield in the Little Cottonwood are not particularly high. Nevertheless, analysis contained in this report indicates that some reductions should be possible (especially after monitoring station 3 within the watershed). There are many sources of P, but in this watershed sources are mainly derived from: human and animal waste, soil attached, and commercially applied fertilizer. Table 16a provides estimates of livestock manure contributions to the 1999 total

[1] Assume percent reductions apply equally to flow weighted mean concentrations and yields. For the goal setting process it was assumed flow weighted mean concentrations and yields were equal. For example, in 1999 FWMC for TSS was 260.1 mg/l and accumulated yield was 262.6 lbs/acre. In most years during the study the two categories--- FWMC(mg/l) and yields (lbs./acre) were similar enough to assume correlation.(Tables 34 and 35)

phosphorus load from the watershed. If only 5% of the livestock associated phosphorus reaches the river, this could account for over 50% of the phosphorus load. Phosphorus is also associated with sediment. Assuming 1 pound of phosphorus per ton of sediment, the 4.67 million pound sediment reduction goal described above would lead to a reduction of 2335 pounds of phosphorus. This is about 10% of the 1999 total phosphorus load for the Little Cottonwood (yield in Table 45 times watershed acres). Upgrading failing septic systems could result in a small additional reduction. Based on these figures, a 50% reduction in total phosphorus concentrations and yields seem an attainable goal. However, this reduction goal was considered too high within the three-year time-frame for this sized watershed. Even with improvements in feedlots, buffer strips, and septics phosphorus levels are assumed to not get below .110 mg/l or .166 lbs/acre. Inherent phosphorus levels found in the clay loam soils as well as built up phosphorus and other unknown factors make it difficult to obtain 50% reductions. **Water quality technicians recommend a more conservative goal of 30%. This translates into a goal of .152 mg/l FWMC or .232-lbs/acre total phosphorus yield at the mouth of the watershed within three-years.**

## Nitrate Nitrogen

The 1998-2000 flow-weighted mean concentration for nitrate nitrogen falls below the 10mg/l drinking water standard at the mouth of the Little Cottonwood River. In the headwaters area, the concentration is 11.6 mg/l. Based on the interconnectedness of surface water and groundwater, particularly in the upper portion of the watershed, maintaining a nitrate concentration below 10mg/l is important. The further refine nitrate reduction goals in the watershed recent research from Red Top Farms was used. Research conducted by Minnesota Department of Agriculture special projects unit staff at the Red Top Farm in Nicollet County, just to the east of the project area, have documented reductions in tile drainage nitrate of up to 60% (from average of 23 mg/l to 11.5 mg/l).

Water quality results from the first four years of the Red Top Farms study[2] indicate that producers can have a profound impact on the amount of nitrate leaching from their fields. Nitrate ($No_3$-N) concentrations in 1995-96 drainage waters (subsurface drainage tile) at the start of the demonstration were typically 20-25 mg/l. These numbers appeared to be typical ranges found under tile-drainage fields in southern Minnesota. By simply changing several basic nitrogen management strategies during the 1997 corn season, significant water quality improvements were observed. The farmer at Red Top switched to a spring-applied nitrogen program and lowered his fertilizer inputs to take the full 40 lb./acre legume credit from the previous year soybeans. Implementation of existing Nitrogen BMPs and University of MN Fertilizer Recommendations for southern MN resulted in a 40-60% reduction in the nitrate concentrations and no yield loss. Additionally, the results have been extremely positive for the majority of pesticide products that have been studied at the site since 1996. Figure 32 shows the decrease in nitrate within the tile water of the demonstration field at Red Top after key nitrogen management changes occurred.

[2] Minnesota Department of Agriculture, Red Top Farm Demonstration Site, Montgomery & Wotzka, 2000.

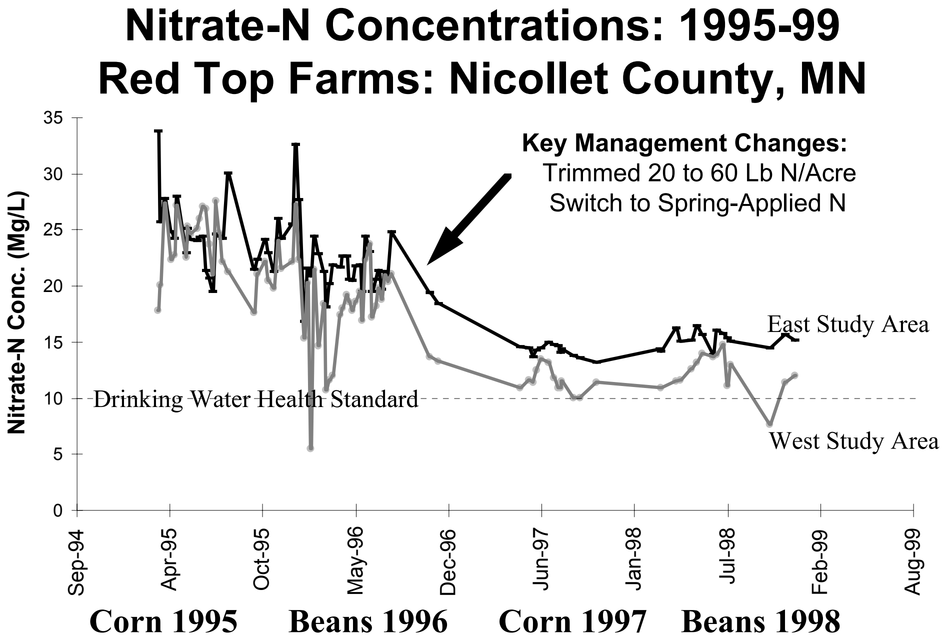


**Figure 32:** Nitrate reductions at Red Top Farms Study (1995-1999). Sub-surface tile drainage from two 30-acre fields is monitored for nitrate-nitrogen at the Nicollet County farm. The graphic above shows the response after improvements in nitrogen management were implemented. By simply changing several basic nitrogen management strategies, reductions of 40-60% were documented.

With intensive nutrient management activities in the Little Cottonwood River watershed, similar reductions are feasible. In the Little Cottonwood, a combination of septic system improvements and key nitrogen management changes on corn acres, a 40% reduction in nitrate concentrations and yields could be attainable, but considering the large number of corn acres and subsurface drain tile within the watershed it was felt this reduction goal is not realistic within the time frame. **Therefore a more realistic goal of 30% was set. This translates to a long-term flow-weighted mean concentration goal of about 5mg/l or 5.2-lbs./acre yield at the mouth of the watershed.**

## Pathogens

Overall, fecal coliform bacteria levels in the Little Cottonwood River were not particularly high. One site conistnently exceeded water quality limits. Site 3 had a geometric mean greater than the state water quality standard of 200 colonies/100 ml (Table 28). Sites 2 and 4 had individual date water quality standard violations for only 11% of the samples taken. **As such, the goal of this project is to consistently meet state water quality standards for fecal coliform bacteria.** (below 200 col./100ml)

## Biological-Fishery

Although no formal management plans have been documented for the river regarding the biological structure, informal fisheries goals by the DNR have been set as a result of fish surveys. Game fish such as walleye, northern pike, channel catfish and smallmouth bass have been present in the lower and middle reaches (mi. 56-0) and their presence should be of special concern to the area. The following are general informal guidelines presented by the DNR.

- **Long-term goal of securing more wetland habitat within the middle portion of the watershed (mi. 18-56) to improve northern pike spawning areas.**

- **The presence of small mouth bass utilizing the lower reaches (mi.18-0) (as indicated by 1986 survey) should be of special concern to the area and in stream as well as watershed management strategies should be addressed to enhance this habitat.**