Lower Cannon River Watershed

The TMDL & Implementation Plan

Eileen Weigel, Danielle Dutton
October 1, 2009
Background

- Lower Cannon River
  - Turbidity TMDL: July 2007
  - Implementation Plan – DRAFT stages

http://www.geocities.com/justin_meager/codandmysid.jpg
Minnesota Rules, 7050.0222, subpart 4:

“The quality of Class 2B surface waters shall be such as to permit the propagation and maintenance of a healthy community of cool or warm water sport or commercial fish and associated aquatic life, and their habitats. These waters shall be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable."

- The entire Lower Cannon River is classified as a Class 2B water.
Watershed Characteristics
**Impaired Waters**

- Class 2B waters: 25 (NTU) for Turbidity

**303(d) listed waterways in LCR:**

- 1996 - The Cannon River, HUC boundary in Rice Lake Bottoms to Vermillion Slough/Mississippi River
  - Aquatic life impairment based on turbidity data from MPCA

- 2004 - The Cannon River, Pine Creek to Belle Creek
  - Based on turbidity data from the Cannon River Watershed Partnership (CRWP) and Metropolitan Council.
Notes: T= Turbidity, FC= Fecal Coliform

http://www.pca.state.mn.us/water/tmdl/tmdl-maps.html
1. Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking
2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target
3. Loading Capacity - Linking Water Quality and Pollutant Sources
4. Load Allocations (LAs)
5. Wasteload Allocations (WLAs)
6. Margin of Safety (MOS)
7. Reserve Capacity (only inferred by LA and WLA guidelines)
8. Seasonal Variation
9. Reasonable Assurances
10. Monitoring Plan to Track TMDL Effectiveness
11. Implementation
12. Public Participation
13. Submittal Letter
14. Administrative Record
CWLA TMDL Requirements

Minnesota’s set of more comprehensive set of goals.

1. Water use designation
2. Severity of impairment
3. TMDL completed in 15 years
4. Risk to human health
5. Risk to aquatic life and threatened or endangered species
6. Illustrate where public agencies have demonstrated readiness
7. Coordination and Cooperation with other units
Land Use

- Row crops: 60.54%
- Grass, pasture, etc: 16.08%
- Forest: 8.79%
Streamflow – the big issue

- Streamflow:
  - Avg annual; Avg May flow; and Avg September flow.
  - Increased by factors of two to three
  - Runoff from the land = TSS

- The second challenge - stream channel stability.
  - Flows = Continued Channel adjustment
    - Channel widening (bank erosion)
    - Downcutting (streambed erosion)
The sum of:

- Wasteload allocations (WLAs) for point sources
- Load allocations (LAs) for nonpoint sources
- Natural background
- Margin of safety (MOS)

Magic Number:
25 NTU == TSS load: 44 mg/L
(conservative value)
USGS Long Term Resource Monitoring Program

- @ Confluence: 20% exceedance value = Impairment

Monitoring on Pine-Belle reach

- Additional sampling conducted by MPCA, MCES, CRWP
- Found: 9% exceedance value = Not impaired

*MPCA believes lower % partially due to differences in sampling design and methodology

TMDL developed with Pine-Belle data
Inventory of sources

- NPDES – Municipal and Industrial Permit Holders

- Stormwater
  - 3% of Lower Cannon River is Urban/Developed
  - Red Wing only municipality to obtain MS4 permit
    - Municipal Separate Storm Sewer System (MS4)
    - Discharges to Mississippi River – N/A

- Construction Permits
  - EPA estimates Soil Loss: 20 – 150 tons/acre/yr
Inventory of Sources

- Aggregate/mining operations (often permitted)
- Unpaved roads

Agriculture:
- 60% of land use in LCRW is agricultural row crops
- Livestock grazing
  - Roughly 18% of land use is grassland/pasture

In stream sources
- Increase of channel instability and accelerated sediment yield
- Bank Failure
### Events influenced by stormflow:

- Convective thunderstorm/heavy rainfall, lack of crop canopy to protect soil
- If streambank erosion is primary cause – would see TSS predominant at High Flows

### Table 10 - Lower Cannon Stormflow and Crop Canopy Effects on TSS Loading

<table>
<thead>
<tr>
<th>Location</th>
<th>All Data (tons/day TSS)</th>
<th>50&lt;sup&gt;th&lt;/sup&gt; percentile (median)</th>
<th>90&lt;sup&gt;th&lt;/sup&gt; percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confluence 07040001-511</td>
<td>Stormflow samples removed (tons/day TSS)</td>
<td>47</td>
<td>266</td>
</tr>
<tr>
<td></td>
<td>Percent of current load not associated with stormflow samples</td>
<td>86%</td>
<td>76%</td>
</tr>
<tr>
<td></td>
<td>Pre-crop canopy (April-June) samples removed (tons/day TSS)</td>
<td>31</td>
<td>211</td>
</tr>
<tr>
<td></td>
<td>Effect of April-June sample removal</td>
<td>21% reduction</td>
<td>34% reduction</td>
</tr>
<tr>
<td>Pine-Belle 07040002-502</td>
<td>All Data (tons/day TSS)</td>
<td>19</td>
<td>227</td>
</tr>
<tr>
<td></td>
<td>Stormflow samples removed (tons/day TSS)</td>
<td>11</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Percent of current load not associated with stormflow samples</td>
<td>57%</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>Pre-crop canopy (April-June) samples removed (tons/day TSS)</td>
<td>6</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Effect of April-June sample removal</td>
<td>68% reduction</td>
<td>81% reduction</td>
</tr>
</tbody>
</table>
Lake Byllsby

Mean Daily Flow Comparison

Blue: Little Cannon
Pink: Welch
Yellow: Byllsby Dam

High contributor of Streamflow

was made not to attempt to explicitly account for these effects on the TMDL.”
Allocations

- Wasteload Allocation (WLA)
  - Permitted
  
  Remaining wasteload sources (MS4, construction, and industrial stormwater) was determined based on the estimated percentage of land in the impaired reach watersheds affected by these uses.

- WLA: 4.7 tons/day of sediment
Load Allocation (LA)

- Nonpoint sources + “natural background” sources.

- LA: **1300 tons/day** during high flow conditions.

  - An assessment of nonpoint sources was not part of the TMDL process beyond recognizing the various categories of nonpoint sources.
Margin of Safety (MOS)

- Loading capacity for each flow zone is set at the mid-point of the zone.

- The Margin of Safety for each zone is then calculated as the difference between the mid-point of the zone and the right-hand (lower flow) side of the zone.

- MOS protects against TSS loading where there is less capacity in the river due to lower flows.
Reductions

- Confluence:
  - High Flows: 82%
  - Mid Range: 39%
  - Dry Conditions: 20%
  - Low Conditions = 0%

- Pine-Belle
  - High Flows: 49%
  - Mid Range: 27%
  - Dry Conditions: 8%
  - Low Conditions = 0%

#’s derived from Comparison of 90th percentile TSS daily load to capacity at the mid-point of the flow zone
Priority Management Areas

“A detailed source assessment of the nonpoint sources in the Lower Cannon River watershed has not been completed to date.”
Future Research

- Lower Cannon River
  - Modeling? S.W.A.T
  - Water Monitoring
  - GIS
  - In order to:
    - “We must move away from random acts of conservation and provide solid, convincing evidence to land managers of the hydrologic pathways and processes that are driving poor water quality.” Magner (TISWA paper)
Future Research and Alternatives

- **Investigations needed**
  - Riparian Channel Assessment and Inventory
  - Tillage Survey
  - Gully Mapping

- **Nonpoint Source Management Alternatives**
  - Managed Rotational Grazing
  - Continuous Grazing

- **Point Source Management Alternatives**
  - *Urban Stormwater Runoff*
Land Management Alternatives

- **Structural Practices**
  - Terraces
  - Water and Sediment Control Basins
  - Stream J-hooks and Rock Weirs
  - Stream Crossings
  - Fencing and Watering Systems
  - Wetland Restorations
  - Buffers

- **Vegetative Practices**
  - Grassed Waterways
  - Conservation Tillage and Residue Management
Objective #1

- Task A: Assessment and inventory
- Task B: Structural Practices Installation
- Task C: Vegetative Practices Installation
- Task D: Ordinance Adoption and Enforcement
- Task E: Market Development
Objective #2 – Point Source Measures

- Task A: Education/Outreach
- Task B: Construction Sites and Erosion Control
- Task C: Pollution Prevention / Good Housekeeping
Objective #3: Monitoring

- Task A: Long Term Water Quality Monitoring
- Task B: MPCA’s Intensive Watershed Monitoring
- Task C: BMP effectiveness Monitoring
Objective #4: Education and Outreach

- Task A: Education/Outreach Activities
- Task B: Research
- Task C: Website/Media
- Task D: Project Coordination and Promotion
“Unfortunately, current understanding of the different source or subwatershed contributions to turbidity in the Cannon River watershed is not sufficient for such numerical breakdowns.”
Effects of Impoundments?

- Built 1976 – 1983 in headwaters
  - to help control flow during periods of heavy precipitation.
  - Prior to installation
    - Belle Creek est: 44,000 Tons annually
    - Impoundments estimated to reduce sediment loading by 3,000 tons annually
  - No monitoring has been conducted to sufficiently verify the estimated loads, or any subsequent reductions
Personal Observations

- Hard to disagree with Turbidity impairment from MPCA
  - Pg 6 of TMDL cites a personal account from a citizen monitor, relating observations of slumping on Belle Creek

Citizen stream monitors collect data on transparency, temperature, stream stage, and appearance of streams throughout the watershed. Mrs. BJ Norman is a long time monitor of Belle Creek. In a letter to CRWP in 2005 Mrs. Norman writes:

Belle is always changing. This year (2005) I witnessed particularly the “slumping” off of great chunks of soft bank down stream. Belle wanders quite a bit through the soft sediments of the valleys. Seems that once it starts it will “rapidly” chew away at one bank and build back up on the opposite bank.
But what about the Soils?

- Windblown silt (loess) deposited by the last ice sheet
  - Loess – typically: 5 to 15’ thick and thickens eastward
  - Non-cohesive and erodes easily
  - Hence: “much of the land is classified as highly erodible, especially where the loess lies on steep slopes”

- “There is potential for this eroded material to be stored locally in tributary flood plains and to contribute to suspended sediment loads. **This was not quantified**”
Windblown silt overlies loam to clay-loam glacial till from older glaciations in most areas
  - Glacial tills are less susceptible to erosion because of cohesiveness of clay

Yet, East of Cannon Falls, the Cannon River:
  - Continually adjusting in gradient to the Mississippi River
  - Channel adjustment could lead to scour of historically eroded sediment deposits
1994-1996 Macroinvertebrate assessments

- Cannon River Partnership / St Olaf College / EPA/ Local School Teacher
  - “relatively healthy”
  - NPS pollutants: impact is “slightly moderate”
  - Habitat scores lowest: “unfenced pasture”
  - High scores: wide riparian zones (> 25 meters)
“Good level” of diversity with approx. 14 species found being Game Fish

At mile 35 – DNR found “Ozark Minnow” species of concern
Algae?

Total Suspended Non Volatile Solids TSNVS

- In Lower Cannon River
  - OM / TSVS: 10 – 50%
  - Highest % occur when TSS values are low
  - Decline when TSS values increase

- Sources:
  - Transported from Uplands, dislodged from streambed during high flows
    - Phytoplankton (algae) – floating goop
- Chlorophyll-a observations at Welch and Confluence of LCR
  - Chlorophyll-a 80 ug/L ~ Turbidity 37 NTU
  - Turbidity 37 NTU ~ TSNVS approx. 50 mg/L
  - TSNVS could be dominate influence
    - Algal growth may contribute to Turbidity
    - Need reduction of Chlorophyll-a 20 ug/L ~ Turbidity 2.4 NTU

- LCR TMDL: No attempt made to “explicitly account for this relationship” or allocate loading
A note on this TMDL...

- First Turbidity TMDL
- Identification of Sources – continual battle
- Modeling can be difficult
- More time should have been spent identifying sources – linking problem areas to landowners
- Although CWA does not directly address allowed authoritative action – identification of landowners/sources is important!
Success?

- Only if organizations work together and enforce rules and regulations
- Need to pin point sources
- To determine extent of success, long term monitoring needs to take place
Future TMDLs

- TMDLs on a watershed approach
  - Aided by CWLA
  - Belle Creek and unnamed tribgs, increased area by 40%
    - Influence of Creek is difference between two reaches, had to adjust for increase in flow
    - Appears Belle Creek and tribgs have major influence on confluence

- SSC instead of TSS?
  - 25% of sample > 63 um, show different results
Pine Cr to Belle Cr: TMDL approved for FC, T

Trout Brook: TMDL needed, NO3, T

Spring Cr: TMDL needed, T

Butler Cr: TMDL needed, E coli, T

Belle Cr: TMDL needed, E coli, T

Hay Cr: TMDL needed, T

Little Cannon River: TMDL needed, Ecoli, T

Notes: T= Turbidity, FC= Fecal Coliform

http://www.pca.state.mn.us/water/tmdl/tmdl-maps.html