Carver Creek Turbidity Implementation Plan

July 2013

Submitted by:

Carver County Land and Water Services

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1 Introduction

Section 303(d) of the Clean Water Act requires that every two years states publish a list of waters that do not meet water quality standards and do not support their designated uses. These waters are then considered “impaired.” A total maximum daily load or TMDL must be developed for those impaired waters once they are placed on the list. The TMDL provides a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards.

The state agency responsible for listing waters in Minnesota is the Minnesota Pollution Control Agency (MPCA). In 2002, the MPCA added Carver Creek to Minnesota’s 303(d) list of impaired waters for an impairment of aquatic life due to turbidity levels in exceedance of the water quality target of 25 nephelometric turbidity units (NTUs) for Class 2B waters. A TMDL study was conducted by Carver County Water Management Organization (CCWMO) and approved by the Environmental Pollution Control Agency (EPA) in September 2012.

This Implementation Plan includes measures to help achieve the goals that are outlined in the Carver Creek Turbidity TMDL. A stakeholder committee was formed by area landowners, local government agencies, and local organizations to help guide the process on which action items should be included in this study for use throughout the watershed. This group first met on February 21st, 2013, the second meeting was March 7th, 2013, and the last meeting was held on March 28th, 2013. Minutes of these meetings are in Appendix A.

2 TMDL Report Summary

2.1 Description of Impairments

In 2002, Carver Creek (AUID 07020012-516) was listed on Minnesota's 303(d) list of impaired waters from its headwaters to the Minnesota River for an impairment of aquatic life due to turbidity levels in exceedence of the water quality target of 25 NTU for Class 2B waters. The objective of this TMDL is to estimate allowable pollutant loads and to allocate these loads to the known pollutant sources in the watershed so that the appropriate control measures can be implemented.

Table 2.1 Carver Creek Impaired Reaches.

Turbidity Impaired Reaches of Carver Creek Watershed	
AUID 07020012-516	Carver Creek

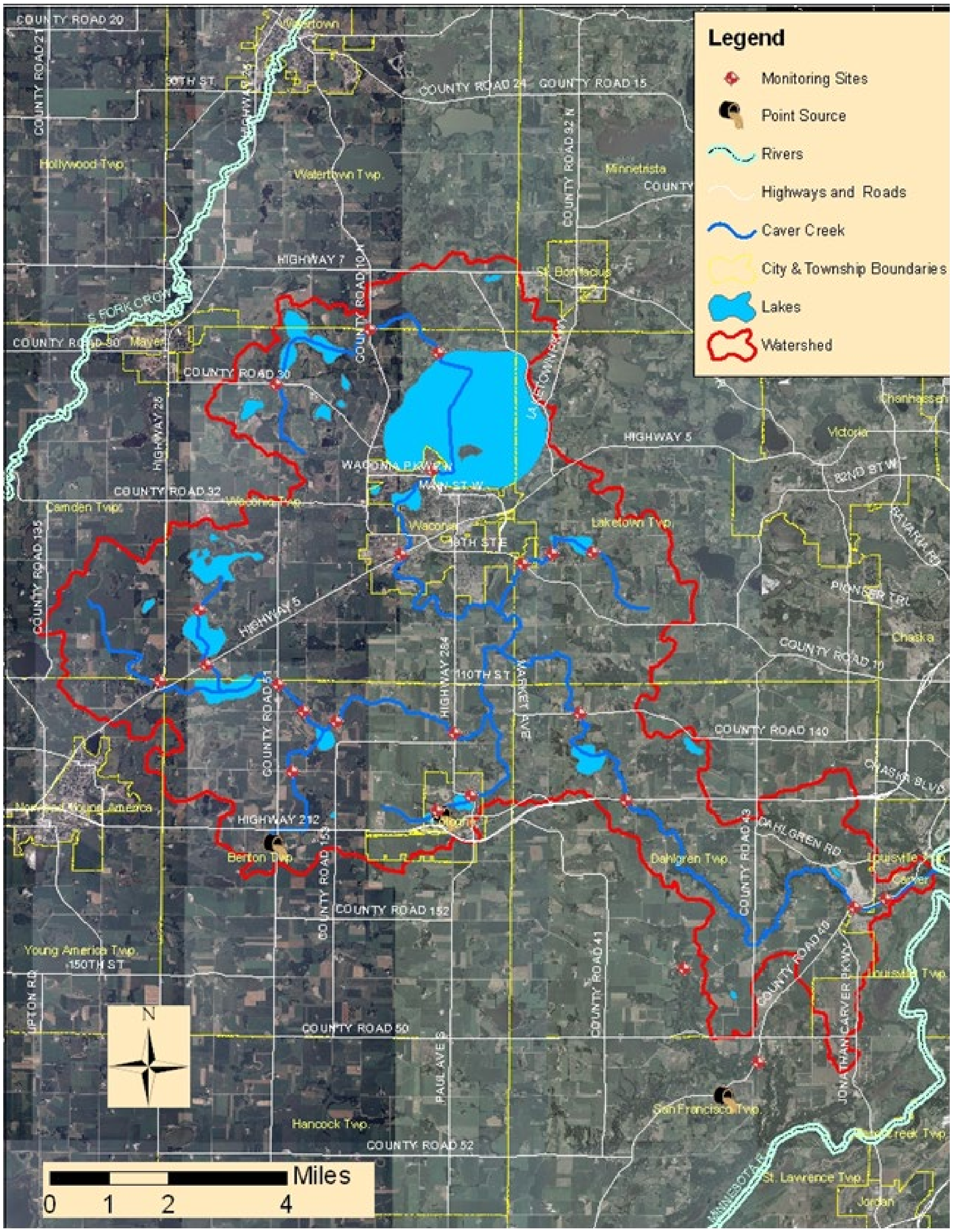


Figure 2.1 Location of Carver Creek Watershed

2.2 Development of the Flow Duration Curve

The duration curve method depicts water quality data over the full range of expected flow conditions, and it is well suited to water quality impairments that are correlated with flow (USEPA, 2007). The flow duration curve serves as the foundation for development of the load duration curve, on which TMDLs can be based. It relates flow values to the percent of time those values have been met or exceeded. The use of "percent of time" provides a uniform scale ranging between 0 and 100. Thus, the full range of stream flows is considered. The curves generally use average daily flow values sorted from highest to lowest. The values are plotted, with zero corresponding to the highest flow value and 100 corresponding to the lowest value. Based on the flow duration curve method guide (USEPA, 2007) the flow duration curve can be divided into separate flow regimes represented by various percentiles. Typical divisions include high flow (<10 percent), moist conditions (10-40 percent), mid-range flow (40-60 percent), dry conditions (60-90 percent) and low flow (>90 percent). The flow duration curve for Carver Creek is shown in Figure 2.2. The curve uses average daily flow values monitored from 1990 through 2007 at the MCES monitoring station.

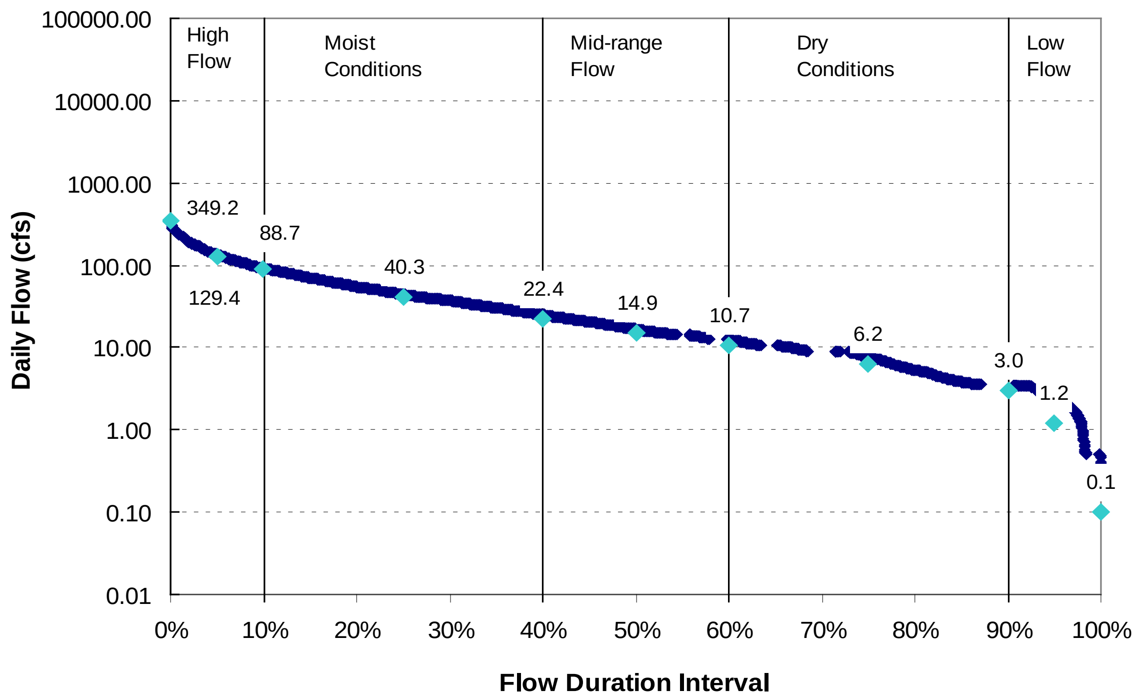


Figure 2.2 Flow Duration Curve for Carver Creek at MCES Monitoring Station.

2.3 Calculation of TSS Equivalent for Turbidity Standard

Minnesota has a water quality standard for turbidity in streams. For Carver Creek, the turbidity standard is 25 NTU. Turbidity cannot be expressed as a load as required by the TMDL regulations. To achieve a load based value, a surrogate of 100 mg/L TSS is being used based on the correlation between turbidity and TSS loads.

MCES developed a statistical relationship between turbidity and TSS for the creeks in the metropolitan area (MCES, 2008). A simple linear regression equation was used to fit the monitoring data sets of TSS and turbidity. The regression analysis for Carver Creek is plotted in Figure 2.3 and the equation was:

$$\log(\text{TSS}) = 0.2565 + 1.2472 * \log(\text{NTU})$$

The equation was then used to estimate an average TSS value equal to 25 NTU. Based on this analysis, 100 mg/L was proposed as the surrogate of 25 NTU for Carver Creek. Therefore, 100 mg/L was used as the TSS concentration target.

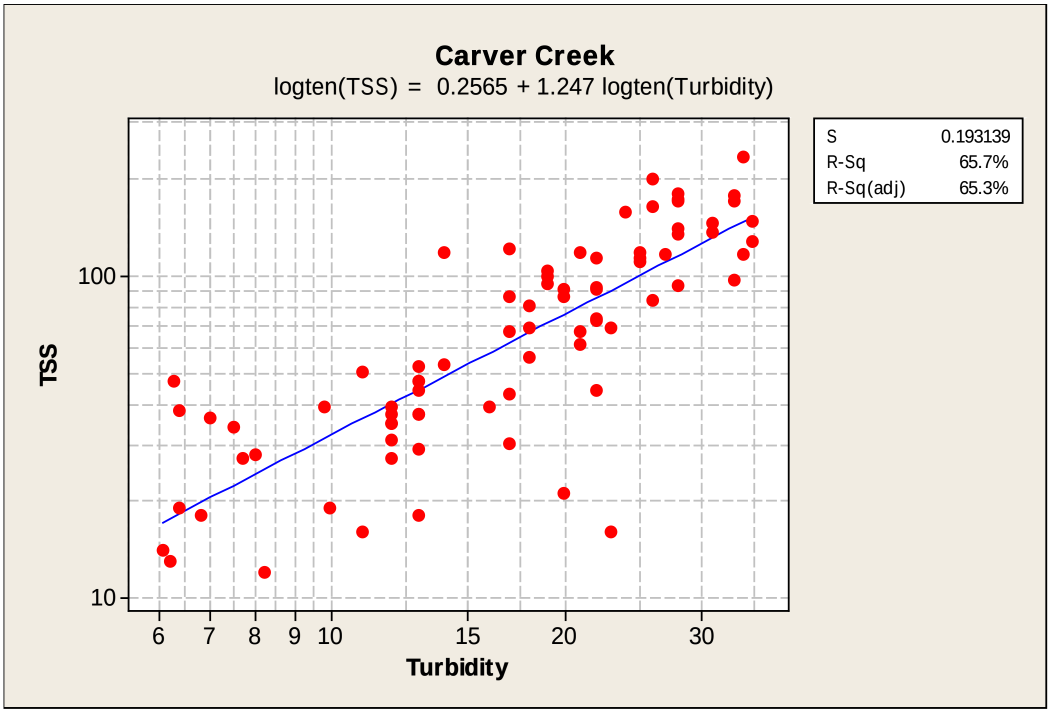


Figure 2.3 Regression Analysis of Turbidity and TSS for Carver Creek (MCES, 2008)

2.4 Determining Loading Capacity

There are several components to be estimated for TMDL allocations. They include loading capacity (TMDL), WLA, LA and MOS. Before the individual components of the TMDL can be allocated, the total loading capacity of the water body must be determined. The TSS load duration curve, which is estimated by multiplying stream flow and the target water quality standard, actually represents instantaneous loading capacities that vary as a function of flow (according to the guidance from the USEPA on using the duration curve method; USEPA, 2007). The load duration curve method is based on the flow duration curve analysis that looks at the cumulative frequency of historic flow data over a specified period. Because this method uses a long-term record of daily flow volumes virtually the full spectrum of allowable loading capacities is represented by the resulting curve. In the TMDL equation table of this report (Table 4.1) only five points on the entire loading capacity curve are depicted (the midpoints of the designated flow zones). However, it should be understood that the components of the TMDL equation could be illustrated for any point on the entire curve. The load duration curve method can be used to display collected TSS monitoring data and allows for estimation of load reductions necessary for attainment of the turbidity water quality standard (USEPA, 2007).
The TSS load duration curve for Carver Creek (Figure 2.4) was developed by multiplying stream flow with the numeric water quality target for TSS (100 mg/L). The curve is based on data from the MCES monitoring station, utilizing data from 1990 to 2007. The developed load duration curve displays the TSS loads that Carver Creek can carry and still be in attainment of the turbidity water quality standard based on using 100 mg TSS/L as a surrogate to the 25 NTU standard.

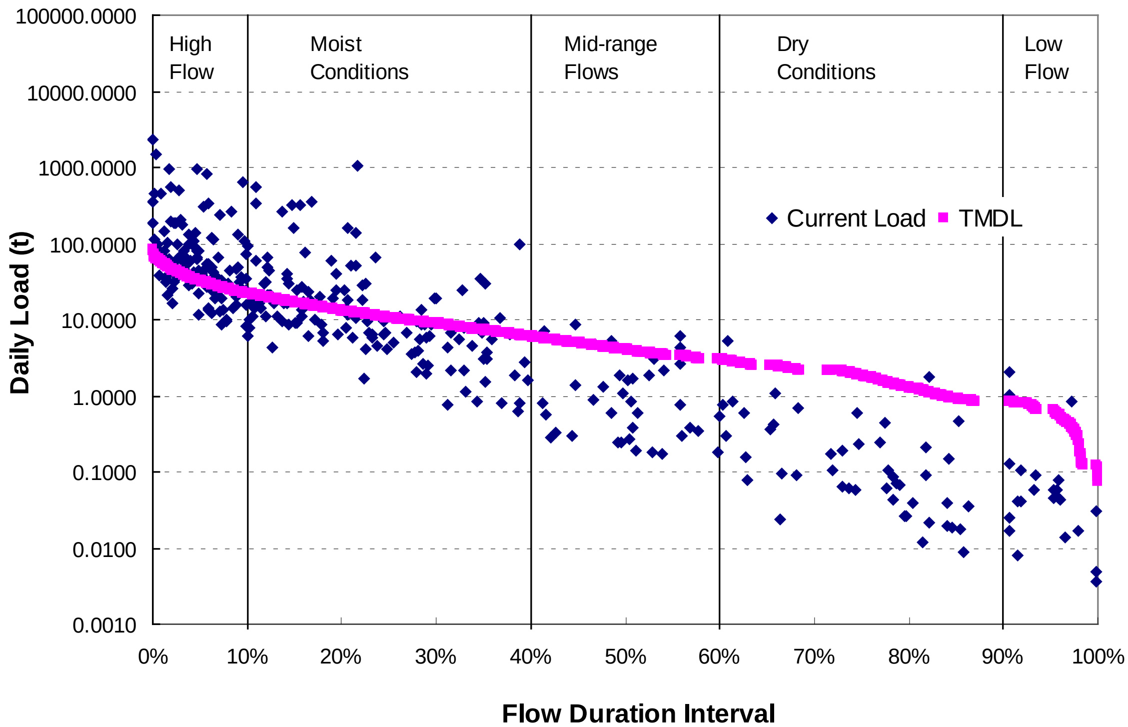


Figure 2.4 TSS Load Duration Curve for Carver Creek at MCES Monitoring Station.

The load capacities of TSS for the five flow regimes were calculated for the midpoint values of their flow conditions. Due to the significant variations ranging from 129.4 cfs at high flow to 1.2 cfs at low flow, the load capacities are substantially different for the five flow regimes. The estimated load capacities vary from 32.4 t/day (32,400 kg/day) at high flow conditions to 0.6 t/day (600 kg/day) at low flow conditions. The load capacities at the moist conditions, mid-range flow and dry conditions are respectively 10.6 t/day (10,600 kg/day), 4.0 t/day (4,000 kg/day), and 1.8 t/day (1,800 kg/day).

2.4.1 Allocation of TMDLs

Once the total loading capacity for TSS for the five flow regimes is determined, it is possible to allocate TSS loads to the different components of the TMDL. Table 2.2 presents the allocated loads for total WLA, LA, and MOS as well as the individual allocations for WLA sources for the five flow regimes.

Table 2.2 TMDL Allocations for Carver Creek (kg/day) (AUID: 07020012-516)

TMDL Allocation	High Flow	Moist Conditions	Mid-Range Flow	Dry Conditions	Low Flow
Total Loading Capacity	**32,360.0**	**10,580.0**	**4,030.0**	**1,840.0**	**650.0**
Total WLA	**2,343.0**	**1,043.4**	**652.6**	**521.9**	**466.0**
Permitted Discharges from Wastewater Treatment and Industrial Facilities					
- Bongards' Creamery	379.2	379.2	379.2	379.2	379.2
- Cologne WWTP	36.9	36.9	36.9	36.9	36.9
- Carver WWTP	41.5	41.5	41.5	41.5	41.5
MS4 NPDES Requirements					
- Laketown Township	534.6	166.1	55.3	18.2	2.4
- City of Waconia	1237.0	384.3	127.9	42.2	5.5
- City of Minnetrista	8.5	2.7	0.9	0.3	0.04
- City of Carver	39.8	12.4	4.1	1.4	0.2
- Carver County	14.2	4.4	1.5	0.5	0.1
Construction and Industrial Stormwater	25.6	8.0	2.6	0.9	0.1
Industrial Stormwater	25.6	8.0	2.6	0.9	0.1
Reserve Capacity	**228.8**	**228.8**	**228.8**	**228.8**	*****
- Bongards' Creamery	189.6	189.6	189.6	189.6	*
- Cologne WWTP	18.5	18.5	18.5	18.5	*
- Carver WWTP	20.8	20.8	20.8	20.8	*
Margin of Safety	**3,236.0**	**1,058.0**	**403.0**	**184.0**	**65.0**
Load Allocation	**26,552.2**	**8,249.8**	**2,745.6**	**905.3**	**119.0**

*See Section 4.8 of the Carver Creek Turbidity TMDL for potential future use of reserve capacity

Table 2.3 Percent TMDL Allocations for Carver Creek (*AUID: 07020012-516)*

TMDL Allocation	High Flow	Moist Conditions	Mid-Range Flow	Dry Conditions	Low Flow
Total Loading Capacity	100.0%	100.0%	100.0%	100.0%	100.0%
WLA - Permitted Discharges	1.4%	4.3%	11.4%	24.9%	70.4%
WLA - MS4 NPDES	5.7%	5.4%	4.7%	3.4%	1.3%
WLA - Construction and Industrial Storm Water	0.2%	0.2%	0.1%	0.1%	0.04%
Reserve Capacity	0.7%	2.2%	5.7%	12.4%	*
Margin of Safety	10.0%	10.0%	10.0%	10.0%	10.0%
Load Allocation	82.1%	78.0%	68.1%	49.2%	18.3%

*See Section 4.8 of the Carver Creek Turbidity TMDL for potential future use of reserve capacity

3 Implementation Activities

3.1 Introduction

Carver County, through their Water Management Plan, has embraced a basin wide goal for protecting water quality in the Carver Creek watershed. Currently, Carver County has developed detailed action strategies to address several of the issues identified in this TMDL. The Carver SWCD is active in these watersheds and works with landowners to implement best management practices (BMPs) on their land.

A group of landowners, residents, and staff members of various local government agencies met three times to outline the best path to follow in meeting the goals of the Carver Creek Turbidity TMDL. Through these meetings, a set of BMPs were agreed upon as the best to pursue. A total of three meetings were conducted with attendance ranging from eleven to eighteen. Minutes from these meetings are included in Appendix A. The implementation strategies outlined in this report were derived from these stakeholder meetings.

3.2 Load Reduction Estimates

Estimates for the percent load reduction needed were made by comparing measured concentrations within each flow regime loads to the TSS surrogate concentration that is equivalent to the NTU standard (25 NTU). To make this estimate the listing/delisting criteria for turbidity was considered, which is based on whether or not 10 percent of the data points within a dataset exceed the turbidity standard. Therefore, this would mean reducing the 90th percentile value from the dataset down to the TSS loading target. Table 3.1 provides estimated percent reductions based on the load duration curve sampled TSS concentrations. This serves to provide a starting point based on available water quality data for assessing the magnitude of the effort needed in the watershed to achieve the standard. These reduction percentages do not supersede the allocations provided in Table 2.2.

Table 3.1 Estimated Concentration Reductions Based on Flow Duration Curve and collected TSS samples.

	High Flows	Moist Conditions	Mid-Range	Dry Conditions	Low Flows
TSS Concentration Target (mg/L)	100	100	100	100	100
Measured TSS Concentration at 90th Percentile (mg/L)	706	440	125	32	99
Reduction Needed	86%	77%	20%	0%	0%

To determine if loading reductions are required for MS4s the current loads for these areas were estimated and compared to the WLAs. Current loadings from these areas were estimated using the SWAT Urban TSS loading estimate of 0.31 percent of the total TSS load for the watershed multiplied by the measured load at the 90th percentile (Table 5.1) for each flow regime. This result is then multiplied by the relative area of each MS4 (as a percent of the total MS4 area), with the City of Waconia at 67.4 percent, Laketown Township at 29.2 percent, City of Carver at 2.2 percent, City of Minnetrista at 0.5 percent, and Carver County at 0.8 percent. Table 3.2

provides current estimated loadings for MS4 areas. Comparing these to allowable loadings (Table 2.2) indicates that no reductions appear to needed from MS4 areas. The regulated MS4 communities will need to maintain at least the existing level of treatment of their stormwater discharges to ensure continued compliance with the conditions of the MS4 general permit. At the time of permit application, permittees will indicate that a WLA was assigned to them in this TMDL project, they are currently meeting that WLA since no reductions were called for, and they will continue to maintain the current BMPs on the landscape to ensure compliance with their permit.

Table 3.2 Current MS4 TSS Loadings (kg/day).

MS4 NPDES Permits	High Flow	Moist Conditions	Mid-Range Flow	Dry Conditions	Low Flow
- Laketown Township	246.62	60.43	4.50	0.66	0.63
- City of Waconia	570.63	139.82	10.41	1.53	1.47
- City of Minnetrista	3.94	0.96	0.07	0.01	0.01
- City of Carver	18.37	4.50	0.34	0.05	0.05
- Carver County	6.57	1.61	0.12	0.02	0.02

3.3 Proposed Watershed Activities

BMPs listed for the watershed below are activities that can be implemented to reduce sediment loading to Carver Creek. The goal of this section is to provide and explain BMPs that have been chosen through the Stakeholder Group and will reduce sediment sources through source control, water quality treatment, or runoff control. It is acknowledged that to reach the TMDL goals, in-stream activities must also be undertaken.

The SWAT model that was completed as part of the TMDL effort will be utilized to help with targeting subwatersheds that have the highest relative sediment loading rates. This will ensure that public and private funds are used in a manner that will maximize the benefit to Carver Creek.

3.3.1 Urban activities

Carver County and its communities are currently experiencing a high level of growth. An unavoidable outcome of this growth is the conversion of land from rural/agricultural use to urban use (residential, commercial, roads, etc.) Proper management of stormwater both during and after construction can decrease the potential for flooding and protect water quality.

During construction, land is highly susceptible to erosion, especially when Best Management Practices (BMPs) addressing erosion and sediment control are not installed and maintained properly. Sediment is considered to be one of the most damaging pollutants in Minnesota, and is the major pollutant by volume in state surface waters. Runoff from construction sites is by far the largest source of sediment in developing urban areas. Sediment-loading rates from construction sites are 5 to 500 times greater than those from undeveloped land (USEPA, 1977). Proper design and installation of erosion and sediment control BMP's along with monitoring of their effectiveness and maintenance when required can help reduce sediment loading rates from developing areas. The BMPs and other stormwater control measures that should be implemented at construction sites are defined in the State's NPDES/SDS General Stormwater Permit for Construction Activity (MNR100001). If a construction site owner/operator obtains coverage under the NPDES/SDS General Stormwater Permit and properly selects, installs and maintains all BMPs required under the permit, including those related to impaired waters discharges and any applicable additional requirements found in Appendix A of the Construction General Permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL. It should be noted that all local construction stormwater requirements must also be met.

After construction is finished, developed areas typically have more impervious surface, infiltrate less water, and have larger runoff volumes and rates. In addition, the traditional approach to managing urban runoff confines runoff to pipes and ditches and concentrates large volumes of water into small conduits. The result is high water velocities at the outlets and increased erosion and sedimentation in creeks and streams and along shoreland. Research conducted in many geographic areas, concentrating on many different variables, and employing widely different methods have shown similar results; stream degradation occurs at relatively low levels of watershed imperviousness (10-20%). Degradation occurs due to increases in the volume and velocity of stormwater runoff; and sediments and toxic substances the stormwater picks up. (Carver County Water Plan, 2010)

For industrial stormwater the BMPs and other stormwater control measures that should be implemented at the industrial sites are defined in the State's NPDES/SDS Industrial Stormwater Multi-Sector General Permit (MNR050000) or NPDES/SDS General Permit for Construction Sand & Gravel, Rock Quarrying and Hot Mix Asphalt Production facilities (MNG490000). If a facility owner/operator obtains coverage under the appropriate NPDES/SDS General Stormwater Permit and properly selects, installs and maintains all BMPs required under the permit, the stormwater discharges would be expected to be consistent with the WLA in this TMDL. It should be noted that all local stormwater management requirements must also be met.

3.3.1.1 Pond Design

Carver County's 2010 Water Plan regulates discharge from these development sites and the County has established stormwater management rules to ensure that water leaving the site has been treated to ensure that the receiving water will not be further degraded. These rules require that 90 percent of both total phosphorus and total suspended solids be removed from stormwater prior to discharging to a downstream water body.

Traditional storm ponds that have been in use since the early 1980's have relied on the design criteria based upon the National Urban Runoff Program (NURP) standards. This type of pond provides approximately 60 percent removal of both total phosphorus and suspended solids. To reach the required 90 percent removal, other methods must be utilized. Design criteria for filtration basins, benches, and trenches have been authored by Carver County Water Management Organization to provide guidance on how to achieve the standard. Implementing the standard will also help achieve the goals of the Turbidity TMDL.

3.3.1.2 Piping

Standard practice for most towns and cities is to construct a network of pipes to transport water off of streets and low lying areas as fast as possible to the nearest water body. Due to this, storm water is reaching streams much faster and in larger quantities, causing erosion of the stream itself. Research and innovative best management practices in recent years have strived to reduce this effect to streams.

One approach is to find ways to disconnect, or daylight, sections of the stormwater sewer and route flows through BMPs to both reduce pollutants in the stormwater and reduce the velocity of the flow. . Other techniques include homeowners redirecting downspouts from roofs to flow over a lawn instead of on the driveway. Commercial and industrial sites can pipe stormwater from both roofs and pavement to areas that will treat the water before entering the city's storm sewer network.

3.3.1.3 Volume Control

Development causes land surface changes - like increases in impervious surfaces and soil compaction - that dramatically increase the total volume of runoff generated in a watershed. As the amount of impervious surface increases in a watershed, the amount of natural vegetation and natural storage decrease, resulting in larger volumes of stormwater runoff. For example, converting a farm field to an urbanized area typically doubles the volume of runoff; converting forested areas to impervious surfaces can result in a nine fold increase in stormwater runoff. Larger volumes of stormwater runoff can lead to flooding on neighboring properties or other offsite impacts.

Impervious surfaces and compacted soils, as well as improvements to the drainage system such as storm drains, pipes, and ditches, increase the speed at which rainfall runs off land surfaces within a watershed. Rainfall quickly runs off impervious surfaces instead of being absorbed and released gradually as in more natural landscapes. Higher and faster flows due to development can cause erosion on neighboring properties, degrade aquatic habitats, and increase erosion within stream systems.

In order to address the impacts of development on water quantity, the CCWMO has developed rate and quantity standards for stormwater design to mitigate impacts from development. Water Resource Management Standards are given in Carver County Ordinance Title XV, Chapter 153. The goal of the CCWMO is to manage runoff from development by utilizing BMPs or low impact development techniques to resemble or maintain pre-development hydrological conditions. (Carver County Water Plan, 2010)

3.3.2 Rural Activities

3.3.2.1 Wetland Restoration

Impoundments such as wetlands and ponds are probably one of the most commonly used practices in watershed management to temporarily store excess water, reduce flood damage, stabilize drainage ways, reduce erosion, remove pollutants and provide habitat for wildlife. Sedimentation in combination with biogeochemical processes of adsorption, flocculation, decomposition, and biological uptake are the primary removal mechanisms for suspended solids and nutrients in wetlands, ponds and other water bodies.

Historically, wetlands in Carver County were considered a barrier to agricultural and urban development. The Minnesota Wetland Conservation Act's (WCA) statewide analysis indicates that less than 50 percent of pre-settlement wetland acres remain in Carver County (BWSR).

Any restoration, whether wetland or stream, is the process of removing manmade constraints that led to the degradation of the system (Ebersole et al. 1997, and Frissell et al. 1997). It is not the intent to directly recreate the natural structure, but to identify and mimic conditions that a natural state will create itself (Frissell and Ralph 1998). Using these guidelines, wetland restorations within Carver Creek will reconnect the hydrology of drained areas that have been deemed a priority and have support from willing landowners. In some instances, placing a weir or stop log in the ditch to flood these low areas might be the process that would be recommended.

To aide in targeting areas that are best suited for wetland restoration, Carver County Staff will rely on the Carver County Wetland Restoration Assessment (Water Plan, 2010), the SWAT model for Carver Creek (Met Council, 2009), and MPCA BMP targeting tools. Landowners will be contacted when areas that have been identified through this process to discuss options for wetland restoration projects on their property.

3.3.2.2 Conservation Tillage

Conventional tillage was probably the first and most important innovation that our ancestors developed in an attempt to increase crop productivity for food supply. Tillage was widely used on large areas with the invention of mechanical power, such as tractors, and the development of tillage technology. The major benefits of tillage include preparation of seed and root beds, weed control and establishment of surface soil conditions for water infiltration and soil erosion control. However, conventional tillage buries biomass residues, compacts soil and accelerates the biomass decomposition. Conventional tillage practices result in more surface runoff, greater susceptibility of soils to wind and water erosion and greater nutrient and chemical exports to receiving waters.

Conservation tillage is a method that leaves crop residue from the previous year on the field prior to planting and after to reduce soil erosion. These agricultural practices and techniques conserve both soils and water. Newer tillage practices and techniques may include: keeping biomass residues on the soil surface to minimize water and wind erosion, reducing or eliminating tillage, delaying tillage until near the time to plant the next crops, and tilling in contour across sloping land. Technically, conservation tillage can be defined as any tillage or planting system in which at least 30 percent of the soil surface is covered by plant residue after planting in order to reduce erosion by water or wind (Scherts, 1988).

Conservation tillage techniques include minimum tillage, mulch tillage, strip tillage, and no-till. No-till farming is a form of conservation tillage in which the crop is planted directly into vegetative cover or crop residue with little disturbance of the surface soil. Minimum tillage farming involves some disturbance of the soil, but uses tillage equipment that leaves much of the vegetation cover or crop residue on the surface.

Conservation tillage prioritization will target “hot spots”. Evaluation will primarily be based upon a field assessment of farming practices utilized by farmers and the SWAT model for Carver Creek.

3.3.2.3 Buffer Strips

Filter strips, sometimes referred to as buffer strips, are generally narrow areas of vegetation (mostly grasses) that usually extend along watercourses, streams, ponds and lakes as part of a conservation system designed to conserve water, soil and protect receiving waters. Vegetation within the strip slow the rate of runoff, and capture sediment, organic material, nutrients, and other chemicals conveyed by runoff. Filter strips are less effective in the control of soluble nutrients and pesticides in stormwater runoff. They also provide wildlife habitat and benefit the environment.

Current rules and regulations include that any new public ditch or public ditches that undergo improvements or have redetermination of benefits, must have a 16.5 foot buffer (MN Statute 103E.021). Also, parcels with permitted agricultural land uses along a public water have a 50 foot setback from the ordinary high water level (MN Rule 6120.330 Subp. 7).

3.3.2.4 Controlled Drainage

Controlled drainage is a management practice where the water table is manipulated through the blocking or releasing of tile drainage. Simple water control structures are placed at various locations within the tile drainage system to raise and lower the water table in the field. This will allow the landowner to regulate the water table to what is needed in the field. Usual operations would include lowering the control structure to allow water to freely drain in the spring and fall to allow for normal planting and harvesting operations. The structure would be partially raised in the summer to allow for crops to have access to water, thus reducing the need for irrigation. And during the winter months, the structure would be raised to limit outflow to Carver Creek. Studies and research have shown that volume of water leaving the field has decreased from 15 to 35 percent, indicating that it would be a beneficial practice for reducing the volume of water within Carver Creek.

Topography is the limiting factor for application of controlled drainage. To be economically feasible, land slopes must be less than one percent. Carver Creek has areas that meet this requirement, but are limited in total size. Also, due to the active management of these structures, some may view this as a disadvantage in time and maintenance. (University of Minnesota Extensions, 2009, http://www.extension.umn.edu/distribution/cropsystems/dc7740.html)

3.3.2.5 Marginal Cropland

Marginal cropland is the recognition that certain areas of farm land is not suitable for all types of crops. With the recent spike in corn and soybean prices, most producers are intensively row cropping. In areas that are susceptible to erosion, this practice will increase the rate of erosion. Utilization of land highlights these areas and crops will be chosen that will benefit not only the farmer, but also the land. In areas that are susceptible to erosion, pasture lands or alfalfa fields offer better protection. Other possible uses for these areas include the installation of sedimentation basins or other features that treat runoff. Both the SWCD and NRCS office have programs that offer both technical assistance to establish these areas, as well as cost share grants to install this type of BMP.

3.3.2.6 Address Road Ditch Encroachment

Township Roads across Carver County are established with either a 4-rod (66 feet) or 2-rod (33 feet) right of way (ROW). Ditches are common within the ROW as a conduit for surface runoff to the nearest water body. Under Minnesota Statutes 160.2715, it is a misdemeanor to plant, till, plow or erect a fence in the ROW.

It has been observed around Carver Creek that these limitations have not been followed. Farming in these areas cause erosion to occur, increasing sediment loading as well as the potential for the road itself to be undermined.

Gathering information from townships, cities, and the county will be essential in determining actual ROW in Carver Creek Watershed. Once this has been accomplished, field verification of intrusions into the ROW will be conducted. Landowners will be notified of any encroachment on the ROW.

3.4 Proposed In-Stream Activities

Field studies by the St. Croix Watershed Research Station have indicated that non-field erosion contributes approximately 70 percent of the TSS loads in Carver Creek. Significant efforts should be made to control field erosion in the watershed to reduce flow and TSS loads contributed from the landscapes to channels but also because reduced flows from the field erosion could also benefit downstream bank erosion. The non-field erosion, or bank erosion, directly contributes TSS to the channels and immediately impairs the water quality of the creek because the TSS from the non-field erosion is not assimilated by local water bodies such as wetlands and ponds. The non-field erosion control BMPs such as bank stabilization are, therefore, necessary in the Carver Creek watershed in order to achieve the water quality standard for turbidity.

3.4.1 Bank Stabilization

Bank stabilization projects are ideal for reducing localized erosion prone areas when large stream restoration projects are not feasible or necessary. Most landowners will look for options for bank stabilization as way to minimize loss of land. The following list has options for bank stabilization, but many others exist.

- <u>Stream barbs and vanes</u> – constructed usually with rock that are narrow, anchored to the eroding bank. The angle of the barb or vane is usually 20 to 30 degrees and pointed upstream. As water flows over the barb, the flow is directed away from the eroding bank.
- <u>Gabions</u> - wire boxes that are filled with rock that act as a form of hard armoring and placed on eroding banks.
- <u>Rip Rap</u> - eroding banks are lined with rock to absorb wave and current energy of a water body to reduce erosion. Usually banks are altered to have a low slope to ensure that rip rap will stay in place.

- Rootwads - A form of bank armoring, using vegetation instead of rock or concrete. Tree trunks are buried into the eroding bank at the toe to reduce energy of flowing water before it hits the bank.
- Tree Revetments - A form of bank armoring that uses native materials to dissipate wave and current energy. Vegetation, usually tree branches and brush materials, are bundled together and anchored to the eroding bank.
- Plantings – Live stakes and plantings can be used to stabilize eroding streambanks by adding root structure to a bank.
- Two-stage ditch – type of ditch that incorporates a small floodplain into the system. This allows for the ditch to mimic natural geomorphic processes of a small stream. It has the potential to increase storage within the ditch.

Bank erosion control measures are costly due to construction and maintenance requirements. In the Carver Creek Watershed, some sub-basins are much more highly erodible than others. Thus, applying BMPs to control bank erosion in selected sub-basins rather than to the entire watershed can greatly reduce implementation costs. As such, bank stabilization prioritization will target "hot spots." Evaluation will be based upon Carver Creek SWAT Model, field assessment, and GIS mapping software.

3.4.2 Stream Restoration

As with wetland restoration noted above, to develop a design of a successful stream restoration project, we must relax the constraints that humans have placed on the system and to re-establish conditions that natural states can create themselves (Aadland, 2011). In other words, human activities have reshaped streams to fit into designed areas by placing barriers thinking that we were improving them. A stream must restore itself by removing human interferences, we cannot force a design to make it work.

When designing these projects, one must look for an ideal model to replicate. This would be a stable reference reach of the same stream since it carries the similar volumes with similar watershed characteristics. These site specific design criteria include the hydrology, geology, hydraulics, bedload composition, sediment transportation, and other processes since both form and processes are interdependent. (Aadland, 2011)

Using these techniques, stream restoration projects will have a higher success rate for Carver Creek Watershed. Potential sites will be prioritized by utilizing staff input, GIS layers, SWAT model, and landowner interest.

3.5 Education

Outreach and education are key components for any successful implementation plan with a goal of increased awareness, collaboration, sense of community, and open dialogue amongst all participants. Carver County has taken an active role in engaging residents with the Carver County Education Coordinator. This position runs all educational and outreach activities for the Carver County Water Management Organization. Below are activities that will be lead by the Educator.

3.5.1 Workshops

The County will host multiple homeowner workshops in the area to increase the knowledge of certain BMPs that can be used. Not only will landowners learn about BMPs, but this will allow for citizens to learn of different programs that offer grants to install certain BMPs.

Also, the County is responsible for holding a series of workshops for contractors, developers, city officials, and others involved with urban development. These workshops are designed to increase knowledge of stormwater best management practices, introduce new methods and developments in stormwater research, and offer a time to network with other professionals.

3.5.2 Ongoing Publications

Carver County Water Management Organization publishes an online newsletter every two months touching upon various water quality issues. In addition to the six yearly online newsletters, a monthly Water Column is published in 5 newspapers in the County. These mediums can be used to highlight implementation strategies, methods, and successes

3.5.3 Citizens Outreach

The County provides information to citizens using many types of media. Information distributed includes basic info on water quality, environmental center, and more specific information such as programs the County offers. With a wide range of avenues to reach local landowners, information about implementation strategies and different best management practices will be widely available.

4 Prioritization of BMPs and location

Implementation activities throughout Carver Creek should be based upon a methodology that allows for targeting certain “hot spots”, instead of a scattershot approach that is common when relying on voluntary participation. Sections 4.1 through 4.3 summarizes the approach that CCWMO Staff will take in selecting these areas.

In addition to finding locations, a set of BMPs that local landowners are willing to use must be agreed upon. Stakeholder meetings were conducted throughout the months of March and April to establish this list, Section 4.4 outlines this process more.

4.1 SWAT Modeling

Objectives and tasks established for the Carver Creek Turbidity TMDL highlighted a need for a watershed scale model that was able to simulate natural, agricultural and urban ecological systems relevant to the hydrologic cycle, TSS yields and movements in the watershed. The SWAT (Soil and Water Assessment Tool) model developed by the U.S. Department of Agriculture Research Service and Texas A&M University was therefore chosen. SWAT is one of the advanced models recommended for TMDL studies by the USEPA. SWAT has been incorporated into the USEPA’s BASINS modeling platform (USEPA, 2001). BASINS is a multipurpose environmental analysis system used by regional, state, and local agencies to perform watershed and water quality based studies.

SWAT was created initially for agricultural non-point source pollution studies in the early 1990s. Since then, it has undergone continued review and expansion of capabilities. An urban routine, which is an important feature for watersheds with mixed land uses, was incorporated into SWAT in 1999. The routine includes a set of United States Geological Survey (USGS) linear regression equations (Driver and Tasker, 1988) and build-up/wash-off equations (Huber and Dickinson, 1988) for estimating constituent loads. SWAT also includes models and databases about weather, soil properties, topography, vegetation and land management practices. These databases are necessary to simulate water and chemical yields and movements in the complex ecological systems of watersheds. A full modeling study for Carver Creek is included within Appendix A of the Carver Creek Turbidity TMDL. Use of the SWAT model in the TMDL IP report is used to evaluate relative differences between Carver Creek subwatersheds and stream segments for TSS loading rates, targeting subwatersheds with relatively high sediment loading rates as estimated by the model. This approach of targeting areas with high potential to pollute is similar to the one utilized within the Carver Creek Fecal TMDL (MPCA, 2008) and Carver Creek Fecal Implementation Plan (MPCA, 2008). This model also provides a tool for evaluating various BMP implementation scenarios to illustrate the potential magnitude of change that may be possible. Figure 4.1 shows relative differences between subwatersheds and stream segments, numbers within the model are estimated using complex mathematical models that have been calibrated with field data from five stream stations within Carver Creek. More information is discussed within the full modeling study.

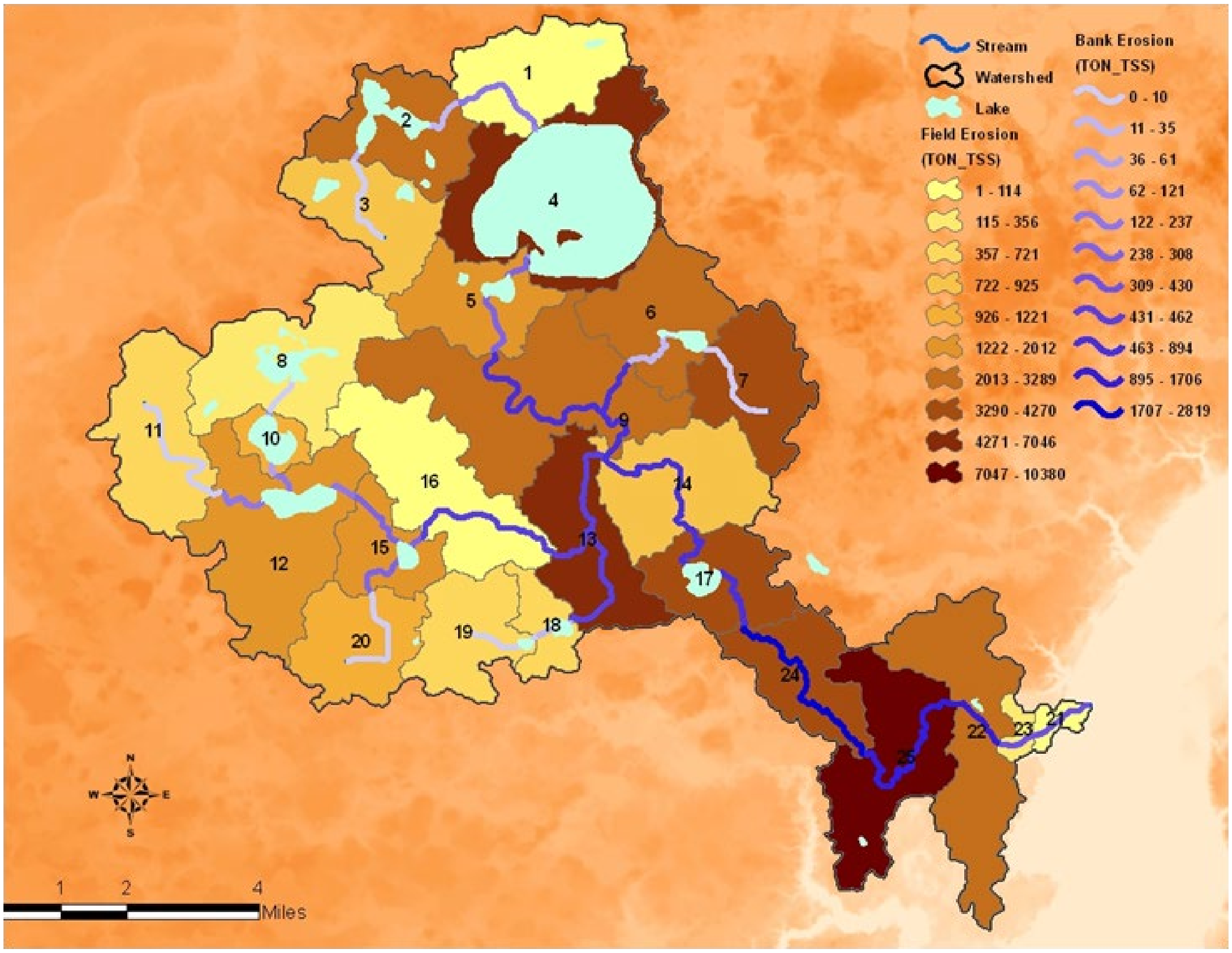


Figure 4.1 Spatial Distributions of Simulated Annual Non-Point Source TSS Loads in Carver Creek Watershed.

4.2 Environmental Benefits Index

The Minnesota Board of Water and Soil Resources and the University of Minnesota developed the Environmental Benefits Index (EBI) dataset through funding from the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources. This dataset covers the majority of Minnesota, with gaps due to the lack of source data.

The dataset is a compilation of three different sources, each scored from 0-100, in 30-meter resolution raster data files. Combining these scores results in a raster dataset that highlights areas that have highly erodible soils, steep slopes, large catchment areas, proximity to surface waters, and good quality of habitat. (Minnesota Board of Water and Soil Resources, 2011)

The first source estimates the potential for soil erosion based upon the USDA Soil Survey Geographic Database and portions of the Universal Soil Loss Equation. Low scores show low probability of erosion, while high scores predict that soil will erode. (Minnesota Board of Water and Soil Resources, 2011)

The second dataset is a combination of a stream power index model and proximity to surface waters. A stream power index models how much force a stream has which causes erosion on the stream bed and banks. Calculations use functions of water volume as a function of catchment area and slope of the stream. Low scores translates to a low stream power index and/or greater distance away from a water body. High scores are the result of a high stream power index and/or near proximity to a water body. (Minnesota Board of Water and Soil Resources, 2011)

The last dataset estimates terrestrial and aquatic habitat quality. This source is a combination of information from the Minnesota Statewide Conservation and Preservation Plan, Minnesota GAP analysis, Sites of Biodiversity Significance, and others. Higher scores indicate higher quality of habitat. (Minnesota Board of Water and Soil Resources, 2011)

An appropriate way to prioritize using this index is to focus on the land areas with the highest EBI scores (e.g., the top five percent). This gives local partners a way to identify areas that are potentially impacting water quality. CCWMO staff will use this tool as a desktop application as a way to prioritize key areas within Bevens Creek watershed for further investigation. As with any such index once candidate areas are identified the next step is to field-validate the information. Some areas may already be under appropriate land management and not need improvement. (Minnesota Pollution Control Agency, 2012)

4.3 Stream Assessment

Based on observations by Carver County staff it is believed that bank erosion is a chief contributor to in-stream TSS load. Estimates made in studies by the St. Croix Watershed Research Station for nearby streams in the lower part of the Minnesota River basin using sediment isotope methodology were considered. These studies distinguished sediment derived from the surface (which they term “field”) versus sediment derived from deeper than 12 inches (or “non-field”). The latter category is assumed to represent sediment from stream banks or gullies (SCWRS, 2009). These studies conclude that approximately 30 percent of the in-stream TSS load is from the surface and 70 percent is from subsurface-derived sediment. The majority of subsurface sediment erosion is assumed to be bank erosion in this watershed. With a large amount of source sediment coming from the stream itself, it is necessary to identify areas that are actively eroding. Use of GIS Mapping tools will highlight possible areas of erosion with staff doing field verification of these sites.

4.4 Selection of management measures by stakeholder input

Due to the need for voluntary action by the majority of residents and entities, a stakeholder group was established to discuss and, ultimately, recommend a list of priority BMPs. It is thought that the list that was generated through this process would have general public support and thus allow for greater involvement in reaching the TMDL goal. The list that was recommended is in table 4.1 and is ranked in order or preference based upon discussions during these meetings. Preference was based upon three groups establishing their top five BMPs and listing them out in order of preference with a large group discussion on these preferences in order to have agreement. Pros and cons were weighed for each BMP and are also included in the table below. Meeting minutes can be found in Appendix A.

Table 4.1 BMP Preference Ranking based upon Stakeholder Group

Rank	BMP	Pros	Cons
1	Wetland Restoration	Reducing large volumes of water in one practice	Cost, landowner acceptance
2	Hard Armor	Stopping ditch bank erosion	Cost
3	Controlled Drainage	Manage volume of water in the soil	Location, level of management
4	Streambank Stabilization	N/A	Cost, acceptance
5	Streambank Restoration	N/A	Cost, acceptance
6	Urban Volume Control	Minimize downstream impacts, manage volume	Development Costs
7	Utilizing pockets of land (Marginal Cropland)	Slow/manage water	Time intensive, loss of land
8	Road Ditches	Utilizing the areas, slow down water, low cost, filter strip	Enforcement, landowner acceptance
9	Ditched Wetland Restoration	Volume reduction, land is already there - use it	Opportunities are limited
10	Strip Till/No Till	Better infiltration, hold more water in soil	Based on soils, tougher in clay soils, shortened planting times
11	Buffer Strips	Low cost, bank stabilization, buffer	High cost to purchase land, enforcement, land out of production
12	Urban Pond Design	Slow down rate of water leaving site	Cost to developers, available lands
13	Urban Piping	N/A	N/A

5 Plan Objectives and Budget

Total costs to implement this TMDL, which encompasses multiple BMPs, has been estimated to be between $18,000,000 and $86,000,000. Individual tasks with cost estimates, priorities, timelines, and milestones are outlined in Tables 5.1 through 5.4, with descriptions of the activity detailed in Section 3. Cost estimates were based upon conversations with Carver County Soil and Water Conservation staff. Completion of these tasks will be dependent upon both Carver County Water Management Organizational levy funds and grant dollars.

It is the goal of this Implementation Plan to reach the Carver Creek Turbidity TMDL at the end of fifty years. Interim ten year goal is to reduce current TSS concentrations at high flows and moist conditions by seven percent.

Table 5.1 Activities and tasks with associated estimated costs and priority for urban BMPs

Activity	Task	Narrative	Timeline	Responsible Party	Low Cost	High Cost	Priority	10 year Milestone
Pond Design	1	Identify and prioritize key drainage areas that have ponds lacking design features up to CCWMO Standards, or has the potential to surpass CCWMO Standards. During this task, staff will also find ways to modify existing storm sewer systems to hook up untreated areas to these ponds.	Staff will identify likely areas and ponds over a twenty year period.	CCWMO, LGUs	$2,000	$8,000	Medium	50% of identifying and prioritizing areas will be completed
	2	Design and construct changes to these ponds	Up to 30% of all ponds in the watershed will include changes as identified by staff over a fifty year period.	CCWMO, LGUs	$87,000	$1,200,000	Medium	5% of the timeline will be completed
Volume Control	1	Identify and prioritize key subwatersheds that are lacking proper volume control. During this task, will also find ways to modify existing storm sewer systems to hook up untreated areas to these volume control structures.	Staff will identify areas without proper volume control over a twenty year period.	CCWMO, LGUs	$3,750	$15,000	Medium	75% of identifying and prioritizing areas will be completed
	2	Design and incorporate new volume control BMPs in these areas identified in Task 1	Up to 50% of urban land use will be treated by new volume control BMPs over a fifty year period.	CCWMO, LGUs	$1,440,000	$18,700,000	Medium	5% of the timeline will be completed

Table 5.2 Activities and tasks with associated estimated costs and priority for rural BMPs

Activity	Task	Narrative	Timeline	Responsible Party	Low Cost	High Cost	Priority	10 year Milestone
Wetland Restoration	1	Identify areas within priority subwatersheds as outlined in the SWAT model and have willing landowners to proceed with a wetland restoration.	Staff will identify areas within priority subwatersheds as outlined in the SWAT model and have willing landowners to proceed with a wetland restoration over a twenty year period.	SWCD, CCWMO	$25,000	$100,000	High	50% of identifying areas will be completed
	2	Acquisition of land through easements from willing landowners in areas identified in Task 1	Acquisition of up to 5% of all land area within the watershed to be restored to wetlands over a fifty year period.	SWCD, CCWMO	$9,600,000	$24,800,000	High	5% of the timeline will be completed
	3	Design and construct wetland restoration projects	Up to 5% of all land area within the watershed will be restored to wetlands over a fifty year period.	SWCD, CCWMO	$210,000	$2,600,000	High	5% of the timeline will be completed
Conservation Tillage	1	Identify areas that currently do not have conservation tillage implemented ranked by priority subwatersheds, priority stream reaches, proximity to stream, and susceptibility to erosion	Over a forty year peroid, staff will identify areas that currently do not have conservation tillage.	CCWMO, SWCD, NRCS	$12,500	$50,000	Medium	25% of identifying areas lacking conservation tillage will be completed
	2	Incorporate conservation tillage into land management plans for volunteer farmers	Incorporate conservation tillage on up to 50% of current lands identified by MLCCS as row crop over the next forty years.	CCWMO, SWCD, NRCS	$134,000	$580,000	Medium	25% of the timeline will be completed
Buffer Strips	1	Identify areas that are lacking at least 16.5 feet in areas that are in priority subwatersheds and priority stream reaches	Over a twenty year peroid, staff will identify likely areas.	CCWMO, SWCD	$50,000	$200,000	High	50% of identifying areas will be completed
	2	Acquisition of land through easements from willing landowners in areas identified in Task 1.	Acquisition of land that would equate to up to 50% of public and private ditches in the watershed will have a minimum of 16.5 feet of buffers installed over a forty year period.	CCWMO, SWCD	$1,070,000	$2,750,000	High	25% of the timeline will be completed
	3	Design and construct buffer strips	Up to 50% of public and private ditches in the watershed will have a minimum of 16.5 feet of buffers installed over a forty year period.	CCWMO, SWCD	$75,000	$305,000	High	25% of the timeline will be completed
Controlled Drainage	1	Identify areas that meet the limitations of controlled drainage , with greater weight given to those areas that are within priority subwatersheds as outlined in the SWAT model	Staff will identify areas that meet the limitations of controlled drainage over a twenty year period.	CCWMO, SWCD	$12,500	$50,000	Medium	50% of identifying areas will be completed
	2	Design and install control structures in fields identified in Task 1	Up to 5% of fields with row crops will have controlled drainage installed over a forty year period.	CCWMO, SWCD, NRCS	$70,000	$640,000	Medium	25% of the timeline will be completed
Marginal Cropland	1	Identify areas that are unsuitable for row crops with help of volunteer landowners	Staff will identify unsuitable areas for row crops over a twenty year period.	CCWMO, SWCD, NRCS	$6,250	$25,000	Low	50% of identifying unsuitable areas will be completed
	2	Incorporate crop selection and rotation into land management plans for volunteer landowners	Up to 20% of row crop land areas will diversify crops used in marginal lands over a forty year period.	CCWMO, SWCD, NRCS	$90,000	$460,000	Low	25% of the timeline will be completed
Road Ditches	1	Identify areas along county roads that have adjacent fields encroaching upon the right of way	Staff will identify encroachment onto right of way over a ten year period.	CCWMO, SWCD	$12,500	$50,000	High	100% of identifying encroachment areas will be completed
	2	Working with road authority and landowners, replant ditches with grass mixes.	It is estimated that up to 50% of all county roads have some encroachment onto right of ways, over a forty year period all these areas will be restored to a grassed right of way.	CCWMO, SWCD	$70,000	$290,000	High	25% of the timeline will be completed

Table 5.3 Activities and tasks with associated estimated costs and priority for in-stream BMPs

Activity	Task	Narrative	Timeline	Responsible Party	Low Cost	High Cost	Priority	10 year Milestone
Bank Stabilization	1	Identify failing bank slopes through GIS desktop work and field verification. Priority will be given to those areas that are within priority stream reaches as outlined in the SWAT model	Staff will identify failing bank slopes over a ten year period.	CCWMO, SWCD	$50,000	$200,000	High	100% of identifying failing bank slopes will be completed
	2	Design with selection of best stream bank stabilization BMP available and install bank stabilization BMPs to areas identified	Up to 25% of protected stream reaches in the watershed will have a streambank BMP installed over a fifty year period.	CCWMO, SWCD	$4,000,000	$24,000,000	High	5% of the timeline will be completed
Stream Restoration	1	Identify stream reaches that are artificially altered or manmade in priority stream reaches outlined in the SWAT model	Staff will identify stream reaches over a twenty year period.	CCWMO, SWCD	$50,000	$200,000	Medium	50% of identifying stream reaches will be completed
	2	Acquisition of land through easements or land purchases from willing landowners in areas identified in Task 1	Will aquire up to 5% of 200 foot buffers on both public and private ditches over a fifty year period.	CCWMO, SWCD	$850,000	$2,200,000	Medium	5% of the timeline will be completed
	3	Properly design and construct restoration sites	Will restore up to 5% of public and private ditches over a fifty year period.	CCWMO, SWCD	$120,000	$6,600,000	Medium	5% of the timeline will be completed

Table 5.4 Activities and tasks with associated estimated costs and priority for educational BMPs

Activity	Task	Narrative	Goals	Responsible Party	Low Cost	High Cost	Priority	10 year Milestone
Workshops	1	Identify education needs and target audiences	Staff will identify education needs and target audiences over a fifty year period.	CCWMO	$6,750	$27,500	High	20% of identifying educational needs will be completed
	2	Coordinate workshop logistics	Staff will coordinate workshops over a fifty year period.	CCWMO	$5,000	$20,000	High	20% of coordinating workshops will be completed
	3	Advertise for workshops	Staff will advertise over a fifty year period.	CCWMO	$6,750	$27,500	High	20% of advertising will be completed
	4	Evaluate workshops to determine appropriateness effectiveness, and follow up with future needs	Staff will evaluate effectiveness of workshops over a fifty year period.	CCWMO	$8,500	$33,000	High	20% of workshop evaluations will be completed
Citizen Outreach	1	Create and distribute articles relating to or about Bevens Creek through newspapers and newsletters	Staff will create and distribute articles over a fifty year period.	CCWMO	$8,500	$83,000	High	20% of distributing articles will be completed
	2	Continue coordinating and holding various Stakeholder Group activities	Staff will continue Stakeholder meetings over a fifty year period.	CCWMO	$4,250	$17,000	High	20% of the timeline will be completed
	3	Increase the number of members in the Stakeholder Group through networking	Staff will increase the number of members over a fifty year period.	CCWMO	$5,000	$20,000	High	20% of the timeline will be completed
	4	Increase citizen awareness of the Bevens Creek TMDL and IP through information displays and handouts at various events	Staff will increase citizen awareness over a fifty year period.	CCWMO	$5,000	$20,000	High	20% of the timeline will be completed
	5	Update and maintain CCWMO website with up to date information and links	Staff will update and maintain website over a fifty year period.	CCWMO	$12,500	$50,000	High	20% of the timeline will be completed
	6	Distribute updates, notices, and announcements to interested parties through email	Staff will email communications over a fifty year period.	CCWMO	$10,750	$41,500	High	20% of the timeline will be completed

6 Monitoring Plan

Continuation of the Carver County monitoring sites within the Carver Creek watershed is important part of this implementation plan. Currently, five automated stream sites are monitored by Carver County Staff. This will allow for ongoing monitoring of flow, turbidity, Total Suspended Solids and transparency, giving staff valuable data on trends within Carver Creek.

Other monitoring activities that will ensure proper implementation of this plan include the MPCA Intensive Watershed Monitoring and Assessments that are on a rotating 10 year cycle for the state. This program will be monitoring Carver Creek in 2014 and will increase our knowledge of the creek through increased biological monitoring and the establishment of baseline data for previously unmonitored portions of the creek.

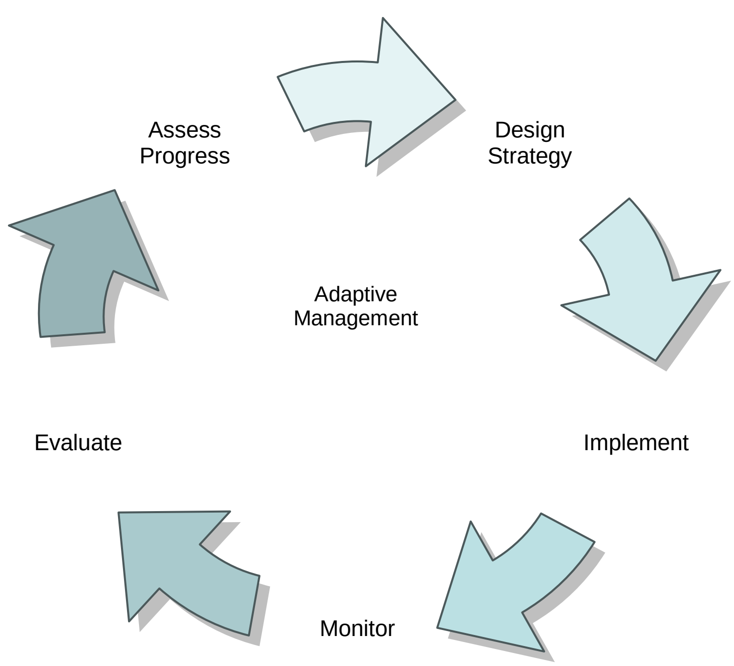
Collaboration with Carver County Soil and Water Conservation District and Carver County WMO Staff will help with tracking BMPs that are installed within the watershed. This will allow for BMP effectiveness monitoring, helping to ensure that future projects are properly identified and constructed to increase the benefit to the creek with less funding.

7 Adaptive Management

The sediment allocations represented in this TMDL represent aggressive goals; consequently, implementation will be conducted using adaptive management principles. These principals are a systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. In active adaptive management, managers design practices so as to discriminate between alternative models, and thus reveal the "best" management action. This sometimes involves testing practices that differ from "normal", in order to determine how indicators will respond over a range of conditions. In passive adaptive management, managers select the "best" management option, assuming that the model on which the predictions are based is correct. Both passive and active adaptive management require careful implementation, monitoring, evaluation of results, and adjustment of objectives and practices. Active adaptive management usually allows more reliable interpretation of results, and leads to more rapid learning.

The criteria outlined in section 4.0 of the implementation plan will rely on monitoring for measuring our progress towards active adaptive management, while some passive adaptive management will be tracked through modeling efforts. Adaptive management is appropriate because it is difficult to predict the sediment reduction that will occur from implementing strategies with the scarcity of information available to demonstrate expected reductions. Limited reduction research is available for BMPs at this time, but this is expected to change in the next several years as state agencies and local experience provide more accurate reduction data. The County has and will continue to look at viable tools that will help to predict and measure the actual reductions that installation of a particular BMP may have.

Future technological advances may alter the specific course of actions detailed here. Continued targeted monitoring based on a project work plan and "course corrections" responding to monitoring results are the most appropriate strategy for attaining the water quality goals established in this TMDL.



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Appendices

Appendix A: Stakeholder Group Meeting Minutes

Carver County Water Management Organization
Bevens and Carver Creek Turbidity TMDL Stakeholder Meeting
February 21, 2013

Present: Roger Sauerbrey
Gary Widmer
Scott Hoese
Hillary Drees
Chip Hentges
Paul Moline
Keith Kloubec
Tim Sundby
Chris Zadak
Charlie Sawdey
Patrick Moore

1. Welcome and Introductions

The meeting began at 2:05 p.m. Tim Sundby welcomed everyone to the meeting and gave a short background as to why this group was pulled together. Patrick Moore was introduced as the facilitator for the meeting and he briefly outlined his background with Minnesota CURE (Clean Up the River Environment).

The large group was broken into five pairs that introduced each other. These groups were Chip Hentges and Roger Sauerbrey, Paul Moline and Keith Kloubec, Gary Widmer and Scott Hoese, Tim Sundby and Chris Zadak, Patrick Moore and Charlie Sawdey.

2. Watershed Discussion

These groups were then asked to answer the following question: "Its twenty years in the future and the creeks are both clean, how did that happen?" The groups discussed and came up with a list of different ideas and options, which are summarized below.

CH/RS Group:

- Maintain Road Ditches - currently some farmers are plowing to the road and allowing for grass vegetation to grow in the bottom of the road ditches.
- Replacing open tile intakes.
- State mandate on lawn fertilizers to have no phosphorus. Currently only the Metro counties have a ban on phosphorus, but still allows for landowners to drive outside of the metro and buy phosphorus fertilizers.

PM/KH Group:

- Diversify crops through incentives that are more than the current corn/soybean rotation. Loss of alfalfa is big. The new crop needs to be profitable. Currently the NRCS is emphasizing overall soil health.
- Urban runoff controls. As urban areas expand, need to ensure that these areas are not contributing to the problem.
- Seeing the water as a resource for everyone, not just those that live by the water.
- As metro expands into Carver County, change of land from agriculture back to native land uses. Seeing this as a more socially acceptable thing to do.

GW/SH Group:

- § Buffers, 16' mandatory strip on all public ditches. These could be wider with payments. Laws are enforced. Public first then to private ditches. They noted that during the heavy spring storms that erosion was going through the buffer strips.
- § Variable technology on machines for fertilizing fields. These represent a big cost to small farmers so difficult for them to buy this type of machinery. Also grid sampling is cost prohibitive at the present time. Patrick noted that Co-Ops would be a good way to spread the cost of these machines across the group.
- § Nutrient Management for everyone

TS/CZ Group:

- § Wetland restoration. This takes on the volume issue of the river.
- § Gully/ravine stabilization, noted that areas in Carver Creek have steep slopes with ravines eroding into the stream.
- § Adding another crop to the rotation
- § Stream restoration that restores ditches back to historic meander bends

PM/CS Group:

- § Utilization of BMPs, better way of using them through more exposure of successful use of BMPs
- § Patrick noted that a group in the LeSueur watershed has a potluck dinner along a reach of the stream. The DNR will lead the group down to the river and electroshock the river to see what fish species are currently in the stream. This is the largest event of the year for this group.
- § Incentivizing rotating grazing operations

The discussion was wrapped up with how perception of the river and how we use it needs to be changed. For decades, the Minnesota River has been treated as a ditch, sewer, and a dumping ground. The City of Montevideo dumped 30,000 gallons of raw sewage into the Minnesota River in the 90's. The residents were embarrassed and started pushing for a change to the waste water treatment plant. Through research by these residents, it was highlighted that the City had passed up multiple grants to upgrade the WWTP, mainly because it was not something that was a priority. The perception of the river as a dump and sewer changed because multiple stakeholders recognized the value of the river.

Patrick noted that for Carver and Bevens Creek to be returned to a healthy state, people are going to know who Jonathan Carver was. This highlighted the need for people to be connected to the river, to know the history and embrace everything about the river and not see it as just another waterway.

3. TMDL Presentation

Tim Sundby gave a short presentation on both Carver and Bevens Creek TMDLs. The presentation gave a quick overview of what a TMDL is and how the study is done. This was followed by an overview of the Bevens and Carver Creek Turbidity TMDLs. Both need roughly an 80% reduction at high flows to reach the goals set in the TMDL.

4. General Questions, comments, and Discussion

Following the presentation, multiple questions were raised. Below is the list of questions with answers:

What can be done for volume?

Right now, wetland restorations have shown to be effective at retaining volume. Other than that, current best management practices are pretty limited. Buffers and grassed swales allow for the water to slow down and infiltrate into the soil.

Is the 85% reduction a pie in the sky?

It will be very difficult to obtain that number. This is the requirement of the TMDL to spell out exactly what is needed to meet the State Standard for Turbidity.

Are these numbers similar to other TMDLs?

From the few approved Turbidity TMDLs out there, these numbers seem to be similar.

Are other TMDLs meeting these required reductions?

The first Turbidity TMDL to be approved was in 2009, so very few actual EPA Approved Turbidity TMDLs out there for Minnesota.

Have Streams responded to reductions?

And it will take time for the stream to show effects of any BMPs installed right now. Large systems sometimes takes decades for changes to show up in data.

Will Cities be involved with this group?

Right now, this group was set up for residents in the rural communities. Cities will be included in later meetings.

What are other groups doing to help with this process?

Talking with Sibley County, since 30% of Bevens Creek Watershed is in Sibley County, they are moving forward with redetermination of public ditches for the whole county, which would include installing the one rod (16.5') buffer strips on these ditches. Also, they are following a similar approach to SSTS as Carver, having incentives to fix direct discharges to the creek.

What seasons are the impairments happening?

Right now, the flow duration curve shows that impairments are occurring during high flows. These would be during the spring melt and very intense storms. It is difficult to pull out different seasons within the flow duration curve, however it can generally be said that the high flows are occurring during the spring and some summer storms. Mid range flows are usually the base flow during a wet to average precipitation season and low flows are during late summer into the fall.

When would be a good time for a resident to view the river when it is meeting the state standard?

Probably the best time for someone to view the creek when it is meeting the state standard would be late June to early July. Probably would need to wait a few days after an intense storm as well.

5. Next Meeting

The next meeting for the stakeholder group will be held on March 7th at 1:00 p.m. at the Carver County Public Works Building in Cologne. The meeting will be in Conference Room 1. Homework was handed out for everyone, to read their relevant TMDL taking particular note of Section 7 that outlines implementation practices. Discussion will be centered around the list that was developed at this meeting and what is in the TMDL.

Carver County Water Management Organization

Bevens and Carver Creek Turbidity TMDL Stakeholder Meeting

March 7th, 2013

Present: Scott Hoese
Roger Sauerbrey
Hillary Drees
Virgil Stender
Jon Zieroth
Joe Forner
Larry Dreier
Chris Zadak
Terry Meiller
Tim Sundby
Paul Moline
Charlie Sawdey

1. Welcome and Introductions

The meeting began at 1:03 p.m. Tim Sundby welcomed the group back and went around the room for introductions. Tim asked the group to share an experience when they were involved working in a group setting.

2. TMDL Chapter 7 Review.

At the end of the first stakeholder meeting, Tim Sundby asked the group to review chapter 7 of the respective Bevens and Carver Creek TMDLs. To begin, Tim explained the different sections of chapter 7, noting that the primary difference between the Bevens and Carve Creek and TMDLs is the greater number of MS4 communities within the Carver Creek watershed. Tim concluded by stating that volume control will be paramount, with 30% of the sediment load coming from the land and 70% from in-stream processes.

3. Brainstorming Session

Upon conclusion of Tim's chapter 7 review, he initiated an open brainstorming session to solicit ideas for best management practices to mitigate the volume and sediment problem in Bevens and Carver Creeks. The group came up with the following list:

- Controlled Tiling, especially the southern part of the county.
- Increasing the ability of NURP ponds to meter out water, holding more in wet periods.
- Utilizing biofiltration basins to remove sediment.
- Identifying areas for wetland restoration projects.
- Installing check-dams to slow and control the flow of water in ditches.
- Transitioning marginal crop areas into harvestable grasses during wet years.
- Conserving crops
- Stabilizing banks by hard armoring.
- Identifying ditched areas where water can be held back in order to create a "slough."
- Prioritizing areas of the stream channels for restoration efforts.
- Increased enforcement of illegal road ditch farming practices.
- Installation or enhancement of existing buffer strips/areas.

4. Ranking Suggested BMPs.

The group separated into three smaller groups to come up with their top five suggested BMPs considering feasibility from a cost and logistical perspective. The groups were asked by Tim to provide a pro and con of each selected practice. These groups were Paul Moline, Terry Meiller, Scott Hoese and Jon Zieroth; Hillary Drees, Roger Sauerbrey, Larry Dreier, and Charlie Sawdey; Tim Sundby, Virgil Stender, Joe Forner, and Chris Zadak. The groups discussed ranking of practices separately for approximately twenty minutes. The group convened, and generated the following revisions:

BMP	Pro	Con
Wetland Restoration*	Reducing large volumes of water in one practice	Cost, landowner acceptance
Rip Rap - Hard Armor (identifying areas that would work)	Stopping ditch bank erosion	Cost
Controlled Tiling*	Manage volume water in the soil	Location, level of management
Stream/bank restoration	Stabilize banks	Cost, acceptance
Urban volume control	Minimize downstream impacts, manage volume	Development cost
Utilizing pockets of land	Slow/manage water	Time intensive, loss of land
Road Ditches	Utilizing the areas, slow down water, low cost, filter strip	Enforcement, landowner acceptance
Ditched wetland restoration	Volume reduction, land is already there - use it	Opportunities are limited
Strip till/no till	Better infiltration, hold more water in soil,	Based on soils, tougher in clay soils, shortened planting times
Buffer strips - one rod on public waters*	Low cost, bank stabilization, buffer	High cost to purchase land, enforcement, land out of production
Design urban ponds to meter out more	Slow down rate of water leaving site	Cost to developers, available land
Urban piping - disconnect from straight discharge to waters		

*Received two suggestions.

This discussion concluded with Tim asking the group to continue to think about practices before the next meeting scheduled for March 28th, 2013 at 1:00 PM. Tim noted that representatives from municipalities will be invited to attend the next meeting and also asked the group to invite anyone they feel should attend the next meeting.

5. Adjourn.

The meeting adjourned at 3:05 p.m. The next meeting will be at the same location on March 28th at 1:00PM.

Carver County Water Management Organization

Bevens and Carver Creek Turbidity TMDL Stakeholder Meeting

March 28th, 2013

Present: Scott Hoese
Roger Sauerbrey
Hillary Drees
Virgil Stender
Jon Zieroth
Joe Forner
Gary Widmer
Charles Held
Karen McMullen
Paul Schultz
Richard Mueller
Craig Eldred
Dan Boyum
Chris Zadak
Keith Kloubec
Terry Meiller
Paul Moline
Charlie Sawdey

1. Welcome and Introductions

The meeting began at 1:05 p.m. Charlie Sawdey welcomed the group back and went around the room for introductions.

2. Review of BMP list and Additional Discussion

The meeting began with Charlie Sawdey reviewing the list of prioritized BMP's decided upon during the previous meeting. This started with a brief slideshow containing photographs of individual BMP's on the list, prepared for the WENR committee by Tim Sundby. Upon conclusion of the slideshow, specific questions were asked regarding controlled tiling and hard armoring. It was clarified that an owner has control over how much water is to be held by the outlet system. Further, Chris Zadak mentioned that care must be taken when identifying bank areas for hard armoring, to ensure successful projects. He also mentioned additional channel modification techniques that direct stream energy away from highly erosive banks.

3. Outreach and Education

With confirmation of the prioritized BMP list, the discussion naturally segued into the topic of outreach and education. Charlie separated attendees into four smaller groups to suggest and discuss ways for BMPs to be accepted and utilized. The four groups generated the following activity list:

Activity
Educating renters regarding requirements
Pilot projects for particular BMPS as a marketing tool
Meetings/Events with larger producers
Notification of rules
Promotion using successful projects

Identifying areas of high impact
Illustration of existing urban technologies
Illustrating BMP functionality utilizing video/photo
Upstream/downstream comparison
Informational potlucks, with beer!
Venues
County Fair
Co-Op meetings
FSA office
Dairy Expo

The group convened again as a whole discussing what types of activities will meet specific challenges pertaining to some of the prioritized BMPs.

- Wetland Restoration-It was mentioned more communication and education regarding overarching benefits to wetland restoration will be crucial.
- Controlled Tiling-The main thread of conversation here was again education. We need to stress the positive incentive for farmers to sometimes hold water. Further, a targeted approach will be ideal for installing such a practice. Once the practice has been installed and is functional, field trips to this site will help with illustrating controlled tile benefits.
- Urban Ponding-Showcasing particular urban stormwater practices that can be adapted to rural areas will take advantage of existing technologies.

4. MS4 Discussion

Three MS4 communities were present at this meeting; City of Waconia (Craig Eldred), City of Carver (Dan Boyum and Paul Schultz), and Laketown Township (Charles Held, Karen McMullen, and Richard Mueller). Craig Eldred began discussion about what the City of Waconia is currently doing to meet their MS4 permit requirements. He noted that the city is very active in stormwater management and BMP maintenance. Specifically, he stressed the importance that their extensive street sweeping program has had from a water quality perspective (turbidity, phosphorus), but also from a BMP maintenance perspective. Charles Held, Karen McMullen, and Richard Mueller combined next to discuss activities that Laketown is involved in relative to MS4 requirements. Enforcement of ditch right of way rules and street sweeping are both initiatives in Laketown that are positively impacting water quality. Richard also noted that the agricultural BMP on the north side of Reitz Lake is functioning beyond his expectations. Dan Boyum and Paul Schultz from the City of Carver noted that proper maintenance of stormwater BMPs has been a significant factor in sediment and volume loading to downstream water bodies. Paul Schultz stressed that the turbidity issue will resolved by “good people” referencing the obscure 70’s Canadian rock band ‘Alabama.’

5. Adjourn.

The meeting adjourned at 3:00 p.m. No future meetings were scheduled at this time. Once the Draft Implementation Plan is completed, members will be mailed a copy for comment.