# Coldwater River Watershed Management Plan


***To integrate research, education, and outreach to enhance and preserve freshwater resources***

# Coldwater River Watershed Management Plan

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## 1.0 Executive Summary

The Annis Water Resources Institute (AWRI) was contracted by the Coldwater River Watershed Council (CRWC) to complete a Nonpoint Source Watershed Management Plan for the Coldwater River Watershed. The purpose of developing this plan is to first identify existing and expected water quality problems and then to develop a strategy for improvement and protection of the water resources in the watershed. The CRWC is looking to oversee future efforts in the watershed using the plan as a guide.

In order to complete this plan AWRI had to: review past research and conduct new studies to evaluate water quality; identify nonpoint source pollutants; and recommend actions for better watershed health. Significant findings include:

- The watershed maintains appropriate cold-water fishery temperatures
- The watershed supports small numbers of wild trout
- At times ammonia levels are high enough to be harmful to trout fry
- According to a macroinvertebrate study the watershed habitat quality varies; the quality is good near the headwaters and it degrades towards the mouth of the river
- Tributaries in the watershed will, on occasion, have dissolved oxygen levels below State of Michigan standards
- The watershed has contained levels of bacteria too high for human contact according to State of Michigan standards
- The watershed is very surface-water driven and is greatly affected by rain events according to the hydrology model
- A physical inventory of the watershed highlighted many obvious erosion sites

These studies led to the determination of impaired designated uses and threatened designated uses. Currently the watershed has two impaired designated uses: “total body contact recreation” between May 1 and October 31 and “partial body contact recreation” year round. The watershed also has two threatened designated uses: “other indigenous aquatic life and wildlife” and “cold-water fishery”. The studies also identified the following nonpoint source pollutants: sediment, bacteria, and thermal pollution, which impact these designated uses.

A three-year, five part, strategy was developed to reduce nonpoint source pollution. A major component of the plan includes physical repairs done through recommended best management practices. These best management practices address critical sites and help to reduce the amount of sediment, bacteria, and unnaturally warm water entering specific water bodies. Another large section of the plan consists of an information and education strategy created for specific audiences that will create awareness about good watershed stewardship behavior. A third part of the plan includes recommended tools that would be needed by CRWC to further all of these efforts. A fourth part is a list of ordinance resources for local townships. The final part is a recommended process for the evaluation of future efforts.

## 2.0 Introduction To The Coldwater River Watershed

The Coldwater River Watershed is located in the southwestern portion of the lower Michigan peninsula. To the east of the watershed is the City of Lansing; to its west is the City of Grand Rapids. Included in the watershed are four feeder tributaries: Pratt Lake Creek, Tyler Creek, Duck Creek, and Little Thornapple River, also called primary tributaries. The Little Thornapple River is the headwaters of the Coldwater River. Tyler, Duck, and Little Thornapple, as well as the main body of the Coldwater River were studied for the development of this management plan. The main body of the Coldwater River, from the Thornapple River upstream to M-43 is classified as a cold-water fishery. The Coldwater River, Little Thornapple River, Tyler Creek, and Duck Creek primarily have average cold-water temperatures. The soils of the watershed can be generalized as sand based and easily moved. The hydrology of the watershed has been greatly affected by an elaborate and effective drainage system (Refer to Appendix A for drainage map). The watershed covers approximately 120,737 acres; a majority of land in the watershed, 70.6%, is being used agriculturally (Refer to Appendix B for land use map). There are many agricultural areas in need of best management practices for improving and protecting water quality. Improved field drainage has historically been necessary, so there are many drains and much of the river has been channelized, particularly in Ionia County. There are few if any water storage sites in the watershed. The watershed is a valued resource for recreational and educational activities, not to mention the wildlife it contains. The Coldwater River Watershed is home to waterfowl, including Woodducks, and to native wildflowers, such as Virginia bluebells (*Mertensia virginic),* endangered in Michigan since 1999 (DNR, 1999).

Because of the value this watershed has brought to surrounding communities, a Coldwater River Watershed Council (CRWC) was formed. Members of the council are all watershed residents and volunteer their time. This council has performed numerous activities in the watershed, including physical repairs as well as information and education activities. They have collaborated with groups such as Trout Unlimited and the Annis Water Resources Institute, to name a few. Their latest endeavor was to develop this Nonpoint Source Management Plan through a contract with the Annis Water Resource Institute. The Plan includes information that will comply with rules developed for the Clean Michigan Initiative (CMI) Nonpoint Source Pollution Control Grants (MDEQ, 2001), the CMI Clean Water Fund (MDEQ, 2000), and with the guidance of "Developing A Watershed Management Plan For Water Quality – An Introductory Guide." (Brown et al., 2000).

### 2.1 Purpose For Creating A Watershed Management Plan

A nonpoint source management plan will allow concerned parties an opportunity to focus resources on specific problems in this watershed. Financial resources, technical assistance, physical efforts, equipment, and knowledge, among others, can be brought together under a management plan. It gives organization to future conservation, restoration, and protection actions in the watershed. A management plan is considered a long-term instrument to assure the integrity of a watershed.

## 2.2 Elements Of A Nonpoint Source Management Plan

A nonpoint source management plan is focused around nonpoint source pollutants. Unlike point source pollutants, which include industrial points of discharge and sewage plant discharges, nonpoint source pollutants are more diffuse, and are hard to recognize by the untrained observer. Nonpoint source pollutants include: stormwater runoff from parking lots, agricultural fields, and residential lots; sediment from fields, disturbed stream banks, and construction sites; and nutrients from fertilizers used either for agricultural or residential purposes, improperly stored or spread manure, and improperly functioning septage systems. Nonpoint source pollutants should be a concern for everyone because they can enter our water resources from just about anywhere.

A nonpoint source management plan must take into consideration many variables before it is a complete and sustainable plan. First an assessment of the watershed is done. What is its location? Is their anything about the climate that will particularly affect the watershed? What kinds of soils are present, what are the behaviors of those soils? Who is living in the watershed and how are they using the land in the watershed? How is the waterway functioning, what is its hydrology, water chemistry, and aquatic community health? How does the watershed look in its entirety, is their visible signs of nonpoint source pollutants? All of these questions lead to a firmer understanding of the character of the watershed and what nonpoint source pollutants might be affecting it.

Once the assessment is done the next step is to identify the specific pollutants of concern and to determine the level of their impact on the watershed. Having identified the kind of pollutants that are problematic, a process of prioritization can be created. Now that pollutants are identified, goals for reducing their affects and plans for reaching those goals can be made. Included in the plan are physical repairs or changes in land management styles, called best management practices, along with estimates of cost, and recommended sites for implementation. There is also a strategy for creating awareness, education, and action for watershed residents, recreational users, land managers, and local government. This is called an information and education strategy. The information and education strategy is important to change the behaviors that allowed for the nonpoint pollution in the first place. The strategy also includes estimates for costs of each task, and a proposed time frame to complete the tasks. A third part of a watershed plan includes the need for technical assistance. This section includes a list of recommended equipment, products, maps, and supplies. These are recommended, as things that would be needed to continue scientific studies and to identify additional sites suited for the implementation of best management practices. Also included in this section is a description of the desired items and their costs. The next step to the plan is finding resources needed by local government and others to help protect their water resources.

## 2.3 Public Participation In The Development Of The Management Plan

Prior to the writing of this management plan, the Coldwater River Watershed Council had been a very active source for information and education in the Coldwater River Watershed. This council has participated in water fairs, community festivals, fair booths, conducted two bank reclamation projects, sponsored an annual river clean up event, offered classroom exercises, held their own Coldwater River Day, created their own informational brochure, and developed their own website (Refer to Appendix C for more information on the CRWC). During the development of this management plan, the CRWC further increased their outreach efforts in order to acquire community support for the watershed plan. A stakeholder meeting was held, a power point presentation and a display were created. Also created were two fact sheets and two nonpoint source pollutant description cards were made (Appendix D). Also developed to assist with explaining this Plan to watershed stewards, was a summary pamphlet (Refer to Appendix E). Anyone from the stakeholders meeting was invited to continue giving input throughout the development of the watershed plan. This stakeholder group included drain commissioners, township officials, residents, farmers, staff from the Natural Resource Conservation Service, and other environmental agencies. The CRWC is very committed to reaching new pockets of the community throughout the watershed in order to have watershed protection activities implemented.

## 2.4 Agencies Involved During Plan Development & Foundations Providing Financial Support

Many agencies were invited to join in the development of this management plan. There were also those that took less of an active role in the development but were instrumental in supplementing the CRWC with funds to financially support this plan (please refer to Table 1). Everyone's contribution to this plan was appreciated as it has led to a more complete and detailed assessment.

| Table 1. Funding Contributors |
|---|
| Frey Foundation |
| Steelcase Foundation |
| Grand Rapids Foundation |
| Wege Foundation |
| Barry County Community Foundation |
| Vogt Foundation |
| Trout Unlimited |
| Michigan Department of Natural Resources |

## 3.0 Physiographic And Demographic Characteristics Of The Watershed

### 3.1 Location And Size

The Coldwater River begins in Odessa Township of Ionia County, just north of Tupper and Jordan Lakes. This River is approximately 34 miles in length and runs southwesterly to the Thornapple River, which empties into the Grand River. The watershed is made up of approximately 120,737 acres. A watersheds boundary, thus its size, is determined by elevation. In this case the Coldwater River will drain the surrounding area until the elevation peaks. On the inside of this peak the water will run to the Coldwater River and its tributaries, on the outside of this peak the water will run to other waterbodies in the neighboring watershed. Please refer to Appendix F to see the elevations of the watershed. There are primarily four Michigan counties that share the Coldwater River Watershed: Barry, Eaton, Ionia, and Kent. Between the four counties the watershed covers fifteen townships: Carlton, Castleton, Hastings Charter, Irving, Thornapple, and Woodland Townships of Barry County; Sunfield Township of Eaton County; Berlin, Boston, Campbell, Odessa, and Sebewa Townships of Ionia County; and Bowne, Lowell, and Caledonia Townships of Kent County. (Refer to political boundary map, Appendix G).

### 3.2 Climate

Both its latitude and the Great Lakes influence the Coldwater River watershed, a small piece of the Grand River watershed. The entire Grand River watershed falls between 42° 00' and 43° 55' latitude. The Coldwater River Watershed lays at approximately 42° 50'. This means that this watershed is between source regions of contrasting bodies of polar and tropical air that create changing and complex weather patterns. Landmasses at similar latitudes have distinctive seasons with very cold winters and hot summers. However, the Coldwater River watershed is also affected by Lake Michigan. The lake works to moderate climate making for cool summers and mild winters (GRBCC, 1975). The average maximum temperature for this area is about 57.4°F, the average minimum temperature is 36.7°F, and the average temperature is 46.9°F. The watershed will acquire approximately 32.4 inches of rainfall annually; approximately 60% of precipitation will occur between the months of April to September. (World Climate, 2001).

### 3.3 Geological Characteristics

The Coldwater River watershed lies in the southwest quadrant of the Michigan Basin. In this area there are three bedrock formations present. The largest and oldest, formed in the Pennsylvanian period, is the Saginaw Formation comprised of sandstone, shale, limestone, and lignite. It meets with the Michigan Formation and the Bayport Formation, which were formed in the Upper Mississippian period. The Michigan Formation is made up of shale, sandstone, limestone, dolomite, gypsum, and anhydrite (Brewer, 1991). These formations have created a watershed with varying soils and topography. The Bayport Formation is the youngest of the Mississippian rocks. It is made up of a very useable limestone. Bayport limestone is often used for an ornamental stone as well as agricultural lime, cement, and concrete production (Davis, 1964).

### 3.3.1 Soils

The soils in the Coldwater River Watershed differ throughout the watershed. The riparian corridor of the Little Thornapple River is lined with muck soils, while the surrounding area is primarily sandy soils. As the main channel of the Coldwater River moves from east to west, the soils change from sand to a mix of loam and sand, then finally a loam mixed with muck soils as it meets with the Thornapple River. Duck Creek is surrounded by primarily loamy soils with patches of sand. The Tyler Creek sub-watershed has more sandy soils at its headwaters and more loam at its convergence with the Coldwater River. (Refer to Appendix H)

### 3.3.2 Topographic Slope

Slope is the inclination of the land's surfaces from the horizontal. In the Coldwater River watershed, specifically the northern portion, the slope is very level or near level. In the southern portion, primarily in Barry County, the slope increases from a moderate slope to a steep slope close to the Coldwater's convergence with the Thornapple River. (Refer to Appendix I for a complete view of the watershed)

### 3.3.3 Runoff Potential For The Soils And Slope Of The Coldwater River Watershed

The differing soils in the Coldwater River Watershed allow for varying rates of surface penetration and soil saturation during rain events. If a soil has a slow infiltration rate, such as loam, the soil will at first absorb water until it is saturated and then the water will infiltrate very slowly as it moves deeper into the soil. The slowness of the infiltration allows a lot of precipitation to runoff the surface because the soil cannot take in the water fast enough. The runoff will enter the drainage system, either a natural system or man made, relatively quickly. (Refer to Appendix J for particulars)

### 3.3.4 Sheet And Rill Erosion In The Coldwater River Watershed

Certain soils have greater potential for erosion. Specifically, two types of erosion can be predicted, sheet and rill. Sheet erosion occurs when rainfall hits the ground and basically slides off the land in a large sheet with little to none of the water actually penetrating the surface of the land, while at the same time taking with it loose dirt particles. An example is an agricultural field being used for row crops that is not currently planted. When it rains on this empty field, all the water slides off the bare surface, straight into a drainage ditch that connects to a nearby stream. Rill erosion occurs when precipitation cuts small drainage pathways into the surface of the land giving the precipitation little time to sink into the ground. An example is a blowout in a hillside that continues to increase in size every time it rains. As more soil is carried away, a deeper crevice is carved into the hillside.

This watershed has a lot of soil that is susceptible to both types of erosion. The land surrounding the Little Thornapple and the eastern portion of the Coldwater River has a high potential for erosion damage, as does the land around the southern portion of Tyler and Duck Creek. (Refer to Appendix K for a view of the entire watershed)

### 3.3.5 Hydric Soil Areas

Hydric soil is soil that is flooded, or experiences ponding long enough during the growing season to develop anaerobic (absence of oxygen) conditions in the root zone. In other words, these areas are not prime for agriculture. In the Coldwater River Watershed hydric soils line the river and creek corridors suggesting areas that are unsuitable for farming and potentially difficult building sites. (Refer to Appendix L for specific hydric soil areas.)

### 3.3.6 Wetlands

Using available data from the National Wetlands Inventory, wetlands are believed to be scattered throughout the watershed (Refer to Appendix M). Some of the wetland areas are also noted as hydric soil areas in the above section. An updated survey of wetlands may be appropriate for the future, as certain areas will benefit from expansion of existing wetlands, restoration, or creation of new ones. This will be discussed in section 5.0.

### 3.4 Population

According to the 2000 Census (US Census Bureau, 2000), every county (Table 2) and almost every township (Table 3) in the watershed experienced population growth. Most of the Coldwater River watershed's population is concentrated in small urbanized communities: Village of Woodland in Carlton Township, Village of Freeport in Irving Township, Clarksville in Campbell Township, Village of Lake Odessa in Odessa Township, and Alto in Bowne Township. Some of these townships are growing faster than the national average of 13.1% and faster than the state of Michigan average 6.9% (U.S. Census Bureau). As the development of the South Beltline continues, so will the growth trends in the watershed. The boundaries of counties and townships do not necessarily follow watershed boundaries. To get a more accurate idea of what the population in the watershed is census blocks were tallied. The number of residents in the Coldwater River Watershed is approximately 18,448. *Not every census block follows political boundaries so this method, although more accurate that using total county and township figures, still leaves room for error. For a view of population by census block please refer to Appendix M.

**Table 2. County Population and Growth**

| County | 1990 Census | 2000 Census | % Growth | County Population in Watershed, by Census Block |
|---|---|---|---|---|
| **Barry County** | 50,057 | 56,755 | 13.4 | 7,207 |
| **Eaton County** | 92,879 | 103,655 | 11.6 | 8 |
| **Ionia County** | 57,024 | 61,518 | 7.9 | 7,147 |
| **Kent County** | 500,631 | 574,335 | 14.7 | 4,086 |

**Table 3. Township Population and Growth**

| Township | County | 1990 Census | 2000 Census | % Growth | Township Population in Watershed by Census Block |
|---|---|---|---|---|---|
| **Carlton** | Barry | 2,067 | 2,331 | 12.8 | 3,002 |
| **Castleton** | Barry | 3,379 | 3,475 | 2.8 | 58 |
| **Hastings Charter Township** | Barry | 2,830 | 2,930 | 3.5 | 65 |
| **Irving** | Barry | 1,905 | 2,682 | 40.8 | 1,736 |
| **Thornapple** | Barry | 5,226 | 6,685 | 27.9 | 598 |
| **Woodland** | Barry | 2025 | 2,129 | 5.1 | 1,748 |
| **Sunfield** | Eaton | 2,086 | 2,177 | 4.4 | 8 |
| **Berlin** | Ionia | 3,610 | 2,787 | -22.8 | 87 |
| **Boston** | Ionia | 4,313 | 4,961 | 15 | 544 |
| **Campbell** | Ionia | 1,814 | 2,243 | 23.6 | 2,195 |
| **Odessa** | Ionia | 3,885 | 4,036 | 3.9 | 3,979 |
| **Sebewa** | Ionia | 1,160 | 1,202 | 3.6 | 342 |
| **Bowne** | Kent | 1,907 | 2,833 | 48.6 | 2,806 |
| **Caledonia** | Kent | 6,254 | 8,964 | 43.3 | 338 |
| **Lowell** | Kent | 4,774 | 5,219 | 9.3 | 942 |

### 3.5 Land Use

The predominant land use in the watershed is agriculture, which constitutes more than 85,181 acres and covers 70.6% of the watershed (Refer to Appendix B). The main two crops of the four counties are corn and soybeans. Forest covers 21,498 acres and represents 17.8% of the landscape. Historically, central hardwoods, such as Ash, Basswood, Beech, Hickory, Oak, and Sugar Maple; herbaceous upland grasslands; and scattered lowland conifer forests covered this area. Residential land use and other urban development accounts for 3,129 acres or just over 2.6% of land use in the Coldwater Watershed. Most of this urban development is located in the suburban towns of Alto in Bowne Township, Clarksville and Lake Odessa in Campbell Township, Freeport in Irving Township, and Woodland in Carlton Township. Many of the urbanized areas, for example Bowne Township, are expanding their industrial zones. As expansion in industry results in growing residential areas, many sanitary sewer systems are going to be undersized for urbanized needs.

### 3.6 Rainfall

Rainfall records have been kept for at least thirty years in cities surrounding the watershed. Using rainfall data from the cities of Grand Rapids, Ionia, and Hastings (all three are just outside of the watershed boundaries), the Coldwater River Watershed average rainfall is estimated to be thirty-five inches of rain per year. (Worldclimate, 2001).

### 3.7 Watershed Hydrology

Using Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) modeling software, developed by the United States Corps of Engineers, the hydrology of the river was studied. The HEC-HMS model uses a flow monitoring study completed by the Michigan Department of Environmental Quality (MDEQ, 2002) (Appendix O), runoff potential information (Appendix I), soils information (Appendix H), and land use information (Appendix B). Soils runoff potential and land use characteristics are combined into an index of "curve numbers" (Refer to Appendix P for curve numbers for the entire watershed). Curve numbers are then combined with other calculated hydrologic parameters in the hydrologic model to predict surface runoff. Flow monitoring data was collected and used to calibrate the model. This model helps to determine what parts of the watershed are groundwater driven or surface water driven. (For a full report of the HEC-HMS Model and runoff simulation amounts please refer to Appendix Q)

In summary, the HEC-HMS model determined that flows from a 4% chance (25-year) storm have increased by a factor of 2 between the years 1800 and 1978. This is attributed to an increase in agricultural land use and a decrease in the amount of natural areas. This increase of flows results in greater flooding. Volumes and peak flows associated with a 50% chance (2-year) storm have also increased, and in this case by a factor of 3. Again, this increase is believed to result from the loss of stormwater storage and changes in land use. Based on yields calculated from the hydrologic model completed by Dave Fongers, Michigan Department of Environmental Quality Hydrologic Studies Unit, Geological and Land Management Division, the watershed plan recommends that detention ponds and

other stormwater Best Management Practices intended to mitigate hydrologic impacts should be designed with a discharge rate of 0.02 cfs/acre or less for a 50% chance, 24-hour storm in order to preserve fish habitat and stream stability. (MDEQ, 2003)"

### 3.7.1 Surface Water Driven vs. Groundwater Driven

Groundwater driven systems maintain a more constant temperature and flow. Surface water driven systems have little to no groundwater input. Surface water driven systems have temperatures that can vary greatly daily and seasonally. Tyler Creek and Duck Creek appear to be surface water driven. The more surface water driven these systems are the larger the effects of stormwater events. Without appropriate storage and retention devices the force of stormwater runoff can create a lot of stream bank erosion, a large amount of warm water inputs, and disturbance of aquatic ecosystems. The Coldwater River is fairly surface water driven downstream of Freeport; upstream of Freeport does not appear to be as surface water driven, but more studies should be done in that area to ascertain the effects of Jordan Lake.

### 3.7.2 Discharge Rates

Discharge rates give a measure of how much water is leaving the watershed. Knowing the amount and duration of rainfall, discharge can illustrate how much water is actually going to recharge groundwater supplies, and how much is just rushing through the system. A discharge rate will increase quickly relative to an increase of stormwater runoff. A larger amount of discharge can increase the amount of force the water puts on sediment and surrounding vegetation. In the case of the Coldwater River Watershed much of the stormwater is running off of the land. Discharge rates increase soon after stormwater events showing that little water is retained in the watershed after storm events. As can be seen in Appendix Q, the amount of stormwater running off the land after storm events increases greatly as the level of storm increases (i.e. a 50-year storm has much greater runoff than a 2-year storm). Further manipulation of the HEC-HMS model should be done in order to predict how added storage capacity in the main tributaries would affect the main channel of the Coldwater River.

## 3.8 Water Bodies In The Watershed

Primarily, three main water bodies were studied for the purposes of this management plan: Duck Creek (16.36 miles.), Tyler Creek (20.04 miles.), and the main body of the Coldwater (31.07 miles.) (Which for the purposes of this management plan also includes the Little Thornapple River). Jordan Lake has a large influence on the watershed since it is the largest lake in this river system and is part of the headwaters for this river, but limited resources prevented extensive evaluation of this lake system. There are a few other small lakes that are also connected to this river system, but they too were not analyzed as part of this project. Many drainage channels are either directly connected into the Coldwater River or to its tributaries, but they were also excluded from in-depth study due to financial and time constraints. The Coldwater River Watershed has been divided into seven subwatersheds to facilitate analysis. They include Bear Creek, Coldwater River at mouth, Coldwater River at Duck Creek, Coldwater River at Messer Creek, Duck Creek, Little Thornapple, and Pratt Lake. Refer to Appendix R for a map of these subwatersheds.

## 4.0 Designated Uses And Water Quality Analysis

In order to create a focused plan for dealing with nonpoint source pollutants, specific threats to water quality must be identified and current water quality impairments must be noted.

### 4.1 Water Body Uses

Water bodies have designated uses that are defined by the State of Michigan as well as certain desired uses that vary from location to location. Local residents, industries, tourists, hunters and fishers involved with that particular water body will decide these desired uses.

### 4.1.1 Designated Uses In The State Of Michigan and Status of Them in Coldwater River Watershed

The State of Michigan has decreed that all State water will fulfill the following designated uses where appropriate: Those appropriate for the water bodies in the Coldwater River Watershed are listed below.

**Table 4. Status of Designated Uses in Coldwater River Watershed**

| Designated Use | Status of Designated Use | Pollutants |
|---|---|---|
| Coldwater fishery | Impaired in Duck Creek and main River Channel | Temperature (s) |
| | Dissolved oxygen levels low in main channel<br>Aesthetic Value Is Reduced<br>Kills Aquatic Life | Ammonia (s) |
| | | Nutrients (s) |
| | | Phosphorus (s) |
| | Might pose a threat covering beds | Sediment (k) |
| Partial body contact recreation | Fishing opportunities are impaired | Pathogens *(E. coli)* (k) |
| Total body contact recreation | Impaired, public access closed on Coldwater River, levels are high through out watershed. | Pathogens *(E. coli)* (k) |
| Warmwater fishery | WQS being met | Sediment (k) |
| Other indigenous aquatic life and wildlife | Moderately to severely impaired habitats, habitat destruction and depletion of dissolved oxygen. | Sediment (k) |
| | | Temperature |
| Agriculture | WQS being met | |
| Industrial supply | WQS being met | |
| Navigation | For small watercraft in some areas | |
| Public water supply | Not a use | |

(s) = suspected
(k) = known

### 4.1.2 Desired Uses

For this particular watershed it is desired that the watershed fulfill its designated uses as well as the following desired use. It is a desired use to manage this water body as a cold-water game fish resource. To fulfill this use, the protection of stream corridors and wetlands, the restoration of natural stream banks and vegetative buffers, and the development of habitat for cold-water game fish species such as Brown and Rainbow Trout would be necessary. The protection of stream corridors and wetlands will help to preserve the beauty of the watershed, protect wildlife habitat, and provide water storage and filtration. Restoring stream banks and vegetative buffers will decrease sedimentation and thermal pollution as well as provide wildlife habitat. By developing a stronger cold-water game fishery the watershed will remain a valued recreational resource and could spark more support for maintaining water quality.

## 4.2 Temperature Of The System

Before any restoration or protection of designated uses can occur, it is necessary to know what nonpoint source pollution problems exist and the suspected or known sources for each pollutant. In order to identify these problems, new scientific studies were performed and previous studies were reviewed and compiled. A very helpful tool for this process was the research report "A Landscape-Based Ecological Classification System For River Valley Segments in Lower Michigan (MI-VSEC 1.0)" (VSEC). The VSEC report was a product of the Michigan Rivers Inventory (MRI) (Seelbach et al., 1997). The MRI combined GIS applications with an extensive field inventory database and designed an assessment technique that both describes and models key features in the biology, hydrology, and water quality of Michigan's major river systems. The VSEC information includes data on mean stream temperature, temperature variation, major hydrology of stream reaches (i.e., groundwater or runoff driven streams), measurements of valley slope, water chemistry (i.e. oligotrophic, mesotrophic, or eutrophic streams), and definitions of valley character (i.e. glacial or alluvial). Much of the information gathered to write this Plan was compared to this model as a form of data verification. Data such as temperature readings were compared to the VSEC report.

As part of the VSEC report, performed in 1997, several classification systems were developed. One system consists of a scale using average temperatures for the month of July and temperature variation behavior. This scale predicts water temperature and temperature variation in streams and rivers. For an extremely successful cold-water fishery a cold average temperature with low variation is desired. That means that in the month of July, the hottest month of the year, average water temperature should range between 14°C -19°C (57.2°F to 66.2°F) and fluctuate no more than a few degrees for very short time periods (Seelbach et al., 1997). However, according to Rule 75 of the Department of Environmental Quality General Rules, Part 4 Water Quality Standards, in the month of July, the monthly maximum temperature should not exceed 20°C or 68°F in the mixing zone for the stream to be considered a cold-water fishery (MDEQ).

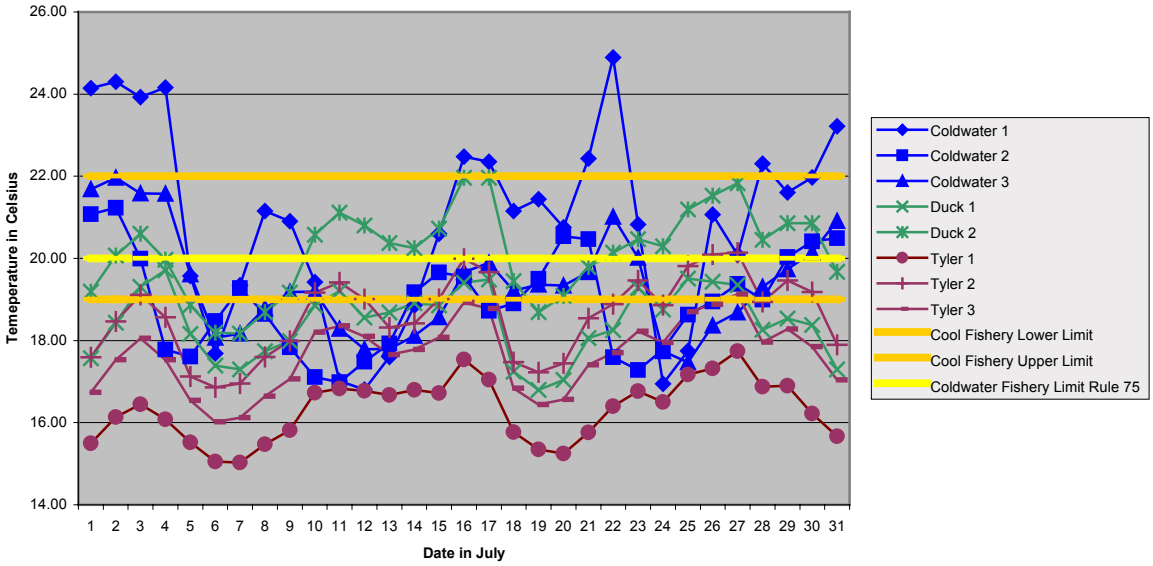
In order to determine if the Coldwater River and its two tributaries, Tyler and Duck Creek, were indeed cool enough to support a cold-water fishery, water temperature data collected by the Michigan Department of Natural Resources (MDNR), in July of 1997,

and the Annis Water Resources Institute, in July of 2002, were reviewed. Stream temperature averages were then compared to the VSEC model for classification. (Appendix S has the comparison available in matrix form).

The water temperature data collected by the MDNR in July of 1997 was recorded at four sites along the Coldwater River. Sampling was done every day during the month of July, every two hours to determine a weekly mean and weekly variation. To see where data were collected on the Coldwater River, please review Appendix T. The mean temperature for the month of July was established as 18.48ºC ±6.27º. This mean temperature is slightly lower than the cool water classification range (19ºC -22ºC) recommended by Seelbach et al. (1997) for July temperatures. These data did not support a cool stream classification but a cold stream classification, although averages were close to this designation. When compared to the MDEQ's water quality standard (a monthly minimum of 20° Celsius) two sites along the Coldwater River did not meet the standards. (Refer to Figures 1and 2, for a comparison of daily water temperatures and standards). Thus, the MDNR's water temperature data indicates that water temperature standards are exceeded along certain stretches of the designated cold-water fishery. Designation was given by the Michigan Department of Environmental Quality (Staff, 1998). Refer to Appendix U to see the portion of the Coldwater River designated as a cold-water fishery by the MDEQ and where the MDNR has given designations for trout.

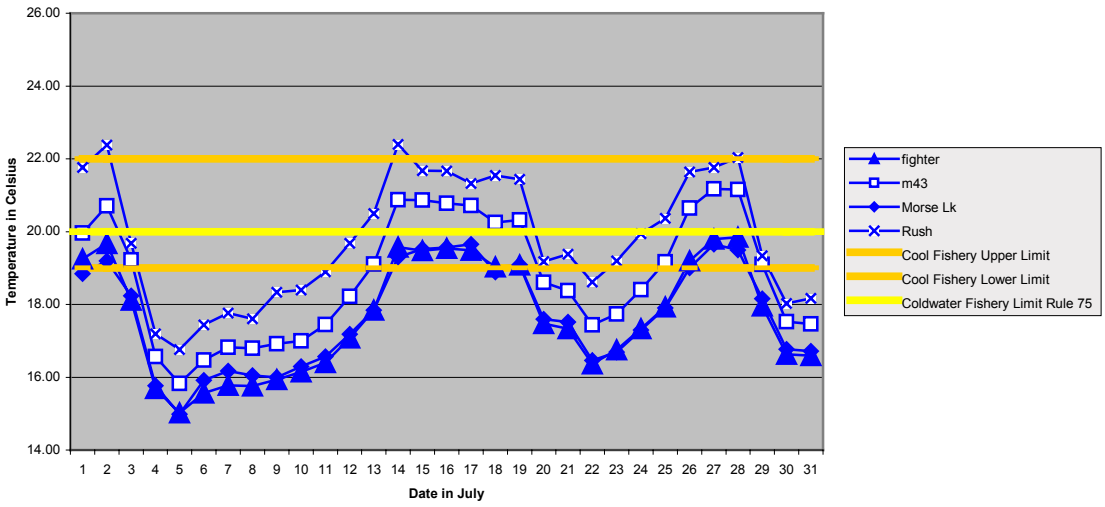
In July of 2002, AWRI collected temperature data at three sites on the Coldwater River, three sites on Tyler Creek, and two sites on Duck Creek. HOBO automatic data loggers were used to record temperatures every two hours. Average July temperature data from five of these eight sites were within ranges to support trout according to Seelbach et al. (1997). A majority of the main body of the Coldwater River, Duck Creek, and Tyler Creek all were determined to be cold-cool water habitats. However, the Coldwater River at Morse Lake Rd. and Duck Creek at Freeport Ave. reveal too high of an average temperature to support trout according to Seelbach. However according to Rule 75 of the water quality standards all sampling areas of the Coldwater River and Duck Creek are too warm for a cold-water fishery. For average daily July temperatures for all eight sites compared to Seelbach's recommendations please refer to Figure 1.

**Figure 1. AWRI 2002 Daily Average July Temperature and Temeperature Classification**




It is alarming that in 1997 the MDNR temperature sampling of the Coldwater River records Morse Lk, Site 1 and Fighter RD, Site 3 in Appendix T, as appropriately cold for a cold-water fishery. Refer to Figure 2 below. Such an increase in water temperature over a five-year period is a serious threat to a cold-water fishery.

**Figure 2. MDNR 1997 Daily July Temperature and Temperature Classification**




Overall, the temperature of the Coldwater River seems to be increasing and not meeting designated standards for a cold-water fishery. Tyler Creek appears to be meeting cold-water fisheries standards and Duck Creek is borderline at Site 2 of Appendix T.

### 4.3 Macroinvertebrate Health

Macroinvertebrates are indicators of stream health. Healthy streams have a large variety of organisms and a moderate population of most types (taxa). As stream health deteriorates, habitat and pollution sensitive organisms will become rare or absent and the more tolerant ones will become common. If a stream contains a number of taxa that are sensitive to water quality conditions and habitat loss, as well as a number of tolerant organisms, it indicates that water quality is most likely good in that area and few pollutants are present. However, if the only types of organisms found are tolerant to water quality impairments and substandard habitat and there is no wide representation of sensitive organisms, the stream most likely has degraded health and a watershed pollutant is present and making an impact. Types of macroinvertebrates that are known to be the most sensitive to water quality impairments and habitat loss include species from the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Tricoptera (caddisflies) orders of insects.

**Mayfly**

**Stonefly**

**Caddisfly**

Dr. Mark Luttenton, GVSU Biology Professor, completed a macroinvertebrate study at three different locations for the Coldwater River and at one location for Tyler Creek (Refer to sampling site map, Appendix V). Dr. Luttenton followed a method used by citizens groups and recommended by the MDEQ. The method was also adopted by the West Michigan Environmental Action Council (WMEAC), who run numerous volunteer monitoring efforts in Kent County. This method is based on protocol 51 (MDEQ, 1997) and is generally performed twice a year allowing researchers a general snapshot of the health of the river. Due to time constraints, only one macroinvertebrate study was completed using the adapted protocol 51; another is recommended in the future. The process starts by filling out a volunteer stream survey form (A blank survey is available in Appendix W). Samples are taken from numerous stream habitats and each habitat sampled is recorded. The insects are divided into groups one through three (three being the most tolerant). The type of taxa observed is recorded using the letter code of R and C (**R**are = 1-10, and **C**ommon = 11 or more). These data are recorded on the volunteer stream survey. Once the habitats are sampled and insects are identified and recorded, each group is tallied and given a numerical score in order to assess stream quality. A complete set of results from this survey may be seen in Appendix X.

The results of our macroinvertebrate analysis indicate that the Coldwater River has good stream quality closer to its headwaters than at its mouth. From its mid-point to its mouth the Coldwater River is only of fair quality. The stream quality of Tyler Creek, one of the main tributaries, is good.

In 1992, the Michigan Department of Environmental Quality (MDEQ) also completed a biological assessment, including a macroinvertebrate study, (sites studied are shown in Appendix V) on the Coldwater River (Wuycheck and Synnestvedt, 1998). The study indicated a good to excellent habitat rating for the Coldwater River. A copy of this assessment may be found in Appendix Y. Also mentioned in the biological assessment was that this cold-water fishery was under-utilized by game fish. Reasons were not documented as to why cold-water game fish were underutilizing the Coldwater River.

### 4.4 Water Chemistry Health

Water chemistry is important because it will show any abnormal levels of nonpoint source pollutants. For the purposes of this management plan studies were reviewed or conducted using the following parameters: total suspended solids, total phosphorous, ammonia nitrogen, fecal coliform, *Escherichia coli* (*E. coli*), total dissolved solids, and dissolved oxygen. The Annis Water Resources Institute tested for some of these parameters, while the Coldwater River Watershed Council examined others.

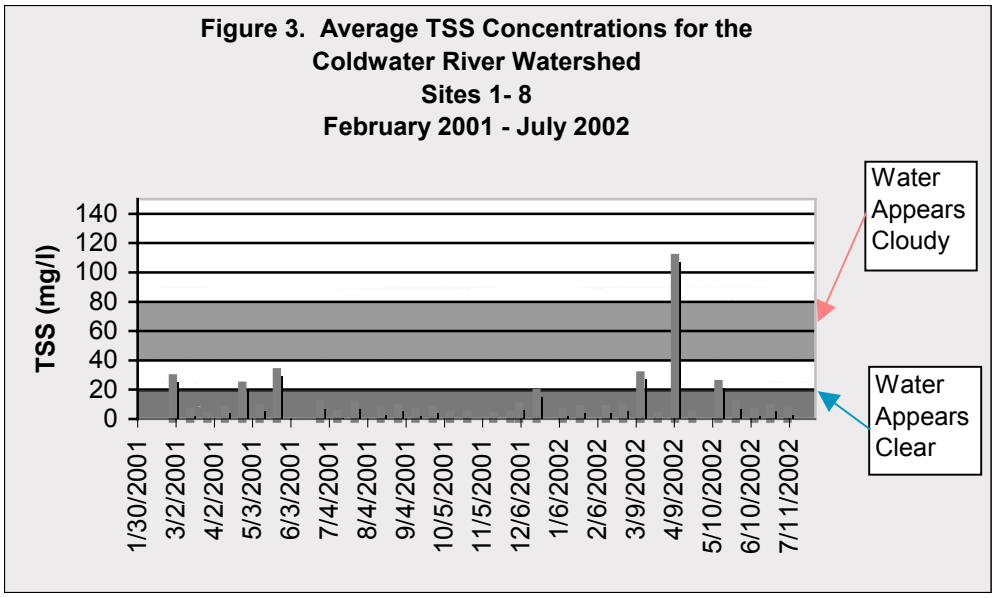
#### 4.4.1 AWRI Water Chemistry Data

AWRI was hired by the CRWC to sample and analyze surface waters to determine whether pollutants were a cause for the poor game fish establishment mentioned above. Water samples were collected approximately twice a month from 8 designated sites throughout the Coldwater River watershed between February 28, 2001 and August 27, 2002. Samples were analyzed for total suspended solids (TSS), total phosphorous (TP), ammonia nitrogen ($NH_3N$), and fecal coliform according to the following methods: the

United State Environmental Protection Agency (USEPA) Standard Method (SDM) 160.2 for TSS, automated ascorbic acid reduction method USEPA SDM 4500-P F for total phosphate, the automated phenate method USEPA SDM 4500-$NH_3$H for ammonia nitrogen, and USEPA SDM 922-D for fecal coliform. Sample sites at road stream crossings were selected to facilitate characterizing conditions of subbasins within the Coldwater River watershed. Site 3 (upstream from Freeport), site 4 (downstream from Freeport, Duck and Tyler Creek), site 7 and site 8 (downstream from all tributaries) were chosen to show the effects of the City of Freeport, Duck Creek, and Tyler Creek on the Coldwater River. Stream segments sampled included the Little Thornapple River (sites 1 and 2), the main body of the Coldwater River (sites 3, 4, 7, and 8), Duck Creek (site 5), and Tyler Creek (site 6). (To see sampling sites please refer to Appendix Z, for complete sets of water chemistry results see Appendix AA)

#### 4.4.1.1 Total Suspended Solids

It appears that, in general, the Coldwater River is visually healthy and clear maintaining TSS ranges (less than 40mg/L) below the cloudy designation. The only exception observed during the period of investigation happened on April 9, 2002, (Figure 3) On this date, sites 1 and 2 were nearly cloudy while sites 3-8 were cloudy as determined using recommended designations provided by the MDEQ (2002).




#### 4.4.1.2 Total Phosphorous

The watershed does not yet have a specific limit for phosphorous but the results from sampling can be compared to the Environmental Protection Agency's (EPA) "Nutrient Criteria Technical Guidance Manual" 2000 EPA-EPA-822-b-00-002. The EPA nutrient criteria are a scale of impairment, for example, at phosphorous levels at 0.09 mg/l nuisance growth, unpleasant to the human eye, can occur. At levels around 0.075 mg/l eutrophication of the system can occur. The watershed has levels this high throughout the sample period. Refer to Appendix AA for complete chemical sampling results. Normal in-stream levels of total phosphorus are generally less than 0.02-0.03 mg/l. (Michigan Water Resources Commission). Only 32 of 280 (approximately 11%) samples show normal levels of total phosphorus. Phosphorus should be considered a threat to this watershed and methods of reducing phosphorous should be encouraged in this watershed.

#### 4.4.1.3 Ammonia

Three percent to six percent of 33 water samples collected at each site contained ammonia concentrations at or above .3 mg/L; notably, ammonia concentrations above .3 to .4 mg/L are toxic to trout fry (DNR, 1975). Ammonia is considered a threat to the designated use of cold-water fishery.

#### 4.4.1.4 Fecal Coliform In The Coldwater River Watershed

Fecal coliform, an indicator of fecal matter, periodically reached unsafe levels for humans. Although a geometric mean could not be established to properly evaluate the level of fecal coliform compared to Rule 62 of part 4 water quality standards, monthly averages could be determined and are verified by similar *E. coli* findings taken by the Kent County Health Department (AccessKent, 2002).

Kent County's Surface Water Monitoring Program samples surface waters for bacteriological quality in accordance with the Michigan Department of Natural Resources, Part 4 Water Quality Standards, Rule 62. *E. coli* values recorded exceeded the monthly maximum for partial body contact (1000 *E.coli*/100 mL) during the months of September 2001 and September 2002 at site 8 (Morse Lake Rd.) and site 4 (Freeport Ave.) The AWRI recorded fecal coliform values exceeded the monthly maximum during September of both years at both locations as well; to note, samples collected in August of 2001 at site 8 and October 2001 at site 4 also exceeded the monthly maximum. (Appendices BB, CC, , DD and EE, contain charts of each site's results for the discussed time frames)

#### 4.4.1.5 Conclusion AWRI Water Chemistry Analysis

To conclude, the AWRI water chemistry data indicate that fecal coliform levels have exceeded set standards at certain times of the year, principally August to October. Ammonia levels spike above minimal levels toxic to trout fry, which could be of concern for this watershed as it is currently supporting random trout populations. Total suspended solids, on 1 sampling date, reached elevated levels exceeding the cloudy designation given by the MDEQ, the reason for this elevated level is unknown and warrants further investigation. Phosphorous levels are below standards for point source discharges, yet high when compared to EPA nutrient criteria. Best management practices that will reduce phosphorous, bacteria, ammonia, and TSS should be implemented in this watershed. To gain a clearer picture of pollutant levels and specific locations of concern, further water chemistry sampling in tributaries and closer to Lake Jordan is recommended.

### 4.4.2 Coldwater River Watershed Council's River Station Water Chemistry Data

To determine whether conductivity or dissolved oxygen are possible causes for the poor game fish establishment, the data provided by Mr. Gary Mast, a member of the CRWC, were evaluated. The River Station, used by Mr. Mast, records the following features of the river: river rising stages, groundwater elevation, water temperature, dissolved oxygen, and total dissolved solids.

#### 4.4.2.1 Conductivity

Electrical Conductivity estimates the amount of ionic material, or total dissolved solids (TDS) found in the water. To record conductivity, a sensor consisting of two metal electrodes 1 cm apart is placed in the water. A constant voltage is applied between the electrodes to create an electric current that flows throughout the water. The current is proportional to the concentration of dissolved ions in the water. The more ions in the water the greater the conductivity, which produces a higher electric current, measured in microSiemens per centimeter (μS/cm). In general, a higher conductivity indicates that

more material is dissolved, which may contain contaminants. Conductivity of a waterway is influenced by nearby rock types, watershed size, evaporation, bacterial metabolic byproducts, and ionic inputs such as urban runoff, agricultural runoff, treated wastewater, and septic system leakage. Conductivity data collected at Usborne Rd. between May 19, 2002 and June 16, 2002 is believed to reveal elevated levels. Because fertilizer runoff is suspected of elevating conductivity levels, further water sampling will need to be conducted to compare these conductivity levels with those recorded at other road/stream crossings. Also recommended would be sampling for Total Dissolved Solids following the procedure outlined in Rule 51, of MDEQ Part 4Water Quality Standards. Sample sites with significantly higher conductivity levels after rainfall events are likely to indicate stream sections significantly influenced by stormwater runoff.

**4.4.2.2. Dissolved Oxygen**

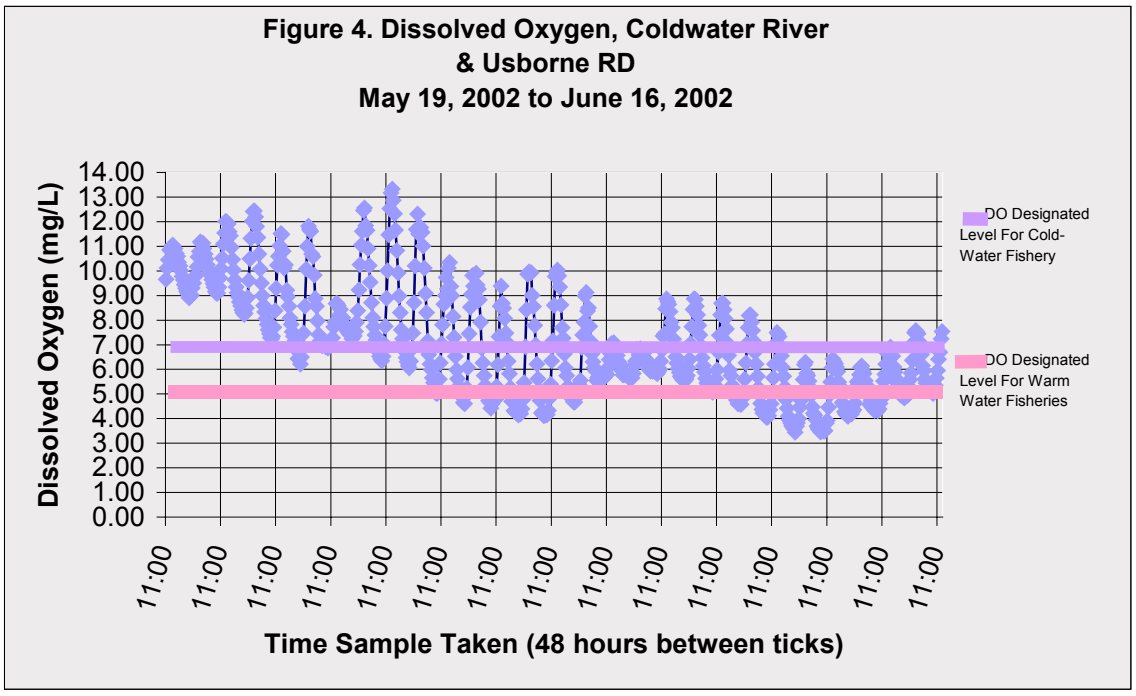
Dissolved oxygen (DO), reported in units of milligrams of gas per liter of water (mg/L), refers to the volume of oxygen gas in the water. DO can be depleted through respiration, decay of organic matter, and direct chemical oxidation (Brown, 1985). Aeration and photosynthesis are the main sources of DO in stream water. Because oxygen concentrations are usually greater in air than in water, oxygen molecules will dissolve into the water due to this difference in concentration. Furthermore, by producing waves, wind serves to create more surface area for oxygen molecules to saturate producing further diffusion of oxygen molecules. Aquatic plants also introduce oxygen as a byproduct of photosynthesis, the process by which plants produce their own food.

Because oxygen is produced during photosynthesis and consumed during respiration and decomposition, daily (diurnal) DO fluctuations result. Photosynthesis, which requires light, occurs only during daylight hours while respiration and decomposition occur 24 hours a day. Consequently, DO concentrations decline throughout the night reaching its lowest point before dawn, when photosynthesis begins. It is at dawn then that fish are most susceptible to stress due to DO depletion. Seasonal variations, like diurnal variations, also affect DO concentrations. Winter months may experience lower DO levels, even though colder water holds more DO. Ice cover or increased decomposition of oxygen-demanding organic material from the previous growing season result in lower DO levels.

Other physical processes affecting DO concentrations are temperature and pollution. Because temperature has an inverse relationship with gas solubility, warmer water will hold less gas than colder water. Summertime fish kills can result if water temperatures become too warm increasing the stress placed on fish. Furthermore, pollution from human activities may lead to unnatural decreases in DO concentrations. When large inputs of sewage or urban and agricultural runoff are introduced into the stream, microorganisms will decompose this organic matter and consume greater amounts of oxygen.

Due to its periodically low levels of saturation, lack of sufficient dissolved oxygen is a potential threat to the Coldwater River game fish populations, especially trout. For a summary of the cold-water fishery of the Coldwater River please refer to Appendix FF.

Rule 64 of the Michigan Water Quality Standards (Part 4 of Act 451) states that surface waters designated as cold-water fisheries, like the Coldwater River, must meet a minimum DO standard of 7mg/L; the Coldwater River often falls short of this minimum (Figure 4). Dissolved oxygen levels at the River Station on Usborne Road were monitored hourly between May 19, 2002 and June 16, 2002. On 5 of the 29 days observed, the DO level was consistently below 7 mg/L for the full 24 hours. Twenty-three of these 29 days saw levels drop below 7 mg/L for some amount of time, a total of 368 hours of 677 total hours (54.36%). On 12 days of the 29 tested, DO levels went below 5mg/L for some amount of time, a total of 119 hours of 677 total hours (17.56%), indicating poor water quality for freshwater systems (DEQ, 1994a). According to these data, DO levels fell below minimum standards for a cold-water fishery in Michigan more than half of the observed days. Notably, student data collected at 4 locations on Tyler Creek also revealed DO concentrations at or below 7 mg/L at each site at least once between April 21, 2001 and February 19, 2002. Further study on downstream reaches of the Coldwater River and its tributaries is also recommended.




## 4.5 Physical Inventory

Mainstream Resources' physical inventory indicated that spates (the momentary and infrequent rise of water levels and stream velocity caused by the rapid inundation of rain water during a storm event) exist and are causing damage in the Coldwater River. The consultant Mainstream Resources, commissioned by the CRWC, conducted a physical survey of the riparian corridor along the Coldwater River, Duck Creek, and Tyler Creek. "The survey was conducted by biologists via pedestrian and watercraft surveys" (Mainstream Resources, 2001). The survey sites, approximately 244 of them, were either road stream crossings or visibly eroding sites. The data collected from the survey helped to identify the main causes of nonpoint source pollution. Approximately 65% of the 244

sites identified had problems related to the increased flow during and after rain events, or spates. (For a total list of causes of nonpoint source pollution in the Coldwater River Watershed as related to this physical inventory refer to Appendix GG). Spates were identified as causing three main problems: a stable toe that has its upper bank eroded, toe and upper bank erosion, and an undercutting toe. (For a total list of conditions and problems refer to Appendix HH) After the survey sites were characterized, a ranking of minor, moderate, or severe was assigned. Those that were listed as severe primarily dealt with cattle access to the bank of the water body. Cattle access, although not a prominent pollutant source, is contributing to the bacterial loading of the river.

### 4.6 Nonpoint Source Pollutants Of Concern And Their Impacts

Nonpoint source pollutants originate from several locations throughout the Coldwater River Watershed. By using the information provided by chapter 4.0, three nonpoint source pollutants affecting this watershed have been identified. They include sediment pollution, thermal pollution, and bacterial pollution. Each nonpoint source pollutant has different affects on the watershed. By using the information provided in chapter 4.0 we can determine the severity of the effects of each of the nonpoint sources of pollution and areas in the watershed that are specifically affected by these pollutants.

#### 4.6.1 Sediment Pollution

Sediment pollution is an excessive amount of organic and inorganic particles entering the stream system. Sediment can come from developed urban areas and typically includes road stream crossings, stormwater runoff, and construction areas. Sediment can also come from farming sources such as croplands and animal crossings, or from recreation such as repeated access on eroding banks. Sedimentation is the act or process of depositing sediment. Sedimentation can be caused by spates, which tear at the soil along unprotected banks. Flashy flows, or spates, are when the water level rises and falls extremely quickly during precipitation events. Channelization is a major cause for spates in the Coldwater River Watershed and because agriculture uses 70.6% of the land, much of the river through this land is channelized. Urbanization is another major cause of spates. The proliferation of impervious surfaces in urban areas results in the increase of stormwater and its facilitated movement to nearby waterbodies. Spates cause flash floods and erosion that can damage habitat both in and out of the water. Sedimentation also contributes to a decrease in water clarity affecting how sunlight penetrates the water, and thus impacting plant growth. Sediment also absorbs heat, warming up the water body, and reduces dissolved oxygen in the water. The amount and consistency of saturated dissolved oxygen is important to some cold-water species, specifically trout and stoneflies (DEQ, 1994a). Sedimentation can also cover fish spawning grounds and insect habitat, causing a decrease in fish production and loss of insects as a food source.

#### 4.6.2 Sediment Pollutant Impacts

The physical inventory, as outlined in section 4.5, indicates that 65% of 244 road stream crossings and erosion sites surveyed showed damage caused by spates. Many of the road stream crossings and erosion sites either have problems with a stable toe with upper bank erosion, toe and upper bank erosion, and/or toe undercutting (Mainstream Resources, 2001).

Many of these spates are related to the amount of drainage channels formed for agricultural use. Land used for agriculture often has drainage channels that connect to either tributaries or the main body of the Coldwater River. These drainage channels do not necessarily have enough vegetation on their banks to keep sediment out of the water body. Vegetation strips, or riparian zones, are not plentiful in this watershed. The water draining off of the land rips through the stream corridor taking sediment from agricultural fields or the streambank and dislodging vulnerable trees in the fragile stream banks. The excessive sediment entering the waterway, either by bank damage due to spates or by agricultural field draining, covers fish spawning ground thus affecting the designated use of "cold-water fishery". The sediment also settles out of the river flow in different portions of the river thus changing the path, width, and depth of the creeks and the river.

### 4.6.3 Thermal Pollution

Thermal Pollution is when a water body is greatly influenced by an influx of water above or below its natural temperature, usually making the water warmer. Generated by development (direct and indirect discharges, lack of stream canopy, deforestation) and farming (water withdrawals reducing stream depth, water inputs from agricultural drains, lack of stream canopy), thermal pollution can result in increased water temperatures and reduced dissolved oxygen levels. This is detrimental to the aquatic life in the water body, especially if the water temperature historically supported a cold-water fishery and can no longer do so because of the temperature increase. To be considered a cold-water stream, the average range of temperatures during July must be from 14° to 19° Celsius (41° to 55°Fahrenheit) and a warm water stream ranges from 22° to 26° Celsius (68° to 77° degrees Fahrenheit (Creal and Wuycheck, 2002)

### 4.6.4 Thermal Pollution Impacts

The MDEQ has identified the Coldwater River as a cold-water fishery. Two of its tributaries, Duck and Tyler Creek, have been identified in the past as suitable for cold-water fish as well as the main channel of the Coldwater from its mouth to M-43. Recent data show that Tyler Creek, the main body of the Coldwater River, and part of Duck Creek has temperature ranges appropriate for a cold-water fishery (Seelbach et al., 1997).

The Coldwater River is naturally cool because it is constantly being added to by cold-water springs throughout the watershed. However, warm water is suspected of being added to the Coldwater River through stormwater runoff, industrial discharges, municipal wastewater treatment plant discharges, and irrigation and/or runoff from agricultural fields. Development will continue to increase in this area as more access is made available due to new highway construction. As the human population continues to grow in the watershed and the land in the watershed is further developed, the amount of warm water introduced, due to stormwater and impervious surfaces, will increase, as will the industrial discharges, wastewater effluent, and septage system discharges. The amount of agriculture in the area will probably not increase due to development. Agriculture already covers most of the watershed; thus it will be affecting the watershed for a long time. Exposed drainage ditches near the headwaters of the Coldwater are an obvious concern as they are suspected of adding warmer water to the river system. Due to a lack

of best management practices, stormwater runoff from many agricultural fields is thought to have an impact on water temperature.

Not only is warm water added to this watershed, but also the cold springs that have fed it with fresh groundwater are not being protected and are threatened by development. The water in the river and creeks once flowed in tree-covered paths that also helped to maintain a cool water stream system. Throughout the watershed canopy cover has been removed and the water is exposed to the sun heightening the temperature and lowering the dissolved oxygen.

If the temperature rises to the range of a warm water fishery, the Coldwater could lose its "cold-water fishery" designation and the "other indigenous aquatic and wildlife species" designation. The Coldwater River is supporting a small Brown Trout population that in past years has been stocked by the Department of Natural Resources. It is one of the southernmost trout streams in Michigan, and many metropolitan residents fish there because of its proximity to Grand Rapids and Lansing. Local fishers and members of the Coldwater River Watershed Council have been catching wild trout in the river that need the Coldwater's cold temperatures and spawning grounds in order to survive.

### 4.6.5 Bacterial Pollution

Bacterial pollution refers to the elevated amount of bacteria found in a water body. This can refer to fecal coliform or *Escherichia coli* (*E. coli*), both of which are indicators of animal or human feces entering the water body. These types of bacterial are used as indicators for the presence of unsafe bacteria and possibly dangerous viruses. Bacterial pollution can occur when manure from livestock operations is spread improperly on agricultural fields or stored improperly allowing it to get into nearby water bodies. Bacterial pollution can also occur when manure is applied at a seasonally inappropriate time, such as when the ground is frozen, causing fecal matter to be washed into the streams with storm events. Even single-family homes that have failing or improperly maintained septic systems can contribute to bacterial pollution. Septic haulers who do not dispose of their collection tank waste properly can also cause bacterial pollution.

### 4.6.6 Bacterial Pollution Impacts

Bacterial pollution affects the river's designated uses of partial and full body contact. *E. coli* levels are monitored in Kent County at two separate sites. From 1999 to 2001 the water has been identified as unfit for human contact five times due to high bacteria levels affecting its designated use of partial body contact (more than 1000 *E. coli* per 100 milliliters calculated as a geometric mean) and sixteen times for full body contact (more than 130 *E. coli* per 100 millimeters calculated as a geometric mean) (AccessKent, 2002). With elevated bacteria levels, recreational activities such as canoeing, kayaking, and fishing cannot occur on the river.

## 4.7 Water Quality Conclusions

Various interested groups have chosen the Coldwater River Watershed as an area for concern because of the designated uses that are impaired. The Natural Resources Conservation Service (NRCS) has designated this area as a priority conservation area

(Bare, 2002) because of the high bacterial levels and sedimentation loading reported by residents in the area. The Michigan Department of Environmental Quality, Surface Water Quality Division, in a draft copy for 2002, has identified the Coldwater River for their Clean Water Act Section 303(d) list to establish a total maximum daily load for bacteria in the year 2006 (Creal and Wycheck, 2002). The Kent County Health Department is also keeping track of the Coldwater River because of the high bacterial levels. They maintain two sampling stations on the river and have had to close the water to the public because of the bacteria levels (AccessKent, 2002). Fecal matter, indicated by bacteria levels, is the most detrimental pollutant for this watershed and could be coming from cattle farms, failed septic systems, improper disposal of septic waste or animal waste. In order to curb the effects of bacteria, best management practices for the handling of waste, either human or animal, need to be implemented. Also needed is an inventory of specific sources for bacteria. The Coldwater River's State of Michigan designated uses of partial body contact and total body contact (between May 1 and October 31) are currently impaired due to bacterial loading.

The watershed currently maintains a fair to good water quality system according to a macroinvertebrate study done by the Annis Water Resource Institute and the Michigan Department of Environmental Quality. However, water chemistry data and dissolved oxygen data collected by the AWRI and CRWC give reason for concern (details in section 4.4). Excessive sediment, suspected temperature spiking, and fecal contamination are threatening the Coldwater River Watershed. Land use and land management practices in the watershed, including the channelization that was done in 1917 (Hilt, 1989), and the ever increasing amount of urbanization and unchecked stormwater combined with soils and hydrologic factors common in the watershed are contributing to spates and a general unstable hydrologic condition. Spates are also contributing to the increased effects of sedimentation and thermal pollution, as shown by the Mainstream Resources physical inventory.

## 5.0 Critical Area Analysis

"A critical area is the geographic portion of the watershed that is contributing a majority of the pollutants and is having a significant impact on the waterbody" (Brown et al., 2000). In the case of the Coldwater River Watershed critical areas were chosen based on the method below.

### 5.1 Inventory Methods For Impaired Area Ranking And Identification Of Critical Area Sites

Two separate methods that reflected results found in the water quality sampling, temperature sampling, and in the HEC-HMS model were used to identify the critical areas in the Coldwater River Watershed Management Plan.

The first method emphasizes threats to the Coldwater River Watershed from bacteria, ammonia, phosphorus, and temperature. Step one, consolidate the seven subbasins (Appendix R) into four subbasins that reflect the limitations imposed by available water quality data. Step two, rank each of the four with regard to their respective impairment.

The Duck Creek subbasin, the Tyler creek subbasin, the Coldwater River downstream of main tributaries, and the Coldwater River upstream of main tributaries are the four subbasins to be ranked (Refer to Appendix II). The impaired area ranking system was based on four factors, each given equal weight that affect the watershed's State designated uses. The first factor is the average fecal coliform reading for that subbasin. This factor affects the impaired designated uses of "full" and "partial body contact" as it is measuring the amount of bacterial loading. The second factor is the average ammonia reading; the third is the average total phosphorus reading. The last factor is the average daily temperature for the month of July 2002. These last three factors relate to the threatened designated uses of "cold-water fishery" and "indigenous aquatic life and wildlife."

Step three, compile the results from method one of the impairment area ranking system as seen in section 5.2.1. Step four occurred after the impaired areas were ranked. Once impaired areas were ranked critical areas were identified for the reduction of non-point source pollutants. Please refer to Appendix JJ to see the critical areas. Step five is the prioritization of designated uses for pollution site, refer to Section 5.2.2..

Method two of our area ranking emphasizes hydrologic conditions in the watershed with the idea of identifying locations of potential stormwater storage areas. Step one was to compute the change in wetlands, land use, 2-year storm yield, runoff volume, and actual runoff (acre-feet). The values for these computations can be found in Table 15. Step two was to locate these findings on a map that included the thirty-one subbasins identified in the HEC-HMS model. (Refer to Appendix KK). From this map critical areas that have the greatest potential for stormwater of storage areas are identified.

**5.2 Method 1 For Impaired Area Ranking**

The impaired area ranking system used water quality sampling and temperature sampling to create the Impaired Area Ranking map for method 1 in Appendix II. Table 5 shows all comparisons, Table 6 shows how the areas are ranked. The fecal coliform average readings were found using the total list of results in Appendix AA, for the sampling period of February 27, 2001 to August 27, 2002. The Tyler Creek subbasin has the highest average readings, and the Coldwater River upstream of the tributaries has the lowest. For ammonia, the Coldwater River upstream of the tributaries has the highest readings, while Duck Creek has the least impaired readings. The readings for total phosphorus show Tyler creek to be most impaired and Duck Creek the least. For daily average water temperature, Tyler Creek is the coldest, least impaired subbasin, and the Coldwater River downstream of the tributaries is the warmest, most impaired subbasin.

| Table 5. Values Used to Rank Each Impairment for Method 1 (Samples Collected February 2001 to August 2002 *except temperature) | | | | |
|---|---|---|---|---|
| **Subbasin** | **Average Fecal Coliform Reading (colonies/100 ml)** | **Average Ammonia Reading mg/l** | **Average Total Phosphorus Reading mg/l** | **Average Daily Water Temperature °C (July 1st to July 31st 2002)** |
| Tyler Creek Subbasin | 421.94 | 0.085 | 0.111 | 17.64 |
| Coldwater Downstream of Tributaries | 326.28 | 0.079 | 0.076 | 19.92 |
| Duck Creek Subbasin | 301.31 | 0.075 | 0.075 | 19.55 |
| Coldwater Upstream of Tributaries | 193.41 | 0.100 | 0.082 | 19.38 |

### 5.2.1 Impaired Area Ranking Results for Method 1

Table 6 below, has the overall impairment ranking. Each factor is ranked 1-4 for all subbasins. For the least desired result the subbasin was given a 4, for the most desired result the subbasin was given a 1. The higher the total score for that subbasin the more impaired the subbasin is. For a view of impaired ranking areas please refer to Appendix II.

| Table 6. Impairment Area Ranking for Method 1 | | | | | |
|---|---|---|---|---|---|
| **Subbasin** | **Fecal Coliform** | **Ammonia** | **Total Phosphorus** | **Water Temp.** | **Total** |
| Tyler Creek Subbasin | 4 | 3 | 4 | 1 | 12 |
| Coldwater Downstream of Tributaries | 3 | 2 | 2 | 4 | 11 |
| Duck Creek Subbasin | 2 | 1 | 1 | 3 | 7 |
| Coldwater Upstream of Tributaries | 1 | 4 | 3 | 2 | 10 |

### 5.2.2 Prioritization Of Designated Uses For Pollution Sites

The designated uses have been prioritized by the severity to which they are affected by the identified nonpoint source pollutants (Table 7). In the case of the Coldwater River Watershed, partial body contact is the most valued designated use. This was selected because it is considered an impaired designated use and it is in place the complete length of the year. The next is full body contact recreation between May 1 and October 31. This is selected second because it is also impaired, but is only deemed impaired for a portion of the year. The third priority for designated uses is a cold-water fishery. This was selected after full and partial body contact because it is currently only threatened. It was however selected above the "other indigenous aquatic life and wildlife" because if a cold stream habitat is maintained these indigenous species will have the habitat they need to survive.

| Table 7. Designated Use Priority Ranking | |
|---|---|
| **Priority** | **Designated Use** |
| 1 | Partial body contact |
| 2 | Full body contact recreation between May 1 and October 31 |
| 3 | Cold-water fishery |
| 4 | Other indigenous aquatic life and wildlife |

### 5.3 Method 2 for Impaired Area Ranking

Method two is based on hydrology, soils, and land use information. Using this information the map, Impaired Area Ranking for Method 2, in Appendix KK, was created as were Tables 14 and 15 in section 5.3.6. One of the major factors contributing to the parameters defined in the impaired area rankings is stormwater runoff. Over time, land use and land cover have changed drastically. These changes in land cover have a direct effect on the hydrology of streams. In pre-settlement days the land cover consisted entirely of forest and wetlands, while today it is predominantly agriculture with growing urban areas. The decrease in wetlands and increase in impervious areas creates an increase in stormwater runoff going directly into the streams. The thirty-one smaller subbasins were ranked from very low priority to very high priority based on five parameters. The five parameters used were wetland percent change (from 1800 to 1978), existing agriculture percentage (1978), 2-year storm yield (cfs/acre) percent change (1800 to 1978), runoff volume (acre-feet) percent change (1800 to 1978), and current actual runoff volume (acre-feet). Each of the five parameters was given a rank with 1 being the lowest priority and 4 being the highest priority. Total runoff volume was weighted giving extreme runoff conditions a ranking of 5 or 6.

#### 5.3.1 Wetland Percent Change From 1800 to 1978

The first parameter used in the ranking system is the percent gain or loss of wetlands in each subbasin. Total acreage of pre-settlement wetlands in each subbasin was determined using the 1800 land cover data set. Total acreage of existing wetlands was determined using the national wetland inventory and 1978 MIRIS land use data. The total percent change of wetlands was then determined for each subbasin and then given a ranking based on the amount of wetlands lost or gained.

| Table 8. Wetland Ranking | |
|---|---|
| **Rank** | **Wetland Percent Change** |
| 1 | Wetland gain or no loss |
| 2 | 1% - 6% loss |
| 3 | 7% - 10% loss |
| 4 | Greater than 10% loss |

#### 5.3.2 Existing Agriculture

The second parameter used was the percentage of agricultural lands in each subbasin. Total acreage of agriculture in each subbasin was determined using the 1978 MIRIS landuse data set and then divided by each subbasin's area to determine the percentage of agricultural lands. A ranking was then given to each subbasin based on agricultural percentage.

| Table 9. Agricultural ranking | |
|---|---|
| **Rank** | **Agricultural Percentage** |
| 1 | 37% - 60% |
| 2 | 61% - 70% |
| 3 | 71% - 80% |
| 4 | Greater than 80% |

### 5.3.3 2-Year Storm Yield (cfs/acre) Percent Change

The third parameter used was yield percent change taken from the HEC-HMS model. The model used 1800 land cover and the 1978 MIRIS land use to identify the yield for a 2-year storm in each subbasin. The percent change from the 1800 scenario to the 1978 scenario was then used to rank each subbasin.

| Table 10. Storm Yield Ranking | |
|---|---|
| **Rank** | **2-Year Storm Yield Percent Change** |
| 1 | 100% - 150% |
| 2 | 151% - 200% |
| 3 | 201% - 250% |
| 4 | Greater than 250% |

### 5.3.4 Runoff Volume (acre-feet) Percent Change

The fourth parameter used was the percent change of runoff volume taken from the HEC-HMS model. The model again compared the 1800 land use scenario to the 1978 land use scenario. The percent change from pre-settlement to 1978 was then used to rank each subbasin.

| Table 11. Runoff Volume Ranking | |
|---|---|
| **Rank** | **Runoff Volume Percent Change** |
| 1 | Less than 100% |
| 2 | 100% - 150% |
| 3 | 151% - 199% |
| 4 | Greater than 199% |

### 5.3.5 Actual Runoff Volume (acre–feet)

The last parameter used was the actual total runoff volume of each subbasin based on 1978 land use data computed in the HEC-HMS model. The actual existing runoff volume is a key parameter in determining subbasins in need of storage implementations to protect the overall health of the watershed. With this in mind two extra rankings of 5 and 6 were given to subbasins contributing extreme amounts of stormwater runoff.

| Table 12. Total Runoff Volume Ranking | |
|---|---|
| **Rank** | **Total Runoff Volume (acre-feet)** |
| 1 | 0 – 75 acre-feet |
| 2 | 76 – 100 acre-feet |
| 3 | 101 – 125 acre-feet |
| 4 | 126 – 150 acre-feet |
| 5 | 151 – 200 acre-feet |
| 6 | Greater than 200 acre-feet |

### 5.3.6 Total Rank

Rankings of each individual parameter for each subbasin were added together to determine a total rank for the greatest potential for storage implementations. A higher ranking means that subbasin has a higher need for storage implementations due to land use changes and loss of storage. Please refer to table 14 for complete rankings and table 15 for values used.

| Table 13. Priority Ranking | |
|---|---|
| **Priority** | **Total Rank** |
| Very Low | Less than 11 |
| Low | 11 – 13 |
| High | 14 – 15 |
| Very High | Greater than 15 |

| Table 14. Impaired area Ranking for method 2 | | | | | | |
|---|---|---|---|---|---|---|
| Subbasin | Wetland Rank | agriculture Rank | Yield (cfs/acre) Rank | %Change Runoff Volume Rank | Total Runoff Volume Rank | Total Ranking |
| BC1 | 1 | 1 | 4 | 2 | 1 | 9 |
| BC2 | 2 | 3 | 4 | 4 | 1 | 14 |
| BC2T | 3 | 4 | 3 | 3 | 2 | 15 |
| BC3 | 3 | 3 | 2 | 3 | 4 | 15 |
| BC4 | 4 | 3 | 3 | 2 | 6 | 18 |
| BC4Tn | 4 | 3 | 2 | 1 | 2 | 12 |
| BC4Ts | 3 | 3 | 2 | 2 | 3 | 13 |
| CR1 | 1 | 1 | 1 | 1 | 3 | 7 |
| CR2 | 2 | 1 | 2 | 2 | 4 | 11 |
| CR2T | 3 | 1 | 1 | 2 | 6 | 13 |
| CR3 | 1 | 2 | 3 | 4 | 2 | 12 |
| CR4 | 3 | 2 | 3 | 3 | 5 | 16 |
| CR5 | 2 | 2 | 2 | 3 | 5 | 14 |
| CR5Tn1 | 2 | 3 | 3 | 3 | 2 | 13 |
| CR5Tn2 | 3 | 3 | 3 | 2 | 1 | 12 |
| CR5Tn2T | 3 | 4 | 2 | 1 | 5 | 15 |
| CR5Ts | 2 | 3 | 4 | 2 | 1 | 12 |
| CR6 | 3 | 2 | 2 | 2 | 4 | 13 |
| CR6T | 2 | 3 | 3 | 3 | 5 | 16 |
| CR7 | 2 | 3 | 3 | 3 | 6 | 17 |
| CR7Tn | 3 | 3 | 2 | 2 | 1 | 11 |
| CR7Ts | 1 | 4 | 2 | 2 | 3 | 12 |
| CR8 | 3 | 3 | 2 | 2 | 6 | 16 |
| DC1 | 1 | 3 | 4 | 4 | 1 | 13 |
| DC2 | 2 | 3 | 3 | 3 | 5 | 16 |
| DC3 | 3 | 3 | 1 | 2 | 6 | 15 |
| DC4 | 4 | 4 | 2 | 1 | 6 | 17 |
| DC4T | 4 | 4 | 2 | 1 | 2 | 13 |
| PLC1 | 4 | 3 | 2 | 2 | 5 | 16 |
| PLC2 | 4 | 2 | 1 | 2 | 6 | 15 |
| PLC2T | 4 | 2 | 1 | 1 | 2 | 10 |

| Table 15. Values Used to Rank Impairments for Method 2 | | | | | |
|---|---|---|---|---|---|
| Subbasin | Wetland Percent change | Percent Agriculture | 2-Year Storm Yield Percent change | Runoff Volume (acre-feet) Percent Change | Total Runoff Volume (Acre –Feet) |
| BC1 | 0 | 59 | 580 | 100 | 2 |
| BC2 | -3 | 75 | 400 | 200 | 72 |
| BC2T | -9 | 81 | 244 | 158 | 80 |
| BC3 | -8 | 77 | 175 | 160 | 135 |
| BC4 | -11 | 77 | 220 | 135 | 219 |
| BC4Tn | -23 | 74 | 167 | 96 | 98 |
| BC4Ts | -10 | 71 | 200 | 148 | 104 |
| CR1 | 1 | 37 | 100 | 93 | 104 |
| CR2 | -2 | 45 | 200 | 138 | 131 |
| CR2T | -9 | 60 | 150 | 124 | 226 |
| CR3 | 1 | 62 | 214 | 235 | 77 |
| CR4 | -7 | 66 | 250 | 178 | 153 |
| CR5 | -3 | 70 | 160 | 188 | 199 |
| CR5Tn1 | -3 | 73 | 213 | 165 | 90 |
| CR5Tn2 | -9 | 75 | 214 | 146 | 59 |
| CR5Tn2T | -10 | 81 | 200 | 99 | 163 |
| CR5Ts | -5 | 80 | 263 | 143 | 51 |
| CR6 | -7 | 64 | 175 | 119 | 129 |
| CR6T | -3 | 74 | 240 | 168 | 174 |
| CR7 | -4 | 79 | 250 | 178 | 259 |
| CR7Tn | -7 | 72 | 200 | 117 | 65 |
| CR7Ts | 0 | 88 | 184 | 126 | 104 |
| CR8 | -8 | 73 | 200 | 121 | 629 |
| DC1 | 0 | 73 | 540 | 400 | 15 |
| DC2 | -4 | 72 | 225 | 174 | 156 |
| DC3 | -8 | 79 | 150 | 126 | 271 |
| DC4 | -22 | 90 | 188 | 73 | 209 |
| DC4T | -27 | 81 | 188 | 69 | 100 |
| PLC1 | -12 | 74 | 220 | 146 | 160 |
| PLC2 | -12 | 67 | 150 | 103 | 282 |
| PLC2T | -12 | 68 | 110 | 73 | 88 |

**5.5 Critical Area Analysis Conclusion**

The Coldwater River Watershed has four designated uses that are detrimentally affected by the nonpoint source pollutants (listed below in Table 16). The watershed has two impaired designated uses, "partial body contact", and "full body contact". The Coldwater River also has two significantly threatened uses, "cold-water fishery" and "other indigenous aquatic life and wildlife". Pollutants were identified as outlined in section 4.2-4.7. In order to stop the pollutants from entering the watershed, and to be able to stop or reduce their impact, sources of pollution were researched. The sources for pollution are known (having scientific support), suspected (has some general scientific support, or eye witness verification), or potential (has been known as a nonpoint source in other watersheds and is displayed through similar symptoms

Critical areas were determined using method one and two. Method one identified the Tyler Creek subbasin as critical because non-point source pollutants are impairing its designated uses. Method two identified several subbasins as critical because of their potential to provide stormwater storage. To see the identified critical areas please refer to Appendix JJ.

| Table 16. Impaired Designated Uses and Pollutants Types, Impacts, and Sources | | | | |
|---|---|---|---|---|
| | **Designated Use To Be Restored, Improved, Or Protected** | **Pollutant Of Concern K-Known, S-Suspected, Or P-Potential** | **Impacts Of Pollution On Designated Use** | **Source Of Pollution K-Known, S-Suspected, Or P-Potential** |
| **Impaired Designated Uses** | **Partial Body Contact**<br>Restored | Bacteria Loading<br>E. Coli (K)<br>Fecal Coli form (K) | Human Health Risk | Wastewater Treatment Plants (P)<br>Land Application of Biosolids (P)<br>Animal Waste Runoff (K)<br>Septic System Failure (P) |
| | **Total Body Contact**<br>Restored | Bacteria Loading<br>E. coli (K)<br>Fecal Coliform (K) | Human Health Risk | Wastewater Treatment Plants (P)<br>Land Application of Biosolids (P)<br>Animal Waste Runoff-(K)<br>Septic Systems (P) |
| **Threatened Designated Uses** | **Cold Water Fishery**<br>Protected | Sediment (K) | Degraded Fish Habitat<br>Decreased Fish Spawning Habitat | Streambanks (K)<br>Croplands (S)<br>Stormwater Runoff (S)<br>Drainage System (K) |
| | | Temperature (S) | Increased Water Temperature<br>Reduction In Dissolved Oxygen | Lack Of Streamside Canopy (S)<br>Water Inputs From Extensive Drainage Network (S)<br>Unmanaged Stormwater (S) |
| | | Nutrients (S)<br>Phosphorus (S)<br>Ammonia (S) | Oxygen Becomes Depleted (Dissolved oxygen levels low)<br>Algal Growth Is Magnified<br>Aesthetic Value Is Reduced<br>Kills Aquatic Life | Animal Waste Runoff (K)<br>Commercial Fertilizer Use (S)<br>Septic Systems (S)<br>Stormwater Runoff (S) |
| | **Other Indigenous Aquatic Life and Wildlife**<br>Protected | Sediment (K) | Degraded Fish Habitat<br>Decreased Fish Spawning Habitat | Exposed Streambank (K)<br>Croplands and Stormwater Runoff (S)<br>Drainage System (K) |
| | | Temperature (S) | Increased Water Temperature<br>Reduction In Dissolved Oxygen | Lack Of Streamside Canopy (S)<br>Water Inputs From Extensive Drainage Network (S)<br>Unmanaged Stormwater (S) |

## 6.0 Water Quality Goals In The Coldwater River Watershed

The primary goal for the Coldwater River Watershed is to have its two impaired designated uses, full-body contact and partial body contact, restored. The next goal is to protect its threatened designated uses of "cold-water fishery" and "other indigenous aquatic life and wildlife". The third goal is to fulfill the watershed's desired uses of protected stream corridors and wetlands, establish vegetative buffers and game fish habitat. The first goal can be achieved by meeting the water quality standards for *E.coli* and fecal coliform. The second goal can be achieved by either continuing to meet or by meeting the State of Michigan's standard water quality goals for dissolved oxygen, total suspended solids, ammonia and phosphate, and by reducing the amount of sediment inputs and thermal pollution. The third goal can be met by implementing proper best management practices for riparian lands, stream corridors, and wetlands. Local townships could possibly, if resources allow, help this project further by adopting ordinances protecting these areas (read section 7.4 for more details on ordinances).

Fortunately, the use of some best management practices can help in achieving more than one objective. For example, reducing sediment will protect fish and aquatic insect habitat as well as lower thermal impacts. If sedimentation was reduced by establishing vegetative strips and excluding cattle access to the river, bacteria levels would be decreased and habitat would be provided. In addition, protecting and establishing wetlands will reduce spates, lessen sediment, and provide habitat.

## 7.0 Proposed Implementation Tasks And Costs

This chapter shall recommend future actions for those interested in the health of the Coldwater River Watershed.

The next section includes proposed best management practices that are intended to reduce the amounts of nonpoint source pollutants entering and flowing through the watershed. Following the discussion about best management practices is a section describing an information and education strategy. The implementation of such a strategy will generate awareness, education, and actions concerning water quality health. The actions described in the information and education strategy are designed to change the behaviors that allowed for the nonpoint source pollutants to become a problem in the first place. It is also assumed that an informed citizen is more likely to support the best management practices suggested. Following the information and education strategy are sections that outline technical assistance needs, potential policies for local units of government, an evaluation procedure, and a cost estimate for all of the above.

### 7.1 Proposed Best Management Practices

As mentioned before in section 7.0, many actions and best management practices support more than one water quality goal. Table 17, shows some best management practices that would be appropriate for this watershed and how each of the pollutants and their causes were prioritized. Pollutants were prioritized to help narrow the focus on the pollutants causing the greatest impairment to each designated use. Each designated use was evaluated and prioritized as were the pollutants based on the degree of impairment and

the feasibility of reducing the pollutant to desirable levels. Pollutants that were known (identified by a "k") were given a higher priority than pollutants that were suspected (identified by an "s"). The pollutant prioritization is outlined in Table 17. The causes of pollutants were also evaluated and prioritized according to the findings of the watershed physical inventory, water chemistry sampling, land use, and the HEC-HMS model. Table 18 has identified cost estimates and a proposed timeline for implementation. Each of the best management practices listed is focused on reducing the nonpoint source pollutants affecting this watershed. Cost are given as estimates based on the Natural Resource Conservation Service using the recommended best management practices and site descriptions listed in the physical inventory completed by Mainstream Resources. These costs could change depending on further inspection and as more is learned about these specific sites. These are minimum cost estimates, as they do not include any operation or maintenance expenses.

| Table 17. Proposed Best Management Practices | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Causes** | **Objectives** | **Structural and Vegetative BMPs** | **Managerial BMPs** | **Land Use Policies** |
| 2. Sediment (K) | 1. Loss of Storage, Change in Land Use (k) | Stabilize stream flows to moderate hydrology and increase base flow | Ponded type detention basin<br>***Responsible Party:***<br>*Drain Commissioners, local governments, landowners* | Storm Water Ordinance and storm water management design criteria<br>***Responsible Party:***<br>*Drain Commissioners, Center for Environmental Study (CES), local governments* | Designs for developments that protect wetlands<br>***Responsible Party:***<br>*Builders/developers, local governments, landowners, Michigan State University Extension (MSUE), MDEQ* |
| | | | Vegetated swale<br>***Responsible Party:***<br>*Drain Commissioners, local governments, landowners, West Michigan Environmental Council (WMEAC)* | | Green/open space protection<br>***Responsible Party:***<br>*County Commissioners, local governments, Conservation Districts, MSUE* |
| | | | Bioretention<br>***Responsible Party:***<br>*WMEAC, local governments, landowners* | | |
| | | | Constructed Wetland<br>***Responsible Party:***<br>*Drain Commissioners, Road Commissions, local governments, landowners* | | |
| | 2. Inadequate Erosion and Sediment Control Measures | Increase use of Conservation and Environmental Farming Practices | Encourage and implement conservation farming BMPs<br>***Responsible Party:***<br>*Natural Resource Conservation Service, (NRCS), Conservation Districts, MSUE, landowners* | Plant filter strips, windbreaks, and plant grassed waterways<br>***Responsible Party:***<br>*NRCS, Conservation Districts, landowners* | Designs for developments that protect wetlands, stream buffers, and open space<br>***Responsible Party:***<br>*Builders/developers, local governments, landowners, Michigan State University Extension (MSUE), MDEQ* |

| Table 17. Proposed Best Management Practices | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Causes** | **Objectives** | **Structural and Vegetative BMPs** | **Managerial BMPs** | **Land Use Policies** |
| | | Reduce soil erosion and sedimentation | Streambank stabilization<br>***Responsible Party:***<br>*Drain Commissioners, Road Commission, MDEQ, MDNR, WMEAC, local governments, landowners* | Phased construction<br>***Responsible Party:***<br>*Road Commission, local governments, builders/developers* | |
| | | | Catch basin inlet devices<br>***Responsible Party:***<br>*Builders/developers, local governments* | Enforcement of SESC<br>***Responsible Party:***<br>*SESC County Enforcing Agent, Municipal Enforcing Agents, Authorized Public Agencies, local governments, builders/developers* | |
| | | | Dry pond<br>***Responsible Party:***<br>*Drain Commissioners, local governments, Builders/developers* | Road/stream crossing inspections<br>***Responsible Party:***<br>*Road Commission, MDEQ, local governments* | |
| | | | | Encourage stream protection in siting developments<br>***Responsible Party:***<br>*Local governments* | |
| | | | | Catch basin cleaning<br>***Responsible Party:***<br>*Local governments* | |
| | | Encourage cover crops and no-till practices | | Conservation tillage<br>***Responsible Party:***<br>*NRCS, Conservation Districts, MSUE, landowners* | |
| | | Install livestock exclusion fencing | Exclusion fencing<br>***Responsible Party:***<br>*NRCS, Conservation Districts, MSUE, landowners* | | Stream buffer ordinance<br>***Responsible Party:***<br>*County Commissioners, local governments* |
| | | Install filter strips | Filter Strips<br>***Responsible Party:***<br>*NRCS, Conservation Districts, MSUE, landowners* | | Stream buffer ordinance<br>***Responsible Party:***<br>*County Commissioners, local governments* |

| Table 17. Proposed Best Management Practices | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Causes** | **Objectives** | **Structural and Vegetative BMPs** | **Managerial BMPs** | **Land Use Policies** |
| 3. Nutrients (s) | 3. Improper Fertilizer Management (s) | Encourage proper fertilizer management and filter/buffer strip installation | Install buffer/filter strips<br>***Responsible Party:***<br>*NRCS, Conservation Districts, MSUE, landowners, local governments* | Use proper conservation methods to reduce amounts of fertilizer needed and used<br>***Responsible Party:***<br>*NRCS, Conservation Districts, MSUE, landowners, local governments* | |
| | | Encourage composting and curbside collection of yard wastes | | Composting and yard waste collection<br>***Responsible Party:***<br>*WMEAC, local governments, landowners* | |
| | 2. Improperly functioning septic systems (s) | Encourage proper installation and maintenance of septic systems | | Identify and prohibit illicit sanitary connections<br>***Responsible Party:***<br>*Drain Commissioners, Road Commission, Health Departments, local governments, landowners* | Kent County Septage Plan<br>***Responsible Party:***<br>*Kent County Septage Plan Committee* |
| | | | | Septic system maintenance<br>***Responsible Party:***<br>*Health Departments, landowners* | Coordinate with Barry County, Ionia County Health Departments<br>***Responsible Party:***<br>*Health Departments* |
| | | Encourage sanitary sewers in areas serviced by water utilities | | | |
| | 3. Animal access and improperly disposed of animal waste (k) | Encourage proper manure management/ application | Build manure storage structures and install filter strips to protect water bodies<br>***Responsible Party:***<br>*NRCS, Conservation Districts, MSUE, landowners, local governments* | | |

| Table 17. Proposed Best Management Practices | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Causes** | **Objectives** | **Structural and Vegetative BMPs** | **Managerial BMPs** | **Land Use Policies** |
| | | Install livestock exclusion fencing | Exclusion fencing<br>***Responsible Party:***<br>*NRCS, Conservation Districts, MSUE, landowners, local governments* | | Stream buffer ordinance<br>***Responsible Party:***<br>*County Commissioners, local governments* |
| | | Reduce amount of pet waste entering waterways | | Encourage homeowners to properly dispose of waste<br>***Responsible Party:***<br>*Landowners, pet owners* | |
| 4. Temperature (s) | 2. Unmanaged Stormwater (s) | Reduce the amount of impervious surfaces | Porous pavement<br>***Responsible Party:***<br>*Road Commission, local governments* | | Low impact design practices<br>***Responsible Party:***<br>*Builders/developers, MSUE, landowners, local governments* |
| | | | Rain gardens<br>***Responsible Party:***<br>*Builders/developers, WMEAC, local governments* | Promote urban forestry<br>***Responsible Party:***<br>*Parks Departments, local governments* | Green/open space protection<br>***Responsible Party:***<br>*County Commissioners, local governments, MSUE, Conservation Districts* |
| | | Divert impervious surface runoff to prevent direct connection to surface water | Infiltration trench<br>***Responsible Party:***<br>*Road Commission, local governments, builders/developers* | Identify and prohibit illegal or illicit discharges to storm drains<br>***Responsible Party:***<br>*Drain Commissioners, Road Commission, Health Departments, local governments, landowners* | |
| | | | Bioretention<br>***Responsible Party:***<br>*WMEAC, local governments, landowners* | | |
| | | | Vegetated swale<br>***Responsible Party:***<br>*Drain Commissioners, local governments, landowners, WMEAC* | | |

| Table 17. Proposed Best Management Practices | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Causes** | **Objectives** | **Structural and Vegetative BMPs** | **Managerial BMPs** | **Land Use Policies** |
| | | | Infiltration pond<br>***Responsible Party:***<br>*Road Commission, Drain Commissioners, local governments, landowners, WMEAC* | | |
| | 1. Lack of Streamside Canopy (k) | Increase coverage of stream | Implement riparian zones<br>***Responsible Party:***<br>*NRCS, Conservation Districts, MSUE, landowners, local governments* | | Encourage protection of riparian zones<br>***Responsible Party:***<br>*County Commissioners, local governments* |
| | | | Plant native vegetation along stream side<br>***Responsible Party:***<br>*NRCS, Conservation Districts, MSUE, landowners, local governments* | | |
| 1. E. coli (k) | 2. Improperly functioning septic systems (s) | Determine TMDL for *E. coli* and reduce inputs to meet water quality standards of 1000 count/100 ml for areas of partial body contact recreation and 130 count/100 ml for total body contact recreation | | | |
| | | Encourage proper installation and maintenance of septic systems | | Identify and prohibit illicit sanitary connections<br>***Responsible Party:***<br>*Drain Commissioners, Road Commission, Health Departments, local governments, landowners* | Kent County Septage Plan<br>***Responsible Party:***<br>*Kent County Septage Plan Committee* |
| | | | | Septic system maintenance<br>***Responsible Party:***<br>*Health Departments, landowners* | |

| Table 17. Proposed Best Management Practices | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Causes** | **Objectives** | **Structural and Vegetative BMPs** | **Managerial BMPs** | **Land Use Policies** |
| | | Encourage sanitary sewers in areas serviced by water utilities | | | Kent County Septage Plan ***Responsible Party:*** *Kent County Septage Plan Committee* |
| | 3. Improper application of biosolids (s) | Encourage proper application of biosolids | | | |
| | 1. Animal access and improperly disposed of animal waste (k) | Exclude livestock access in high-risk areas | Exclusion fencing ***Responsible Party:*** *NRCS, Conservation Districts, MSUE, landowners, local governments* | | Stream buffer ordinance ***Responsible Party:*** *County Commissioners, local governments* |
| | | Reduce amount of pet waste entering waterways | | | |
| | | Control urban wildlife, such as geese and raccoon, populations. | Filter Strips ***Responsible Party:*** *NRCS, Conservation Districts, MSUE, landowners, local governments* | | |

| Table 18. Implementation Costs and Schedule for BMPs | | | |
|---|---|---|---|
| **Objectives** | **Recommended BMPs** | **Estimated Cost** | **Implementation Schedule** |
| **IMPAIRMENT: SEDIMENT** | | | |
| Stabilize stream flows to moderate hydrology and increase base flow | Ponded type detention basin | $41,600/ 1 acre-ft pond for 10-year storm - (3-5% construction costs annually) | Short-Term 0 to 5 years |
| | Vegetated swale | $339/ acre ($20/ acre annually) | Short-Term 0 to 5 years |
| | Bioretention | $8,128/ acre ($100/ acre annually) | Short-Term 0 to 5 years |
| | Constructed wetland | $10,000/site | Intermediate 3 to 8 years |
| | Storm water ordinance and storm water management design criteria | $2,000/local government | Intermediate 3 to 8 years |
| | Designs for developments that protect wetlands | No additional costs | Intermediate 3 to 8 years |
| | Green/open space protection ordinance | $2,000/local government | Long-Term 5 to 10 years |

| Table 18. Implementation Costs and Schedule for BMPs | | | |
|---|---|---|---|
| **Objectives** | **Recommended BMPs** | **Estimated Cost** | **Implementation Schedule** |
| Increase use of conservation and environmental farming practices | Encourage and implement conservation farming BMPs | Conservation Tillage - ($170/ acre Cover Crop; $10-15/ acre Mulch / No Till - annually)<br>Filter Strips - $200/ acre ($4/ acre annually)<br>Exclusion Fencing - $1.50/linear foot | Short-Term 0 to 5 years |
| | Plant filter strips, windbreaks, and plant grassed waterways | $200/ acre ($4/ acre annually) | Short-Term 0 to 5 years |
| | Designs for developments that protect wetlands, stream buffers, and open space | To be determined | Intermediate 3 to 8 years |
| Reduce soil erosion and sedimentation | Enforcement of SESC | ($40,000-50,000 annually) | Short-Term 0 to 5 years |
| | Catch basin inlet devices (assuming 2 CB/acre) | $3,000/ acre ($600/ acre annually) | Short-Term 0 to 5 years |
| | Dry pond | Low to moderate | Short-Term 0 to 5 years |
| | Enforcement of SESC | ($40,000-50,000 annually) | Short-Term 0 to 5 years |
| | Streambank stabilization | $28/foot | Intermediate 3 to 8 years |
| | Phased construction | To be determined | Intermediate 3 to 8 years |
| | Road/stream crossing inspections | Moderate | Intermediate 3 to 8 years |
| | Encourage stream protection in siting developments | To be determined | Intermediate 3 to 8 years |
| | Catch basin cleaning<br>(2 CB Service 1 Acre) | ($96 annually) | Intermediate 3 to 8 years |
| Install filter strips | Filter Strips | $200/ acre ($4/ acre annually) | Short-Term 0 to 5 years |

| Table 18. Implementation Costs and Schedule for BMPs | | | |
|---|---|---|---|
| **Objectives** | **Recommended BMPs** | **Estimated Cost** | **Implementation Schedule** |
| | Stream buffer ordinance | Moderate to High | Long-Term 5 to 10 years |
| Encourage cover crops and conservation tillage | Conservation tillage practices | ($170/ acre Cover Crop; $10-15/ acre Mulch / No Till - annually) | Short-Term 0 to 5 years |
| Install livestock exclusion fencing | Exclusion fencing | $1.50/linear foot | Short-Term 0 to 5 years |
| | Stream buffer ordinance | To be determined | Long-Term 5 to 10 years |
| **IMPAIRMENT: NUTRIENTS** | | | |
| Encourage proper fertilizer management and filter/buffer strip installation | Install buffer/filter strips | $200/ acre ($4/ acre annually) | Short-Term 0 to 5 years |
| | Use proper conservation methods to reduce amounts of fertilizer needed and used | To be determined | Intermediate 3 to 8 years |
| Encourage composting and curbside collection of yard wastes | Composting and yard waste collection | To be determined | Intermediate 3 to 8 years |
| Encourage proper installation and maintenance of septic systems | Coordinate with Barry County, and Ionia County Health Departments | No additional costs | Short-Term 0 to 5 years |
| | Identify and prohibit illicit sanitary connections | $600/ Dye Test; $100/ Staff Investigation per property | Intermediate 3 to 8 years |
| | Septic system maintenance | No additional costs | Intermediate 3 to 8 years |
| | Kent County Septage Plan | To be determined | Long-Term 5 to 10 years |
| Encourage proper manure management/application | Build manure storage structures and install filter strips to protect water bodies | $50,000/structure | Long-Term 5 to 10 years |
| Install livestock exclusion fencing | Exclusion fencing | $1.50/linear foot | Short-Term 0 to 5 years |

| Table 18. Implementation Costs and Schedule for BMPs | | | |
|---|---|---|---|
| **Objectives** | **Recommended BMPs** | **Estimated Cost** | **Implementation Schedule** |
| | Stream buffer ordinance | To be determined | Long-Term 5 to 10 years |
| Encourage sanitary sewers in areas serviced by water utilities | Create a sewer master plan for local governments in the Watershed | To be determined | Long-Term 5 to 10 years |
| Reduce amount of pet waste entering waterways | Install containers, bags, and signs at public parks | $600/park | Intermediate 3 to 8 years |
| **IMPAIRMENT: TEMPERATURE (SUSPECTED)** | | | |
| Reduce the amount of impervious surfaces | Porous pavement | To be determined | Long-Term 5 to 10 years |
| | Rain gardens | To be determined | Long-Term 5 to 10 years |
| | Promote Urban Forestry | To be determined | Long-Term 5 to 10 years |
| | Low impact design development | To be determined | Long-Term 5 to 10 years |
| | Green/open space protection | $2,000/local government | Long-Term 5 to 10 years |
| Divert impervious surface runoff to prevent direct connection to surface water | Infiltration trench | $8,128/ acre ($100/ acre annually) | Short-Term 0 to 5 years |
| | Bioretention | $8,128/ acre ($100/ acre annually) | Short-Term 0 to 5 years |
| | Vegetated swale | $339/ acre ($20/ acre annually) | Short-Term 0 to 5 years |
| | Identify and prohibit illegal or illicit connections to storm drains | $600/ Dye Test; $100/ Staff Investigation per property | Intermediate 3 to 8 years |
| | Infiltration pond | $41,600/ 1 acre-ft pond for 10-year storm - (3-5% construction costs annually) | Short-Term 0 to 5 years |
| Increase coverage of stream | Implement riparian zones | To be determined | Long-Term 5 to 10 years |

| Table 18. Implementation Costs and Schedule for BMPs | | | |
|---|---|---|---|
| **Objectives** | **Recommended BMPs** | **Estimated Cost** | **Implementation Schedule** |
| | Plant native vegetation along stream side | $20/ acre annually | Short-Term 0 to 5 years |
| | Encourage protection of riparian zones | No additional costs | Short-Term 0 to 5 years |
| **IMPAIRMENT: *E. COLI*** | | | |
| Determine TMDL for *E. coli* and reduce inputs to meet water quality standards for areas of partial body contact recreation total body contact recreation | Assist responsible party(ies) | To be determined | Intermediate 3 to 8 years |
| Encourage proper installation and maintenance of septic systems | Identify and prohibit illicit sanitary connections | $600/ Dye Test; $100/ Staff Investigation per property | Intermediate 3 to 8 years |
| | Kent County Septage Plan | To be determined | Long-Term 5 to 10 years |
| Encourage sanitary sewers in areas serviced by water utilities | Township and resident meetings | $100/meeting | Intermediate 3 to 8 years |
| Exclude livestock access in high-risk areas | Exclusion fencing | $1.50/linear foot | Short-Term 0 to 5 years |
| | Stream buffer ordinance | To be determined | Long-Term 5 to 10 years |
| Reduce amount of pet waste entering waterways | Install containers, bags, and signs at public parks | $600/park | Intermediate 3 to 8 years |
| Control urban wildlife, such as geese and raccoon populations | Filter strips | $200/acre establishment, $75/acre/year rental | Short-Term 0 to 5 years |
| | Landscaping for wildlife fact sheets and workshops done in coordination with urban Nature Centers | $200/workshop | Short-Term 0 to 5 years |
| Locate and remove or correct illicit connections to storm sewers | Apply NPDES Illicit Discharge Elimination Plan to entire Watershed. | To be determined | Intermediate 3 to 8 years |
| Encourage proper application of biosolids | Workshops to demonstrate application of biosolids | To be determined | Intermediate 3 to 8 years |

## 7.2 Information And Education Program

The creation of a comprehensive watershed management plan commonly involves at least two citizens groups. The first is a steering committee, usually less than twenty people and preferably no more than a dozen. The steering committee generally includes key decision-makers in the watershed who help give advice about project direction. In this case, the steering committee is made up of the Coldwater River Watershed Council. The second group is an all-inclusive group called "stakeholders." Stakeholders include anyone with a vested interest in the watershed. Common stakeholders include riparian landowners, sport fishing groups, watershed residents, environmental organizations, and local industry. The stakeholder group can get to be very large, even hundreds of people. Yet, the two groups together are just a fraction of the total population that will be affected by the watershed plan. The total population of the Coldwater River Watershed is estimated at 22,254 people.

Because such a relatively few number of people have actually been involved with the creation of this management plan, many will have to be persuaded to trust the decisions made and actions taken by the Coldwater River Watershed Council. Developing such trust is difficult when dealing with scientific recommendations and government policies (Smith and Gilden, 2002). Without trust behaviors concerning watersheds will be extremely difficult to change. If behavior doesn't change, it will be near impossible to meet water quality goals.

Behaviors that affect watershed health vary for different users of the watershed. Rural areas use their resources far differently than significantly urban areas. In order for an education program to be successful, we must identify specific target audiences and create messages that are intended for each audience in particular. The Information and Education strategy must create awareness, educate many, and motivate those aware and educated to action. For the Coldwater River Watershed there are four main target audiences. They are ranked based on the affect the group has on the impaired designated uses and causes of those pollutants. The residential community is ranked the highest. They are listed below in Table 19.

**Table 19. Target Audiences For The Coldwater River Watershed**

| **Large Audience** | Priority | **Sub-Groups To Take Note Of Within Large Audiences** | | | |
|---|---|---|---|---|---|
| Local Decision Makers | 3 | Township Administration | Township Planning Committees | County Administration | Village Administration |
| Residential | 1 | Homeowners with Septic Systems | Home Associations | Schools | Septic Waste Haulers |
| Agricultural Community | 2 | Operators | Farm Administrators | Land Owners | Local Decision Makers |
| Recreational Users | 4 | Hunters & Fishers | Hikers | Children's Groups (Scouts, school extracurricular groups, etc) | Small Watercraft, (canoes, kayaks) users |

Each target audience must receive specific messages that target their concerns and are action-oriented, understandable, and appealing. Some messages must also be expressed to all of the target audiences. The messages should focus on protecting water quality and should be applied to all activities as appropriate. In table 20 below messages are correlated to each of the above large target audiences.

| Table 20. Large Target Audiences and Their Specific Messages | |
|---|---|
| Local Decision Makers | Watersheds cross-political boundaries, and in order to protect and improve water resources we must work together. |
| Residential | Anything done on your property has an affect on our water resources; lets keep our water an asset. |
| Agricultural Community | As caretakers of the land you may have the largest potential to care for the water resources, if we work together we can help each other. |
| Recreational Users | Our water resources are beautiful and fun lets keep them healthy so that we all can stay healthy. |
| All Audiences | The watershed is important to our standard of living; we should all take interest in it and do what we can to protect it. |

With these identified target audiences and messages a multi-faceted information and education strategy can now be implemented. The strategy will include various forms of media, qualitative methods of evaluation, multiple hands-on tasks, tailored promotional items, and numerous methods of information dissemination. Here are some brief descriptions of items and methods to be used in this information and education strategy. Following the description, Table 21, contains a specific list of recommended information and education activities and their costs.

### 7.2.1 Promotional Items

Promotional items are important for establishing awareness about the project. They also work as participation motivators for some of the following items. Promotional items to be used in this strategy include tote bags, fishing hats, t-shirts, static stickers, calendars, and sponges.

### 7.2.2 Multi-Media Campaign

Using the media in its many forms is an excellent way to compile data and to present it in a fashion to help beginner and intermediate watershed stewards. Publications, such as newsletters, reference sheets, and general brochures can consolidate information on government programs, policies, or watershed terminology. Strategically placed signs can enhance awareness of the watershed's existence. Press releases, billboards, newspaper inserts, and websites can reach a broad spectrum of the population. Slide shows can inform small groups and allow for immediate feedback to project managers. However, each method must be tailored to fit its audience. It is recommended that at least two surveys be done of the target audiences. Target audience surveys provide a method for evaluating the potential effectiveness of information and education tools before they are even developed. By using focus groups selected from the target audiences, proper means of information dissemination, content material, and formatting can be established. Two

focus groups for each target audience should give appropriate feedback to allow for adaptation of the strategy. A second form of surveying would be a general knowledge survey conducted through a large mailing. The survey would be based on residents' knowledge of pollutants, watershed characteristics, water behaviors, and uses of the water. This type of survey can help tailor larger media efforts. A Quality Assurance Project Plan will be completed for the General Knowledge Survey.

### 7.2.3 Local Government Activities

Local governments, especially townships, are busy, staffed with part-time help, and swamped with numerous tasks regarding many issues. The purpose of making local government a target audience is to increase their awareness and education concerning the watershed, become an information resource, and to help them through technical assistance to make informed decisions. Many small communities are strapped for funding and have limited technology. Activities that can relieve these burdens are beneficial. Various workshops will be developed and held with assistance from differing agencies. Workshops and presentations concerning model ordinances, the watershed atlas, and basic watershed stewardship education are recommended. Also included are funds to assist with the development of critical area maps and demonstration site tours. Educating target audiences will be extremely helpful when it comes time to implement and enforce zoning ordinances, master plans, etc.

### 7.2.4 Resident Audience Activities

Activities will vary to appeal to groups ranging from homeowners, to families, to students. The purpose is to create awareness about watershed stewardship and best management practices that residents can do immediately. Activities will include watershed fairs, stream bank clean ups, volunteer monitoring, septic system care programs, watershed lessons, and demonstration site tours to name a few. Activities must be planned on dates and times appropriate for these groups. Obviously school programs must be done during school hours, but family and homeowners' activities should be done on weekends and early evenings during the week.

### 7.2.5 Agricultural Activities

Activities for these target audiences are formatted for more personalized interaction. Time must be spent on presenting information in a detailed and non-threatening manner. Activities such as small group discussions, one-on-one program presentations, and demonstration farm tours, including financial breakdowns, are included in this strategy. The smaller groups in this target audience are operators, farm administrators, landowners, and agricultural services. Effort should be made to generate participation from both men and women in this target audience. Women appear to be rather involved in the book keeping aspects of farming and in the decision-making but are often overlooked for information dissemination.

### 7.2.6 Recreational User Activities

These activities are geared to highlight the positives about the watershed and to create awareness of human impacts on the watershed. Recreational users can be watershed residents or from the surrounding area. Recreational users are occasionally irresponsible

concerning their wastes, riparian owners' property rights, and good stewardship behaviors. Informing users about the causes and effects of sedimentation, thermal pollution, and bacteria loading may get them to become better watershed stewards. They may be a resource to watershed stewardship groups like the CRWC by alerting them to pollutant problems or findings in the watershed, good or bad. Activities have been included in this strategy to connect the CRWC and recreational users through partnerships with recreational businesses in addition to hunting and fishing correspondences. These activities, such as a photography contest where winning photos can be used to make a calendar, can be posted on the CRWC website.

### 7.2.7 General Audience Activities

These activities are to be tailored to a broad target audience. Public meetings are meant to update stakeholders and the public as to the progress of the Plan. General workshops can be adapted to target audience's needs, as determined by focus groups, the general survey, or as determined by the steering committee. The general display is meant to be used in almost any setting and to possess the ability to adapt to various audiences, awareness, and education levels. The Coldwater River Watershed Council will set this information and education strategy in motion with support from various partners.

### 7.2.8 Introduction To The Information And Education Activities Table

The first two sections of Table 20are the promotional items and the multi-media campaign. These two sections apply to multiple target audiences following sections identify activities specific to each target audience. In each section the following are listed: specific tasks or items, large audience messages, pollutants being affected, the responsible party, the number desired of each item, the cost per each item, and a time estimate to complete the task, and a proposed method for evaluation. The next column summarizes total costs including estimated staff time. The last column specifies the program year in which the activity will be implemented. The table assumes a three-year implementation program.

## Table 21, Information and Education Activities Table

| Target Audience | Key Message | Items | Pollutant Bacteria Loading(B) Sediment(S) Temperature(T) Nutrients(N) Ammonia(A) Phosphorus(P) | Party Responsible | Number Of | Cost | Hours | Total Cost | Year | Proposed Evaluation Method |
|---|---|---|---|---|---|---|---|---|---|---|
| Promotional Items | Promote Awareness of Project | Tote Bags | B,S,T,N,A,P | CRWC | 225 | 3.00/each | 32 hrs | $675.00 + 32 hrs | 1 | Track participation numbers throughout project |
| | | Fishing Hats | B,S,T,N,A,P | CRWC | 45 | 13.00/each | 32 hrs | $585.00 + 32 hrs | 1 | Track participation numbers throughout project |
| | | T-Shirts | B,S,T,N,A,P | CRWC | 100 | 6.00/each | 32 hrs | $600.00 + 32 hrs | 1 | Track participation numbers throughout project |
| | | Sponges | B,S,T,N,A,P | CRWC | 250 | $1.50/each | 32 hrs | $375.00 + 32 hrs | 1 | Track participation numbers throughout project |
| | | Static Stickers | B,S,T,N,A,P | CRWC | 500 | $0.61/each | 32 hrs | $305.00 + 32 hrs | 1 | Track participation numbers throughout project |
| | | Calendar | B,S,T,N,A,P | CRWC | 2 x 250 copies x 2 yrs | $9.00/each | 120 hrs/each | 4500 + 240 hrs | 2,3 | Track participation numbers throughout project |
| Multi-Media Campai | Educat ion of | Bill Board | B,S,T,N,A,P | CRWC & Advertising Company Lamar | 1 per year | Contract $5,000/each | | $15,000.00 | 1,2,3 | Track numbers of contacts made as result of. |
| | | Introductory Video | B,S,T,N,A,P | AWRI & GVSU Public Television | 1, video, 40 copies | $200.00 production $10.00/copy | 80 hrs | $600.00 + 80 hrs | 2 | Request for copies of, contacts made because of, aired on public television |
| | | Watershed Logo Signs | B,S,T,N,A,P | CRWC and Handicap Non-Profit Group | 2 per year | $1,000/each | 50 hrs/each | $6,000.00 + 300 hrs | 1,2,3 | Survey to test identification of. |
| | | Newspaper Inserts | B,S,T,N,A,P | CRWC & AWRI | 1 insert/yr x 1 paper x 3 yr w/ 10,000 color copies | $15,000/insert | | $45,000.00 | 1,2,3 | Pre- and post-questionnaires |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Reference Cards | B,S,T,N,A,P | AWRI & NRCS, & Conservation Districts | 1 card x 3 known pollutant/ 100 full color copies of each | $1.00/copy, $15.00 materials/pollutant | 20 hrs/each | $345.00 + 60 hrs | 1,2,3 | Pre- and post-questionnaires |
| | | Reference Sheets | B,S,T,N,A,P | AWRI & NRCS, Conservation Districts | 3-2-sided sheets, full color x 100 copies each | $1.50/copy, $15.00 materials/pollutant | 32 hrs/each | $495.00 + 96 hrs | 1,2,3 | Pre- and post-questionnaires |
| | | Newsletter | B,S,T,N,A,P | AWRI & CRWC | 2/yr x 3 yrs x 400 copies | $500.00/newsletter printing | 32 hrs/each | $3,000 + 192 hrs | 1,2,3 | Pre- and post-questionnaires |
| | | General Brochure | B,S,T,N,A,P | AWRI & CRWC | 500 copies | $2,000 | 40 hrs development | $2,000 + 40 hrs | 1 | Pre- and post-questionnaires |
| | | Power Point Slideshow | B,S,T,N,A,P | AWRI | 1 general slide show with voice over, converted to a VCR tape | $400 materials | 120 hrs development | $400.00 + 120 hrs | 1 | Pre- and post-questionnaires |
| | | Focus Groups | B,S,T,N,A,P | AWRI, GVSU Communications Dept. | 10/y x 2yr | $25.00 materials/each | 68 hrs/yr | $500.00 + 136 hrs | 1,2 | Opinions on products and messages and applicability to future products. |
| **Resident Audience Items** | **Anything done on your property** | General Knowledge Survey | B,S,T,N,A,P | AWRI, GVSU Communications Dept. | 1 mailed survey x 1,000 copies | $50.00 materials $720.00 Postage | 160 hrs | $770.00 + 160 hrs | 1 | Opinions on products and messages and applicability to future products. |
| | | Watershed Fair | B,S,T,N,A,P | AWRI & Wittenbach Nature Center | 1 x 3 yr | $400.00 materials | 32 hrs prep/each 8 hrs imp/each | $1,200.00 + 120 hrs | 1,2,3 | Number of participants, contacts made because of. |
| | | Stream Bank Clean Ups | S,N | CRWC, Schools | 2/yr spring and fall | $250 materials/yr | 32 hrs prep/each 8 hrs imp/each | $750.00 + 160 hrs | 1,2,3 | Number of participants, contacts made because of, and amount of trash removed. |
| | | Interpretive Walking Tours | S,N | CRWC, AWRI, Wittenbach Center | 2/yr spring and fall | $50.00 materials/ea. | 32 hrs prep/ walk | $300.00 + 192 hrs | 1,2,3 | Number of participants, contacts made because of. |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Volunteer Monitoring | Bacteria Loading | CRWC, Schools | 2 monitoring days/yr 2 training days/yr | Equipment $5,000.00 | 80 hrs prep/yr 10 hrs imp/each | $5,000 + 360 hrs | 1,2,3 | Number of participants, contacts made because of, amount of viable results.. |
| | | Demonstration Site Tour | B,S | AWRI, NRCS | 1 day x 3yr | Van rental: $100/tour Meeting supplies: $50.00/tour | 100 hrs/yr | $450.00 + 300 hrs | 1,2,3 | Number of participants, contacts made because of. |
| | | What Do You Know About Septage And Sewers Worksheets | B | AWRI, Health Departments | 2- 1 page double sided x 200 full color copies | $1.00/each | 40 hrs prep 20 hrs distribution | $400.00, printing + 60 hrs | 1,2 | Number of sheets filled out, requests for additional information. |
| | | Distribute AWRI Riparian Landowner's Guide | B,S,T,N | CRWC, AWRI | 100 copies x 1yr x 3 yr | $25.00/each | 40 hrs/yr for distribution | $7,500 printing + 120 hrs | 1,2,3 | Number of handbooks requested, contacts made. |
| | | Educator Workshop | B,S,T,N,A,P | CRWC, AWRI | 1/year | | Year 1: 300 hrs Year 2-3: 50 hrs/yr | + 400 hrs | 1,2,3 | Number requested, commentary during, follow up material including survey. |
| | | Watershed Classroom | B,S,T,N,A,P | CRWC, AWRI | 4 various activity with water quality and students/yr x 3 yrs | $500 Materials/yr | 320 hrs/yr | $1,500 hrs + 960 hrs | 1,2,3 | Number requested, follow up material including survey. |
| | | Watershed Lessons | B,S,T,N,A,P | CRWC, AWRI | 2 developed and disseminated kits/yr x 3 yr | $ 50.00 materials/yr | 160hrs/yr | $150.00 + 480 hrs | 1,2,3 | Number requested, follow up material including survey. |
| | | Support of Current Student Monitoring | B,N | CRWC, Wittenbach Nature Center | | $200.00/yr materials | 80 hrs/yr | $600.00 + 240 hrs | 1,2,3 | Amount of viable data, and number of regular participants. |
| | | Septage Sign Up | B | CRWC, County Health Departments | 1 page x 100 copies x 3 yrs | $1.00/copy $30.00/yr materials | 32 hrs development, yr 1 40 hrs/ yr distribution | $390.00 + 152 hrs | 1,2,3 | Number of participants. |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Agricultural Audience Items** | **As caretakers of the land you may have the largest potential to care for the water resources, if we work together we can help each other.** | Agricultural Programs 1 on 1 | B,S,T,N,A,P | CRWC, NRCS, Conservation Districts | 8 days x 3 yr | | 16 hrs/day | 384 hrs | 1,2,3 | Number of participants. |
| | | Coffee Talk | B,S,T,N,A,P | CRWC, NRCS, AWRI | 4 groups (throughout watershed) x 4 mtg/yr x 3 yr = 48 mtgs | | 10 hrs/mtg | 480 hrs | 1,2,3 | Number of participants |
| | | Cost-Share Promotional Mailer | B,S,T,N,A,P | NRCS, Conservation Districts | 1 mailer 11x6 x 1,000 color copies | $1.25/each | 75 hrs | $1,250.00 + 75 hrs | 1,2,3 | Number of contacts made as result of. |
| | | Partnership with Agricultural Service | B,S,T,N,A,P | CRWC, NRCS, Conservation Districts | | | 300 hrs | + 300 hrs | 1,2,3 | Number of contacts made as result of. |
| | | Demonstration Farm Tour | B,S,T,N,A,P | CRWC, NRCS, Conservation Districts | 1 day x 3yr | Van rental: $100/tour Meeting supplies: $50.00/tour | 100 hrs/yr | $450.00 + 300 hrs | 1,2,3 | Number of participants |
| | | Women Of The Coldwater River | B | CRWC, AWRI, Wittenbach Nature Center | 2 mtg x yr | $30.00 Meeting Supplies/ mtg | 32 hrs x mtg | $180.00 + 192 hrs | 1,2,3 | Number of participants |
| **Recreational Audience Items** | **Our water resources** | Increase Access to Conservation Management Products & Plant Materials | B,S,T,N,A,P | CRWC, NRCS, Conservation Districts, Landscaping Companies | 2 Vendor Fairs/yr | Advertising /Materials: $1,000/yr | Planning: 100hrs/yr | $2,000 + 200hrs | 2,3 | Number of landowners receiving information and gaining materials. |
| | | Fish Of The Coldwater Display | S,T, N | AWRI, CRWC, MDNR | 1 Traveling Display | Materials/Printing: $500 | Development/Production 100hrs | $500 + 100 hrs | 1 | Number of requests for, amount of activity at display when used. |
| | | Partnering With Recreational Businesses & Tourism Outlets | B,T | CRWC, Trout Unlimited | | | 100hrs/yr | 100 hrs | 1,2,3 | Reduction of reported abuse by recreation, growing awareness of resource |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Hunting Correspondence | B, S | CRWC, MDNR, AWRI | 2/yr x 3yr x 1 page x 500 copies x | $1.00/ copy $30.00/materials/yr | 80 hrs/yr | $3,090 + 240 hrs | 1,2,3 | Contacts made as result of. |
| | | Fishing Correspondence | B, S, T, N | CRWC, MDNR, AWRI | 2/yr x 3yr x 1 page x 500 copies x | $1.00/ copy $30.00/materials/yr | 80 hrs/yr | $3,090 + 240 hrs | 1,2,3 | Contact made as result of. |

### 7.3 Technical Assistance Items And Costs

Implementation of best management practices and information and education strategy are necessary to achieve the listed goals for the watershed. However, there are some necessary items required to support these activities. Throughout this plan certain recommendations have been made for future work in the watershed. Table 22 lists of them by priority. For any water quality monitoring a Quality Assurance Project Plan will be completed.

**Table 22. Recommended Future Efforts in Coldwater River Watershed**

| Section Mentioned | Task | Estimated Cost to Implement | Possible Group to Do Work |
|---|---|---|---|
| Section 4.2- Section 4.6 | Additional water quality sampling for 16 sites once/month with three rain event samples and 20 additional bacteria samples. | $22,600.00 + $1,600.00 (for additional bacteria sampling) | CRWC & AWRI |
| Section 4.3 | Complete a spring macro-invertebrate survey using the adapted MDEQ protocol 51 | $2,578.00 | AWRI |
| Section 3.7 | Conduct hydrology studies in the area up stream of tributaries and additional modeling simulations for adding storage capacity in the main tributaries. | $1,200.00 | Barry & Ionia Drain Commissioner Offices, CRWC, & AWRI |
| **Total Cost of Efforts** | | **$27, 978.00** | |

Other items that might be considered include obtaining additional copies of the map atlas for local townships. More equipment, such as rain gauges and thermometers, could be used in order to continue monitoring the river. Selective water quality testing of new areas in the watershed or in problem areas could be done in order to identify additional critical areas. It would also be helpful to obtain additional support for stakeholder meetings and steering committee meetings.

Table 23, is a table of desired tools and products and their costs. The first column lists the tools or products desired, the next column gives a little more detail about the item, then the number of desired items is given, and the cost per each item is listed. The next column gives the details of where the item can be purchased from and its item number for purpose of ordering (more details about some products and where they could be purchased from is given in the text after the table). Then the total cost column gives an estimated cost for the desired number of each item.

| Table 23. Desired Technical Tools, Products, and Their Costs | | | | | |
|---|---|---|---|---|---|
| **Tool/Product** | **Recommended item(s)** | **Number** | **Cost/each** | **Seller/item number** | **Total Cost** |
| 32K StowAway Tidbit Thermometers | Data logging digital thermometer | 7 | $91.00 | Onset Computer Company/ TBI32-20+50 | $637.00 |
| Conductivity, Dissolved Oxygen & Temperature Meters | YSI 85 Hand-held Salinity, Conductivity, Dissolved Oxygen & Temperature System w/ 10' Cable, See Description Below. | 1 | $1,450.00 | Forestry Suppliers, Inc./#76288 | $1,450.00 |
| Conductivity, Dissolved Oxygen & Temperature Meters Carrying Case | Carrying Case for 10' & 25" Models | 3 | $52.95 | Forestry Suppliers, Inc./#76233 | $158.85 |
| Rain Gauges | 7852 Rain Collector, Standard w/ 40' Standard Cable. | 3 | $75.00 | Davis Instruments/#7852 | $225.00 |
| Rainfall Data Logger | HOBO Event Rainfall Logger, See Description Below. | 3 | 1-9 $85.00 10+ $77.00 | Forestry Suppliers, Inc./#89424 | $255.00 |
| Software to download Rainfall Data Logger | BoxCar Software Starter Kit for DOS, Windows 3.1x, or Windows 95, PC Interface Cable, and Manual, See Description Below. | 1 | $14.00 | Forestry Suppliers, Inc./#89429 | $14.00 |
| Advanced Software to download Rainfall Data Logger (an advanced alternative to BoxCar Software Starter Kit) | BoxCar PRO Software Kit for DOS, Windows 3.1x, or Windows 95, PC Interface Cable, and Manual, See Description Below. | 1 | $95.00 | Forestry Suppliers, Inc./#89439 | $95.00 |
| Replacement Battery for Rainfall Data Logger | Replacement 3V Lithium Battery | 10 | $1.80 | Forestry Suppliers, Inc./#89423 | $18.00 |
| *River Monitoring Stations + Installation + Water Level Meter + In-Situ, Inc. MP Troll 8000 Data Logger | | 4 | $5,000.00 | CRWC | $20, 000.00 |
| Equipment Maintenance and Calibration for River Monitoring Stations | | 4 | $200.00/ yr | CRWC | $800.00 |

| | | | | | |
|---|---|---|---|---|---|
| Equipment to Download Data from River Monitoring Stations | | 1 | $1,200.00 | CRWC | $1,200.00 |
| Macro Invertebrate Collection Nets | Aquatic Net, Special "D-shaped" opening allows you to easily scrape stream bottoms or "sweep" in thick vegetation. | 3 | $67.75 | Forestry Suppliers, Inc./#53755 | $203.25 |
| Specimen Forceps | Specimen Forceps, No. 4220 - 10" chrome-plated from high grade forged stainless steel. | 3 | $12.95 | Forestry Suppliers, Inc./#53782 | $38.85 |
| Conference Fees | Assistance in costs for registration and in room and board | 1/yr x 3yr | $200.00 | Annis Water Resource Institute | $600.00 |
| Digital Map Atlas | As Needed | | $25.00 | Annis Water Resource Institute | $125.00 |
| Bound Map Atlas | As Needed | | $200-$250 | Annis Water Resource Institute | $1,250.00 |
| More Copies Of Management Plan | As Needed | 5 | $15.00 | Annis Water Resource Institute | $75.00 |
| **Total Cost of Items** | | | | | **$27,144.95** |

*The River Monitoring Station records river elevation, water temperature, pH, dissolved oxygen, and conductivity and if purchased, the YSI® 85 Hand-held Salinity, Conductivity, Dissolved Oxygen & Temperature System would not need to be purchased but is shown as an alternative to buying the River Monitoring Station.

Note, items can be bought from Onset Computer Corporation at www.onestcomp.com, Forest Suppliers, Inc. at www.forest-suppliers.com, Mapmart at www.mapmart.com, and Davis Instruments by calling 1-800-678-3669.

Product Descriptions:
**32K StowAway Tidbit Thermometers** Waterproof to 1000 feet, has a 5 year non-replaceable battery (typical use*) this unit is completely sealed in epoxy; very durable, it has a capacity of 32,520 measurements. It is very small size: 1.2" wide x 1.6" tall x 0.65" thick (30 x 41 x 17 mm) and 0.8 oz. This unit has two measurement ranges†: +24°:F to +99°F (-4°C to +37°C) and -4°F to +122°F (-20°C to +50°C) User-selectable sampling interval: 0.5 seconds to 9 hours, recording times up to several years. Programmable start time/date and memory modes stop when full or wrap-around when full. Nonvolatile EEPROM memory retains data even if battery fails. This unit is capable of multiple sampling with minimum, maximum or averaging, and blinking LED light confirms operation. It has a time accuracy: ±1 minute per week at +68°F (+20°C). (Onset Suppliers, 2002)

**YSI® 85 Hand-held Salinity, Conductivity, Dissolved Oxygen & Temperature System** Determines salinity, conductivity, dissolved oxygen, and temperature. The YSI® 85 is a rugged, microprocessor-based, hand-held digital meter with an attached YSI combination conductivity and dissolved oxygen probe. The conductivity portion of the probe is a four-electrode cell with a cell constant of 5.0 cm/±4% while the dissolved oxygen portion is a polarographic Clark-type sensor that uses cap membranes. DO readings are automatically compensated for salinity and temperature. Unit's non-volatile memory stores up to 50 data sets. Other features of the YSI 85 include autoranging, a bright backlit display, an automatic function check, and a large display that always shows temperature along with your dissolved oxygen, conductivity, temperature-compensated conductivity or salinity reading. The YSI 85 is powered by 6 "AA" batteries (included) which provide about 100 hours of operation (display warns when batteries are low).
Measurement Specifications: Dissolved Oxygen - Range: 0 to 200%/0 to 20 mg/L. Resolution: 0.1%/0.01 mg/L. Accuracy: ±2%/0.3 mg/L. Conductivity - Range: 0 to 499.9 µS/cm, 0 to 4999 µS/cm, 0 to 49.99 mS/cm, 0 to 200.0 mS/cm. Resolution: 0.1 µS/cm, 1.0 µS/cm, 0.01 mS/cm, 0.1 mS/cm. Accuracy: ±0.5% full scale. Salinity - Range: 0 to 80 PPT. Resolution: 0.1 PPT. Accuracy: ±2% or ±0.1 PPT. Temperature - Range: -5°C to 65°C. Resolution: 0.1°C. Accuracy: ±0.1°C(±1 Isd). (Forestry Suppliers, 2002).

**7852 Rain Collector** 0.01” Designed to meet the guidelines of the World Meteorological Organization, the self-emptying tipping-bucket design is exceptionally accurate. Choose 0.01” or 0.2mm increments. Standard with 40’ (12m) standard cable. (Davis Instruments, 1999)

**HOBO® Event Rainfall Logger** Accurately records time/date stamped rainfall data. Connect the unit to the inside or outside of a standard tipping bucket rain collector to record detailed rainfall history including quantity, time, date, duration, and intensity. The HOBO® Event is user programmable to match the bucket's tip size and features a minimum recording interval of 0.5 seconds. With a 0.01 inch bucket, the 8,000 event capacity will store up to 80 inches of rainfall data. The data is stored in the unit's non-volatile EEPROM memory, which retains collected data even if the battery fails. The unit can be launched and data read easily in tabular form or exported to spreadsheets such as Excel and Lotus 1-2-3 using Starter Kits for DOS, Windows 3.1x or Windows 95 (Starter Kits sold separately). Event type: tipping. Operating temperature: -20°C to +70°C/-4°F to +158°F. Time accuracy: ±100 ppm at 20°C. Relative humidity range: (when case is open) 0 to 95%, non-condensing. Power: user-replaceable, 3V lithium battery with an expected life of one year of continuous use. Dimensions: 4.25" x 3.5" x 1.75". (Forestry Suppliers, 2002).

**BoxCar® Starter Kit** Provides basic launch, readout, plotting, and export capabilities for HOBO® and StowAway™ loggers and shuttles. For PCs running DOS, Windows 3.1x

or Windows 95/98/NT. PC interface cable and manual included. (Forestry Suppliers, 2002).

**BoxCar® Pro Starter Kit** This software allows advanced data display and analysis and accommodates multiple logger launch. You can plot multiple parameters on the same graph (each with their own units) and then focus in on your data of interest using the zoom and axis-control tools. Supports all Onset loggers and shuttles (including HOBO® and StowAway®) and the HOBO® Weather Station Logger. PC interface cable and manual included. Minimum system requirements: PC system running Windows XP/2000/ME/98, at least one available serial COM port, CD-ROM drive, 16-bit minimum color display, and 10 MB of available disk space. (Forestry Suppliers, 2002).

## 7.4 Model Township Ordinances For Selected Communities In The Coldwater River Watershed

Ordinances can be used as a foundation for the institutionalization of watershed stewardship behavior. There are many example ordinances in existence that deal with stormwater, septic systems, and the protection of wetlands. There is a new model septic ordinance being produced through the Kent County Septage Disposal Project. Wetland protection is growing in the State of Michigan through a draft ordinance being developed through the Huron River Watershed Council. On a local scale a work group in Kent County is adapting the ordinance for adoption by townships. As a precursor for wetland protection ordinances the education tools and restoration incentives being developed by the Wetland Workgroup should be reviewed and implemented when appropriate.

For more information on the Kent County Model Stormwater Ordinance contact:
Roger Laninga
Drain Commissioner
(616) 336-3688
1500 Scribner
Grand Rapids, MI 49503

For more information on the Kent County Septage Disposal Project contact:
Kate Rieger
Annis Water Resources Institute
(616) 331-3749
740 West Shoreline DR.
Muskegon, MI 49441

For more information on the Huron River Watershed Council contact:
Huron River Watershed Council
(734) 769-5123
1100 North Main, Suite 210
Ann Arbor, MI 48104

For information about the local wetland ordinance adaptation for Kent County Contact:
Bonnie Shupe
Clerk of Cannon Township
(616) 874-6966

For information concerning the Wetland Workgroup contact:
Robert Zbiciak at (517) 241-9021,
zbiciakr@michigan.gov
Land and Water Management Division,
Michigan Department of Environmental Quality
P.O. Box 30458
Lansing, MI 48909-7958

## 7.5 Evaluation

In order to evaluate the success of this management plan, and to be able to keep it flexible for unknown future needs an evaluation strategy is needed. It will be made up of four tasks.

### Task 1. Developing Evaluation Questions With An Evaluation Team

The team, whose members will be selected by the CRWC and their consultant, will identify the goal(s) of the evaluation and generate a list of questions related to evaluating the project. The evaluation will look specifically at the implementation of best management practices, the feedback from the information and education strategy, any changes in water quality for the Coldwater River Watershed, and project management.

### Task 2. Developing The Evaluation Approach And Tools

In order to evaluate the success of the Plan multiple tools will be used. The first tool is a short bi-annual survey of the stakeholders and the steering committee to be passed out and collected at meetings. The purpose of the survey will be to find out if publications are circulating correctly, if the group is still focused on the same goals, and if new information has surfaced requiring a change in the Plan. Items that would show positives results of this plan, such as any documentation of ordinance adoption, water resource protection, watershed management planning, increase acreage enrolled in watershed friendly programs, participation in workshops, and interest in water chemistry sampling, will be recorded to evaluate the projects progress. Another form of evaluation will be the project's ability to respond to needs voiced in public comments and incorporation of those needs into the information and education strategy. Also, data showing the restoration of impaired uses or the protection of threatened uses will be used as an indicator of project success.

### Task 3. Collecting And Analyzing Data

Under this task, the consultant will be responsible for the tools and methods developed in Task 2. The appropriate data collection and analysis method will depend on the tool used. An evaluation meeting will occur at the end of each project year, and may involve the consultant meeting with individual members of the evaluation team or the team as a whole.

The consultant will conduct an initial analysis of the data as it is collected to determine if there is a need to revise the evaluation tools for continued use in the evaluation process. This evaluation will contain both quantitative and qualitative results. The consultant will prepare an informational summary of analysis for each of the project years. Each year end report will include: an introduction, giving background information, goals, etc; methodology, of every evaluation tool used and for analyzing the data; results of the evaluation tools; lessons learned; and conclusions and recommendations.

**Task 4. Prepare Draft And Final Evaluation Summary**
Starting from the first project year there will be an evaluation summary completed. Every year will build on what was done in previous years making one comprehensive report. The products of this evaluation strategy, or evaluation tools, include but are not limited to the three tools discussed in Task 1, three-year end reports, and one final evaluation report.

| **Table 24. Cost of Project Evaluation** | | | | |
|---|---|---|---|---|
| **Task** | **Project Year 1** | **Project Year 2** | **Project Year 3** | **Total Cost /Task** |
| **Task 1**. Developing Evaluation Questions With An Evaluation Team | $585 | $585 | $585 | $1,755 |
| **Task 2**. Developing The Evaluation Approach And Tools | $1,320 | $880 | $880 | $3,080 |
| **Task 3**. Collecting And Analyzing Data | $1,755 | $1,755 | $1,755 | $5,265 |
| **Task 4**. Prepare Draft And Final Evaluation Summary | $2,185 | $2,185 | $2,185 | $6,555 |
| **Total Cost/ Year** | $5845 | $5,405 | $5,405 | **Total Cost For Evaluation: $16,655** |

### 7.6 Total Cost Estimate

To implement this plan and to achieve water quality goals, many things are needed. The estimated cost of best management practices, technical assistance, and information and education activities are broken down in Table 25, along with the cost of staffing such a project. To note, this number may seem large, but when it is divided by the number of residents in the watershed and based on a three year implementation schedule the cost breaks down to approximately $8.56/person/year.

**Table 25. Total Cost Estimate**

| Activities/Items | Cost Materials | Total Hours | Sub-total Cost for Hours | Total Cost |
|---|---|---|---|---|
| *Best Management Practices Sub-Total:* | *n/a* | *n/a* | *n/a* | *n/a* |
| Promotional | $7,040 | 400 | $8,000 | $15,040 |
| Multi-Media | $74,110 | 1,544 | $30,880 | $104,990 |
| Resident | $18,480 | 3,624 | $72,480 | $90,960 |
| Agriculture | $1,880 | 1,731 | $34,620 | $36,500 |
| Recreational | $9,280 | 960 | $19,200 | $28,480 |
| Government | $780 | 534 | $10,680 | $11,460 |
| All | $760 | 380 | $7,600 | $8,360 |
| *Information & Education Sub-Total:* | *$112,330* | *9,173* | *$183,460* | *$295,790* |
| Future Recommended Efforts | $27,978.00 | n/a | n/a | $27,978.00 |
| Equipment/Materials | $27,119.95 | n/a | n/a | $27,119.95 |
| *Technical Assistance Sub-Total:* | *$55,122.95* | *n/a* | *n/a* | *$55,122.95* |
| *Evaluation Cost Sub-Total:* | *$16,655* | *n/a* | *n/a* | *$16,655* |
| **Total Cost (except BMPs)** | | | | **$367,568** |

## 8.0 Conclusion

The Coldwater River Watershed is a valuable resource to its residents. The Coldwater River itself is still considered to be a cold-water stream and valuable for education and recreation purposes. It is a resource that needs to be protected from non-point source pollution. Currently the watershed has two impaired designated uses. The impaired designated uses are "total body contact recreation" between May 1 and October 31 and "partial body contact recreation". The watershed also has two threatened designated uses, "other indigenous aquatic life and wildlife", and "cold-water fishery". The following nonpoint source pollutants, sediment, bacteria, and thermal pollution are hampering these designated uses. These pollutants can be reduced in the watershed if best management practices for better water quality and an information and education strategy for creating better watershed stewardship is implemented. There are several local groups interested in the welfare of this watershed.

The Coldwater River Watershed Council (CRWC) is one such group dedicated to the welfare of the watershed. The CRWC is seeking grants through the Clean Michigan Initiative grant program, the United States Environmental Protection Agency Nonpoint Source Pollution Control program, and through local foundations and donors to implement this Nonpoint Management Plan. The CRWC, an established incorporated non-profit, is seen as long time stewards and a likely candidate to receive implementation support. They will be managing the funding in order to get this plan implemented. The Council would like to reduce the nonpoint source pollutants by first improving the high flow rates that occur after rain events, limit cattle access to the river, and create awareness and education of good watershed stewardship behavior to the residents, industries, and local decision makers in the watershed.

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[DEQ] Department of Environmental Quality Water Quality Parameters. Bacteria. www.deq.state.mi.us/documents/deq-swq-npdes-Bacteria.pdf

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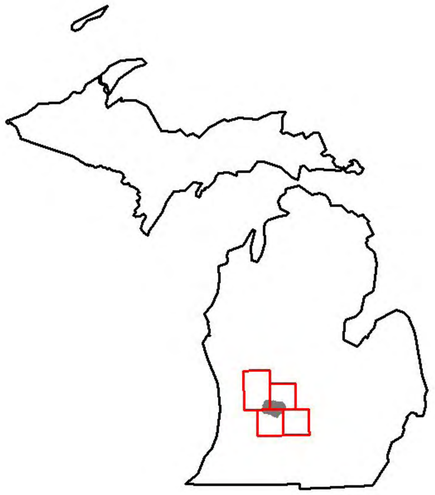
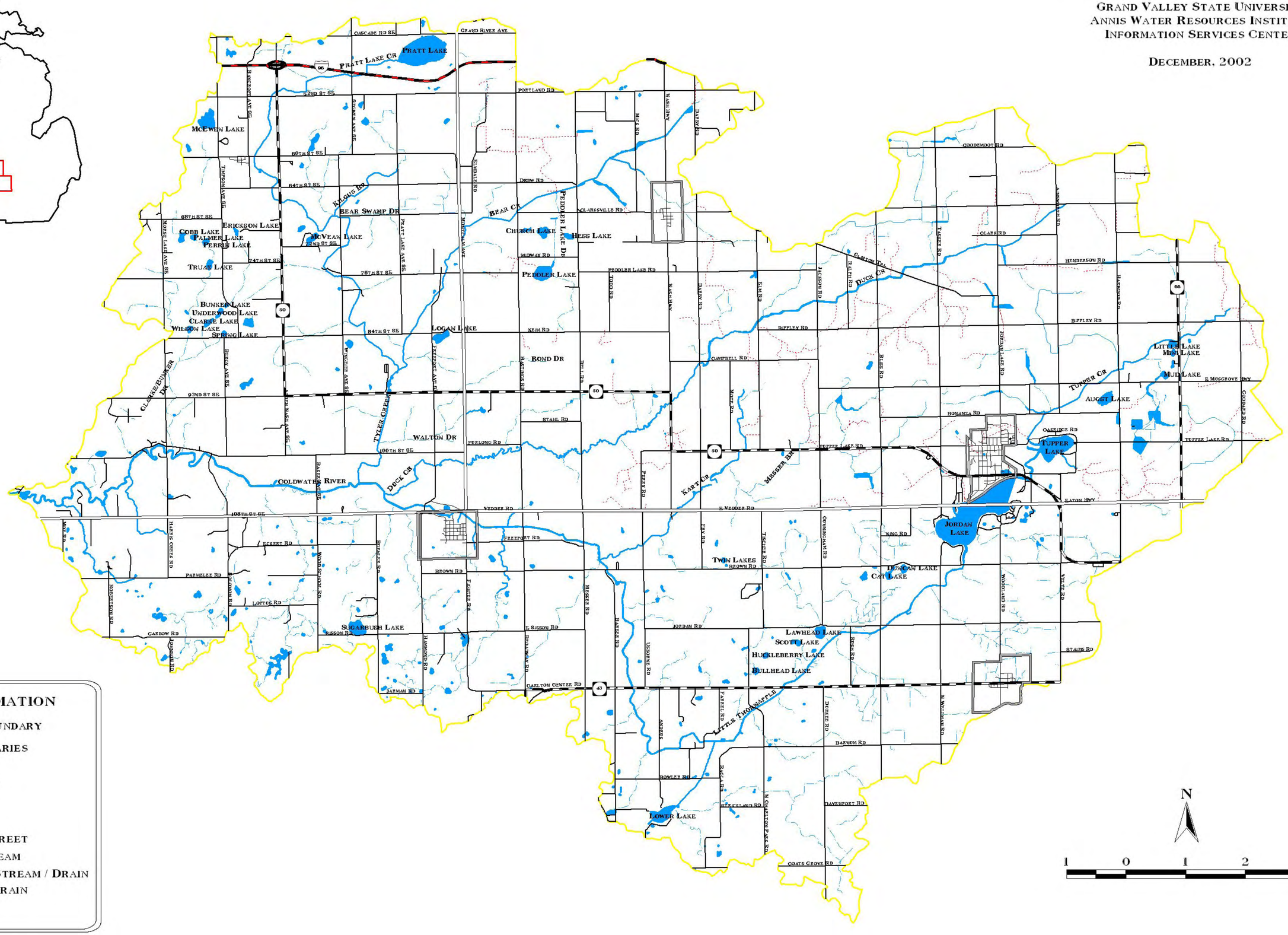
**Appendix A**
Drainage Map

BASE INFORMATION
MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION
MICHIGAN GEOGRAPHIC DATA LIBRARY

GRAND VALLEY STATE UNIVERSITY
ANNIS WATER RESOURCES INSTITUTE
INFORMATION SERVICES CENTER

DECEMBER, 2002






## BASE INFORMATION

- WATERSHED BOUNDARY
- COUNTY BOUNDARIES
- CITIES/TOWNS
- STATE HIGHWAY
- INTERSTATE
- COUNTY ROAD
- RESIDENTIAL STREET
- PERENNIAL STREAM
- INTERMITTENT STREAM / DRAIN
- CLOSED TILE / DRAIN
- LAKES

# COLDWATER RIVER WATERSHED
# BASE INFORMATION

**Appendix B**
Land Use Map

Base Information
Michigan Center For Geographic Information
Michigan Geographic Data Library

Land Use / Cover Information
Kent County 1991 Annis Water Resources Institute
Barry, Ionia, and Eaton Counties 1978:
Michigan Center For Geographic Information -
Michigan Geographic Data Library

Grand Valley State University
Annis Water Resources Institute
Information Services Center

December, 2002

Pratt Lake Cr
Pratt Lake
McEwen Lake
Kilgus Dr
Bear Swamp Dr
Bear Cr
Pedler Lake Dr
Cobb Lake
Erickson Lake
Perrin Lake
Lake Number Ten
Church Lake
Hess Lake
Truax Lake
Pedler Lake
Duck Cr
Bunker Lake
Underwood Lake
Clarke Lake
Wilson Lake
Spring Lake
Logan Lake
Bond Dr
Clarke-Bunker Dr
Tyler Creek
Walton Dr
Tupper Cr
Litter Lake
Mud Lake
August Lake
Coldwater River
Duck Cr
Kart Cr
Messer Dr
Tupper Lake
Jordan Lake
Twin Lakes
Duncan Lake
Cat Lake
Sugarbush Lake
Lawhead Lake
Scott Lake
Huckleberry Lake
Bullhead Lake
Little Thornapple
Lower Lake

## Base Information

- Watershed Boundary
- County Boundaries
- Cities/Towns
- State Highway
- Interstate
- Perennial Stream
- Intermittent Stream / Drain
- Closed Tile / Drain
- Lakes

## Land Use / Cover

- Urban
- Agriculture
- Open Field
- Forest
- Water
- Wetland

N

1 0 1 2 3 Miles

# Coldwater River Watershed
# Land Use / Cover

**Appendix C**
Coldwater River Watershed Council Portfolio

**COLDWATER RIVER WATERSHED COUNCIL**
10250 Morse Lake
Alto, Michigan 49302
Fax (616) 891-0302

*"Working together to protect, rehabilitate, and sustain the ecological and cultural communities that make up the Coldwater River watershed."*

## What makes the Coldwater River Special?

The Coldwater River has a combination of cold, clean water and good public access, as well as the ablity to support the human and wildlife communities that live within the watershed. The rural character of the river presents a unique opportunity to preserve and nurture this valuable resource for recreation and education.

## What is the Coldwater River Watershed Council?

The watershed council is a group of people working together to protect, sustain, and rehabilitate the ecological and cultural communities that make up the Coldwater River ecosystem.

Rivers are natural systems that flow across political boundry lines. Bridging those lines by building partnerships between all of those who are using the resources of the river is the key to the protection and continued viability of the Coldwater River. Our watershed includes parts of Kent, Ionia, Barry, and Eaton counties, and consists of all the land that drains into the Coldwater River and its tributaries.

## What has the Coldwater River Watershed Council done for the watershed?

The CRWC has organized a well funded, incorporated, non-profit entity that has implemented river repair projects and participated in a fish habitat experiment. Annual river cleanups and public meetings sponsored by the CRWC create awareness of watershed activities.

## List of activities and deeds of the Coldwater River Watershed Council 1997-2002

**1997:**

-August, Participated in Trout Habitat project on in-town stretch of Coldwater River in Freeport, Michigan.
-October, First slate of officers elected.
-October 16-17, President Dick Smith attended Lake Michigan council meeting on Mackinaw Island.
-Established a bank account at Hastings City Bank.
-Held a community meeting at Freeport Community Center with Janice Thompkins as principal speaker.
-Started putting a monthly column in the local advertising paper called the "Coldwater Column".
-Sponsored a river cleanup extending from M-43 to Morse Lake Road. Lunch provided by WMTU.
-Held a meeting at Freeport Community Center with Jim Scott, Steve Bare, and Steve Utic of three local county NRCS offices.
-Board members Jim Oosting and Dick Smith attended a meeting of Watershed Councils on Betsie River.
-Board started preliminary work on the Coldwater Park Bank restoration.

**1998:**

-September, Established working committees.

**1999:**

-February, Riparian owner list prepared and submitted to board.
-Drafted and sent a letter to Bowne Township Planning Board to oppose 600-unit mobile home project on Tyler Creek.
-Decided to produce an information and membership pamphlet.
-November, Achieved tax-exempt status.
-Started looking for grants from foundations. Hired grant writer Debra Steketee.

**2000:**

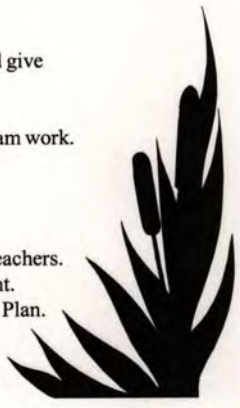
-February, Student river monitoring program gathered momentum.
-August 29, Completed Coldwater Park Bank Restoration.
-High school monitoring group leaders began bi-weekly meetings to co-ordinate efforts in order to get consistent results for all groups.
-Established Website.
-Hired Glenn Brovant to sample eight sites on the Coldwater River.
-Water samples taken to Annis Water Resources Institute for analysis in order to be qualified for legal action if necessary.
-Received grants totaling $138,000 from local foundations.
-September, Hired Mainstream Resources to study the Coldwater River and its tributaries for problems that can be solved with grant money.
-Hired accounting firm Walker and Fluke, tax purposes.

**2001:**

-May, Held public information meeting to explain the Mainstream Resources Study and give exposure to high school monitoring groups.
-Bought in-stream monitor with grant money from Wege Foundation.
-November, Met with Lansing Chapter Trout Unlimited about joining efforts on in-stream work.

**2002:**

-March, Applied for Inland Fisheries Grant to increase large woody debris.
-Grant of $1000.00 was received from Barry County Community Foundation.
-April 16, Held meeting in the Wittenbach Center in Lowell for student monitors and teachers.
-June 18, First Stakeholders meeting held to discuss the Management Plan development.
-October 2, Second Stakeholders meeting held to review the draft of the Management Plan.



# PROFILES OF THE MEMBERS OF THE CWRC

### J. R. OOSTING

Retired Oral Surgeon. Active in environmental issues for entire life. Board member CWRC.

### DICK SMITH

Structural and architectural repairs to precast concrete buildings for Kerkstra precast. President and secretary of CWRC.

### TED CURTIS

Retired industrial education instructor. Career spanned forty years with teaching/ industry experience in six states.

### PATRICK PULLEN

Watershed instructor at Thornapple Kellogg High School. Twelve years teaching experience in Biology, Zoology/Botany, and Earth Science.

### RON BARCH

32 years of experience as a classroom teacher. Graduate degree in Curriculum design. Charter member of Jordan Lake Association. 8 years Board of Directors for West Michigan Trout Unlimited. Member of the Kent Intermediate Environmental Education Council. Small business owner: Alder Creek Publishing. Married with two grown daughters, resident of Hastings for 25 years. Member of CWRC.

### PAUL W. EBERHARDT

National Director of the Federation of Fly Fishers. Former board member of West Michigan Trout Unlimited. Self-employed painter and decorator in the local area for 15 years. Five-year member of CWRC.

**Appendix D**
Fact Sheets and Description Cards

# The Coldwater River Watershed

**What is a Watershed?** **A watershed is an area from which all precipitation flows to a single stream or lake. For example, the total area drained by the Mississippi River constitutes its watershed, whereas that part of the Mississippi River drained by the Ohio River is the Ohio's drainage basin.**

## Where is the Coldwater River Watershed?


## What are the Problems in the Coldwater River Watershed?

**Thermal Pollution: the discharge of heated liquid into the watershed at a temperature harmful to a cool water habitat**

**Excess Sedimentation: deposit of an unnatural amount of sediment in the river due to erosion**

**Spates: an abundant, usually overwhelming flow or fall, as of a river or rain**

**Bacteriological Quality: analysis of a bacterial population where the presence of pathogenic or non-pathogenic bacteria indicates water quality**

**For example: On given months, bacteriological quality water samples from the Coldwater River exceeded *Eschericia coli* (E. coli) values for "partial body contact", boating and wading, and "total body contact", swimming, designations. E. coli bacteria is common to intestential tracts of humans and animals and is used as an indicator of possible sewage contamination.**

**Limits set by Health Dept.:**

- ***Total body contact:*** **not more than 130 E. coli per 100 milliliters as a 30-day average**
- ***Partial body contact:*** **not more than 1000 E. coli per 100 milliliters calculated as the average of 3 or more samples during 1 sampling event**

➢ **Did you know that the Coldwater River is named after its cold-water habitat?**

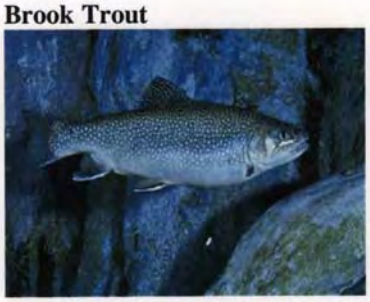
➢ **Did you know that the Coldwater River is approximately 34 miles in length and runs into the Thornapple River, which runs into the Grand River?**

➢ **Did you know that the Coldwater River watershed covers 3 counties and is approximately 150 square miles?**

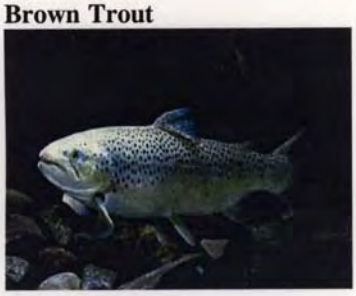
## Cold Water Habitat Fish Species:

**Blacknose Dace**

**Brook Trout**



**Brown Trout**



**Sculpin**

**Rainbow Trout**

## Common Species in the Coldwater River Watershed:

**Beetles, Mayfly nymphs, Stonefly nymphs, Midge larvae, Sowbugs, Scuds, Caddisfly larvae, & Crayfish.**

**Crayfish**

# Designated Uses And The Coldwater River Watershed

The State of Michigan has decreed that each of its water bodies will fulfill the following designated uses: agriculture, industrial water supply, public water supply at point of intake, navigation, warm water fisheries, other indigenous aquatic life and wildlife, partial body contact recreation, total body contact recreation (between May 1 and October 31), and occasionally, if appropriate, a coldwater fishery. (Brown, 2000) The Coldwater River watershed has four designated uses that are detrimentally affected by nonpoint source pollutants. Two of these designated uses are impaired: partial body contact and full body contact. The other two designated uses are threatened: cold-water fishery and "other indigenous aquatic life and wildlife".

## Cold-water Fisheries And Other Indigenous Aquatic Life And Wildlife Known To Be Threatened, To Be Protected

The Coldwater River is designated by the Michigan Water Quality Standards as a coldwater stream from its confluence with the Thornapple River upstream to Route 43, or Carlton Center Road (Staff, 1998). Sediment, a known problem for the watershed, is threatening this cold water stream. The Natural Resources Conservation Service (NRCS) has designated this area as a priority conservation area (Bare, 2002) because of the high bacterial levels and sedimentation loading. The sediment can raise temperature, clog fish gills, and cover spawning grounds. This river is used as a recreational resource for fishing, school group activities, boating, swimming, and hunting. If the sediment loading continues it will lose its valued recreational status. It appears that the sediment is brought to the stream through stormwater runoff. The runoff if coming from urban impervious areas and agricultural fields. If proper stormwater management practices are implemented, these two designated uses will become more protected.

# FULL BODY CONTACT AND PARTIAL BODY CONTACT
## KNOWN TO BE IMPAIRED, TO BE RESTORED

The EPA has placed the main body of the Coldwater on its draft 2002 303(D) list and slated it for study in 2006 because of the bacteria. The Kent County Health Department already samples the Coldwater River for bacteria and because of the high levels has had to stop access to the river to public access several times.

"Surface waters are sampled for bacteriological quality in accordance with the Michigan Department of Natural Resources, Part 4 Water Quality Standards, Rule 62.(1), (2), Act 245, P.A. 1929 as amended. The number and frequency of samples collected at each station is determined by its designation as "total body contact" or "partial body contact". Samples are tested to determine the presence of Eschericia coli (*E. coli*), a bacteria common to the intestinal tracts of humans and animals. *E. coli* is used as an indicator of possible sewage contamination of human origin. Animals (wildlife and domestic) are often a source of elevated *E. coli* levels.

Total body contact:
Not more than 130 *E. coli* per 100 milliliters as a 30-day average.
Compliance is based upon the geometric average of all individual samples (minimum of three samples taken at five separate events).
OR
Not more than 300 *E. coli* per 100 milliliters calculated as the geometric average of three or more samples taken at a single event.

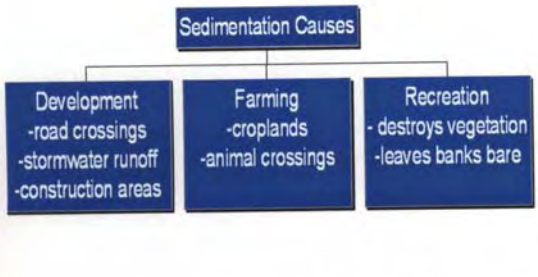
Partial body contact:
Not more than 1000 *E. coli* per 100 milliliters calculated as the geometric average of three or more samples, taken during the same sampling event." (Access Kent, 2002)

Kent County's Surface Monitoring Program recorded *E. coli* values that exceeded the monthly maximum for partial body contact (1000 E. Coli/ 100 ML) during the months of September 2001 and September 2002 at Morse Lake Rd. and Freeport Ave. The AWRI recorded fecal coliform values above the monthly maximum during September of both years at both locations as well; samples collected in August of 2001 at Morse Lake Rd. and October 2001 at Freeport Ave. also exceeded the monthly maximum allowed. Thus, the Impaired Designated Uses that need to be restored in the Coldwater River watershed are "Partial Body Contact" and "Total Body Contact".

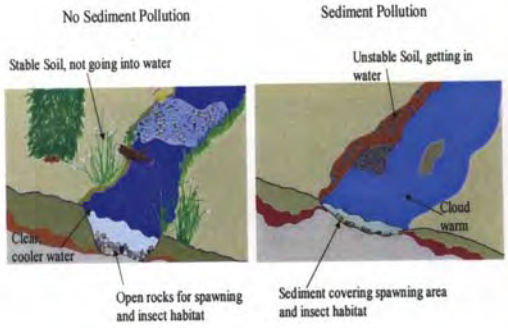
# What is Sedimentation?

## Sedimentation:

Deposition of sediment through erosion.



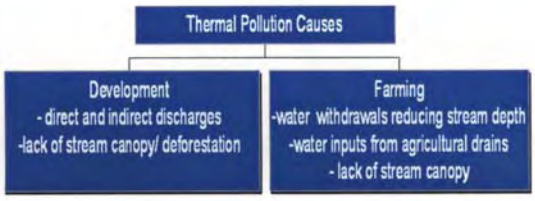

- **Sedimentation degrades fish habitat and decrea diversity of fish and insect species.**



# What is Thermal Pollution?

## Thermal Pollution:

The discharge of heated liquid or factors causing elevated temperature of natural waters that are harmful to the environment.

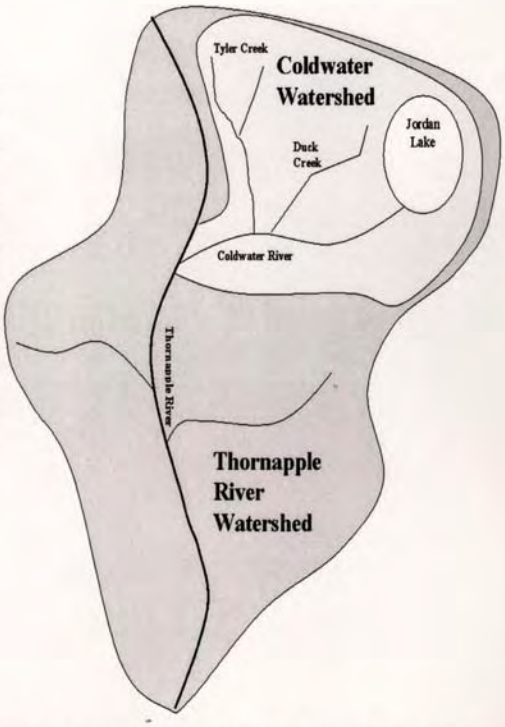



- Increase in water temperature causes a decrease in disso oxygen resulting in more stress on fish and possible fish de

**Appendix E**
General Summary Pamphlet of Management Plan

# THE COLDWATER RIVER WATERSHED, MICHIGAN

**What** is the Coldwater River Watershed? First, a watershed is an area from which all precipitation flows into a single stream, river, or lake. A watershed functions as a natural drainage system. Generally a large watershed is made up of smaller parts, called subwatersheds. A watershed can be a very huge system (example, Mississippi River watershed) or a small system (example, Duck Creek). The Coldwater River Watershed is a subwatershed of the Thornapple River, which is a subwatershed for the Grand River.




**Where** is the Coldwater River Watershed? The watershed lies within the boundaries of Kent, Ionia, Barry, and Eaton Counties in central west Michigan.


# Who Is Working On The Coldwater River Watershed?

The Coldwater River Watershed Council (CRWC) is a non-profit organization dedicated to the protection, sustainability, and rehabilitation of the Coldwater River Watershed ecosystem. The Council is working to develop a non-point source management plan for the watershed. The Council has already been involved in student monitoring programs, water quality studies, physical inventories, and development of aquatic wildlife habitat. They also host public projects such as annual stream clean-ups and writing a monthly column in the local paper called the Coldwater Column. They have secured many grants in order to accomplish these tasks and plan on continuing their efforts.

In order to develop a management plan, the Coldwater River Watershed Council has contracted Grand Valley State University's Annis Water Resources Institute (AWRI) to review, consolidate, and collect data about the watershed. AWRI is also charged with recommending future best management practices (BMPs), creating an information and education strategy, and assisting in moving the plan towards implementation.

Both the CRWC and AWRI consider comments received from residents of the watershed, government officials, and environmental agencies to develop a complete and detailed management plan. CRWC, along with other individuals and groups, will be responsible for seeing the management plan implemented in the watershed.

Here is a photo of the CRWC Watershed Day at the Wittenbach Nature Center. The students in the photo help with water quality monitoring.

# Why Is There A Need For A Management Plan?

**Management Plan?**
In order to help an entire watershed, management plans are developed. They assist the many townships, villages, cities, and county governments in making decisions about their watershed resources. The plan will include information on water quality, its suitability for human and animal use, and future projects

Every body of water in the State of Michigan has been designated to have eight uses. They are agriculture, industrial water supply, public water supply at the point of intake, navigation, warm water (or) coldwater fishery, other indigenous aquatic life and wildlife, and total body contact recreation between May 1st and October 31st with partial body contact thereafter. The Coldwater River is fulfilling a majority of its designated uses. However, two of its designated uses are impaired and two are potentially threatened.

The two that are potentially threatened are coldwater fishery and other indigenous aquatic life and wildlife. They are threatened due to excessive sedimentation and the possibility of warm temperature water entering the stream. The sediment could potentially raise temperature, clog fish gills, and cover spawning grounds. It appears that the sediment is brought to the stream through stormwater runoff and is eroded from the banks during high flow periods. The runoff is coming from urban impervious areas and agricultural drains. Stormwater can also be contributing to warm water entering the stream from non-porous surfaces. Warmer water changes the habitat of the stream. If proper stormwater best management practices are implemented, impairment of these two designated uses will be reduced.

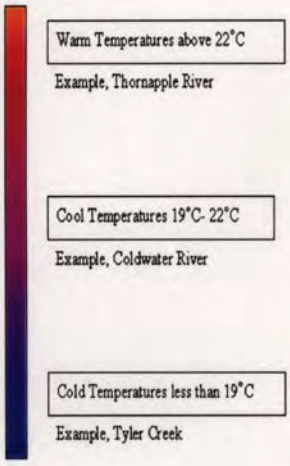
The two designated uses that need to be restored, and then protected, are partial body contact and full body contact. Total body contact includes any activity that will submerge the human body such as swimming, water skiing, or wading. Partial body contact would include activities like boating or fishing. Along the main body of the Coldwater River, the bacteria levels are too high for human safety and public access to the river is sometimes closed. When levels decrease, public access is again allowed. The bacteria, *Escherichia coli* (*E. coli)*, are an indicator of fecal matter in the water. Fecal matter in the water could mean that there are microbes present that could harm humans. Fecal matter could be coming from residential septage systems, animal farms, or improperly spread manure on agricultural fields. There are many management practices for manure management and agricultural practices that can reduce the amount of fecal matter getting into the river.

If best management practices are put into place at specific problem sites and if individuals living, working, and playing in this watershed learn how to be better stewards of their water resources, there is a good chance that the Coldwater River and its tributaries will improve and will remain a valuable resource for generations to come.

# How Do We Know About These Problems?

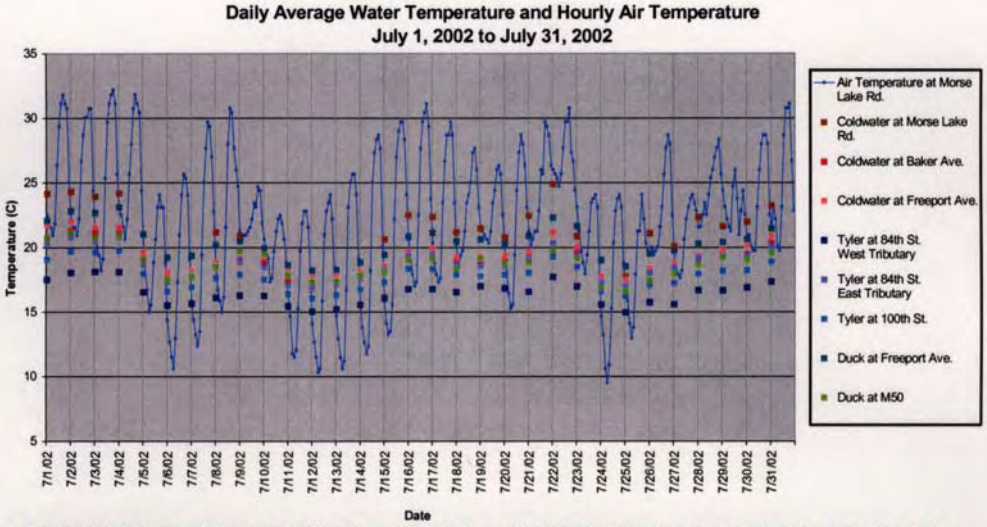
There have been many studies directed toward the Coldwater River watershed. Government officials, students, homeowners, and scientists conducted the studies. These investigations included the analysis of temperature, dissolved oxygen, physical inventories, aquatic insect surveys, fish sampling, and hydrologic modeling. Recently, many of these tests were summarized.

In general, Tyler Creek is the coldest part of the watershed, Duck Creek is the next coolest, and the main body of the Coldwater River is the warmest, although still cool in temperature. In preliminary studies, the dissolved oxygen levels in the main body of the Coldwater fluctuate severely and threaten fish survival. Additional dissolved oxygen studies should be done to see if this problem exists throughout the whole watershed. The physical inventory, conducted by walking or boating through the watershed, concluded that many areas of the stream bank are affected by high flow periods. The high flows erode banks and can also flood valuable cropland. The physical inventory recommends additional best management practices along the river corridor to help slow the flow during the high flow periods. Aquatic insects are evident throughout the watershed. Aquatic insects tell us a lot about stream quality. If there is high diversity of species, with a high number of sensitive species, the quality is good, whereas lower diversity could mean poorer quality. Fish sampling is somewhat related to the aquatic insect survey, as these insects are a food source for certain species of fish. Historic fish sampling done in the watershed indicates that the Coldwater River can support a modest trout population, other coldwater fish, and warm water fish. The hydrologic model reveals that the stream is flashy, stormwater drains rapidly, making levels within the stream rise quickly, and that there is a lack of retention. This model helps to evaluate the value of management practices such as water basins, which alter flood flows.




All of these studies helped in identifying what designated uses are impaired or threatened and why.

# EXAMPLE STUDIES




Digital data loggers recorded water temperature and air temperature every two hours throughout the watershed. From those data, daily water temperature averages were calculated and can be seen in the chart above. These data showed us that Tyler Creek is the coldest, then Duck Creek, then the Coldwater River. The affects on Coldwater River water temperature can be influenced by groundwater inputs, air, and stormwater runoff events.




Here are some photos of aquatic insects. Samples were taken from several stream sites in the watershed. The debris gathered in large nets is sorted out into insects, plant material, and sediment. The insects are then identified by their family names. The method is used frequently to assess water quality and aquatic habitats to determine stream quality. Every area sampled had a suitable aquatic habitat.

# What Is Going To Be Done Now?

There are several actions recommended for implementation in the watershed as a result of the development of the management plan. The recommended actions are related to specific groups of people in the watershed. These groups are called target audiences. Please review the table below to see what groups are encouraged to participate in the implementation activities of this plan.

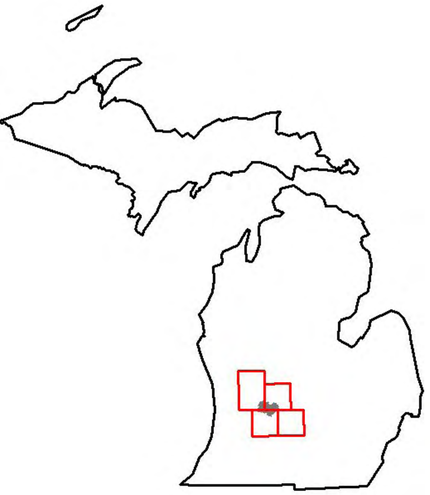
**Target Audiences For The Coldwater River Watershed**

| Large Audience | Sub-Groups To Take Note Of Within Large Audiences | | | |
|---|---|---|---|---|
| **Local Decision Makers** | Township Administration | Township Planning Committees | County Administration | Village Administration |
| **Residential** | Homeowners with Septic Systems | Home Associations | Schools | Septic Waste Haulers |
| **Agricultural Community** | Operators | Specialty Agricultural Groups (Pork Association) | Land Owners | Local Decision Makers |
| **Recreational Users** | Hunters & Fishers | Hikers | Children's Groups (Scouts, school extracurricular groups, etc) | Small watercraft users (canoes, kayaks) |

How will these groups be able to implement suggested actions? As each group was identified, specific activities were created to increase awareness, education, and action. This is called an information and education strategy. Step one is to get target audiences informed and educated about the issues that affect them. Step two is networking and this must happen between interested parties. Once a few people understand the issues in the watershed and they are ready to take action they move on to step three. Step three is implementation. Implementation can happen in individual homes, on private or public land, or on land away from the stream corridor or in the stream corridor. Using a list of recommended best management practices, partnerships with appropriate organizations, and grant support, an implementation process can begin.

For current information and education tasks or implementation actions please contact the CRWC or AWRI by contacting Abigail Matzke at matzkea@gvsu.edu or (616) 331-3994.

**Appendix F**
Elevation of Watershed Map



KENT COUNTY

IONIA COUNTY

BARRY COUNTY

Pratt Lake
Pickerel Lake
Pratt Lake Cr
Gibbs Dr
Bear Swamp Dr
Bear Cr
Erickson Lake
Lake Number Ten
Trask Lake
Peddler Lake
Dug Cr
Bunker Lake
Underwood Lake
Clabaugh Lake
Wilson Lake
Logan Lake
Dodd Dr
Little Lake
Mud Lake
August Lake
Karr Cr
Messer Dr
Upper Lake
Walton Dr
Jordan Lake
Twin Lakes
Duncan Lake
Cat Lake
Sugarbush Lake
Scott Lake
Huckleberry Lake
Lower Lake

Digital Elevation

| | |
|---|---|
| 690 - 712 | 869 - 890 |
| 713 - 734 | 891 - 912 |
| 735 - 756 | 913 - 934 |
| 757 - 779 | 935 - 957 |
| 780 - 801 | 958 - 979 |
| 802 - 823 | 980 - 1001 |
| 824 - 845 | 1002 - 1024 |
| 846 - 868 | |

**Base Information**

- Perennial Stream
- Intermittent Stream / Drain
- Closed Tile / Drain
- Lakes
- Section Line
- County Line

N

1 0 1 2 Miles

# Coldwater River Watershed

## Topographic Relief

Base Information and Wetland Information
Michigan Center For Geographic Information
Michigan Geographic Data Library
Topographic Relief
Shuttle Radar Data
Nasa, 2002

Grand Valley State University
Annis Water Resources Institute
Information Services Center

Map Prepared December, 2003