Gilkey Creek Watershed Management Plan

Table of Contents

Executive Summary		2
Introduction		5
Watershed Description		8
Hydrology		20
Goals and Objectives		27
Methods		29
Public Participation		29
Local Policy and Ordinances		33
Landscape Preservation Plan		35
Findings and Recommendations		40
Designated and Desired Uses		40
Water Quality	[EPA Elements A and C]	42
Pollutant Loading	[EPA Element B]	53
Best Management Practices	[EPA Elements C, D, F and G]	58
Education Plan	[EPA Elements E, H, and I]	67
Evaluation		79
Appendix		85

Executive Summary

Underlined words are defined in the glossary, located in the appendix.

The Gilkey Creek Watershed Management Plan outlines designated and desired uses for the watershed, historic and present conditions, watershed goals, best management practices recommendations, and an education and evaluation plan.

Designated uses are water quality goals set by the State of Michigan, MDEQ. The Gilkey Creek is managed by the state in the City of Flint, and managed by the Genesee County Drain Commission in the City of Burton. This presents a management problem for attaining designated uses in the City of Flint when upstream portions in Burton are solely managed for flood control. This plan hopes to address this issue by setting goals for the *entire* watershed to meet state designated uses and to achieve desired uses for the Gilkey Creek set by stakeholders. Desired uses were those set by stakeholders that do not tie directly to the state's designated uses or water quality standards (see Appendix).

Designated and Desired Uses

The management of water quality involves identifying the status of potential uses of that particular water body. Michigan law states that rivers are supposed to meet eight designated uses including:

1. Agriculture
2. Industrial water supply
3. Public water supply at point of intake
4. Navigation
5. Warm water fishery
6. Other indigenous aquatic life and wildlife
7. Partial body contact recreation
8. Total body contact recreation (between May 1 and October 31)

Identifying the impaired and threatened designated uses is a critical step in watershed management. Uses that are considered impaired are not currently meeting water quality standards established for that particular use. Uses that are currently being met but are at risk of impairment from human activity are defined as threatened. Assessment of use **impairment** in the Gilkey Creek Watershed was completed using several sources of information including: MDNR fisheries reports, MDEQ water quality assessments, physical inventory road stream crossing surveys and observation of use by stakeholders.

In addition to the eight designated uses identified above, many communities establish desired uses. These uses are not based upon water quality criteria but rather reflect some qualitative goal established in the watershed planning process.
The Gilkey Creek Watershed (GCW) is attaining uses for Wildlife, Agricultural and Industrial water supply, and has *two designated uses that are impaired: Aquatic Life, and Warm Water Fishery. The uses requiring Total Body Contact and Partial Body Contact are threatened.* The uses of navigation and public water supply are not applicable to the

Gilkey Creek. The Gilkey Creek has never been utilized for agricultural water supply, public water supply, navigation, or industrial supply. *Desired uses for the Gilkey include: (1) use of the creek as an educational tool, (2) increased recreational use, and (3) increased aesthetics.*

Once stakeholders determined what designated uses the watershed was not meeting, a common vision and goals were set for the GCW.

Watershed Goals and Recommendations

Watershed goals were determined and ranked by Center for Applied Environmental Research (CAER) and stakeholders of the GCW. Objectives and action items were developed for each goal. Recommendations to meet each goal are summarized below:

1. Improve wildlife habitat and other aquatic life habitat: **Reduce impacts from drain maintenance**, Increase the riparian corridor and create/incorporate a green infrastructure network.
2. Improve warm-water fishery: Reduce sediment inputs, decrease impact from storm events, and re-vegetate along the stream corridor.
3. Increase creek aesthetics, educational opportunities and recreational use (for partial and total body contact): **Assessment of E.coli levels**, Increase visibility and aesthetic quality, promote current recreational opportunities, and identify potential recreational opportunities.
4. Reduce flooding and improve navigation: Improve storm water management practices, source control, improve existing infrastructure (bridges, culverts, storm drains), and increase riparian vegetation and wetland areas.
5. Improve creek for public health and drinking water: Reduce **threat** of bacteria and nutrient levels, create a wellhead protection program, reduce impacts from roadways, and prioritize brownfield sites that pose a **potential** threat to **surface water contamination**.

Historic and current conditions

Historic and current conditions in the GCW were assessed by reviewing historic reports, conversations with stakeholders, analysis of aerial photographs and physical inventory. These processes revealed that preservation in the GCW is feasible primarily along the riparian corridor in the 100-year floodplain. Primary education and prevention measures should occur in the headwaters prior to any restoration efforts in the downstream reaches.

Best Management Practices

A Best Management Practice (BMP) is a land management practice that a landowner uses to reduce and control pollution causes and sources. When BMPs are implemented correctly, they serve greatly to reduce incoming pollution in a stream. There are three types of BMPs: structural, vegetative, and managerial. Structural BMPs require construction activities such as culvert or bridge replacement, bank armoring, or pervious pavement. Vegetative BMPs require plantings for erosion control or water treatment; this may include grassed swales, or native vegetation for stabilizing stream banks. Managerial BMPs require changing operational procedures at a site, for example

reducing the slope for grading to prevent erosion, or use of silt fences. All three types of BMPs are recommended in this watershed management plan.

Education

Successful implementation of the watershed management plan and the BMPs *is based on the assumption that stakeholders understand the problems and solutions* for the watershed. An education plan was developed to correspond with BMP recommendations that details target audiences, estimated costs, and delivery mechanisms for success.

CAER found that the challenges to successful implementation in the GCW are driven by two factors, primarily the high amounts of residential properties (47% of total land), which will require a large-scale intensive education effort. Preservation and restoration of the watershed are largely dependent on the collective action of the residents of the GCW. Another challenge is the policy in the GCW. Successful timing of implementation depends on coordination between the cities of Burton and Flint, and the Genesee County Drain Commission.

Evaluation

The last section of the watershed management plan details how to evaluate the success of its efforts. Watershed planning is an iterative process that will need to change based on results from the program's evaluation. Furthermore, as education efforts are carried out and BMPs are installed, the plan will have to be revised to address new issues.

Introduction

The Gilkey Creek Watershed Management plan (GCWMP) was developed by the Center for Applied Environmental Research (CAER), a division of University Outreach at the University of Michigan- Flint with support from the Ruth Mott Foundation. The GCWMP was developed for and belongs to the stakeholders and community of the Gilkey Creek Watershed. CAER is a resource in the community for working with partners for implementation of this plan.

The Gilkey Creek Watershed consists of a fifteen square mile area of land that drains to the Gilkey Creek in the cities of Burton and Flint in Genesee County, Michigan (**Figure 2** and **Figure 3**). Increases in the frequency and magnitude of flooding and concerns about public health have led stakeholders to attempt to understand the causes and solutions to "problems" associated with the creek. In order to achieve this understanding a watershed management plan was developed. Here are the plan's guiding principles:

- Watershed planning must be done using an iterative and adaptive approach
- Providing public access to the river resource is a prerequisite for protecting water quality
- Watershed planning should be integrated into master planning, parks and recreation planning, and infrastructure planning
- Land use within the watershed is a major influence on water quality because of its effects on the hydrology of the watershed
- Source control is key to protection of water quality
- Preservation of high quality streams is more cost effective than restoration of degraded streams
- BMPs should consist of a blend of structural, vegetative and managerial BMPs
- Public involvement and education are crucial to water resource preservation, and must be initiated at the beginning of the process and sustained permanently by stakeholders

Watershed planning is an iterative process that requires collective action by stakeholders to determine the best solutions to problems in a watershed. In facilitating this process CAER *engaged stakeholders*, examined land use trends, and physically inventoried the watershed to develop the watershed management plan. As the lead agency involved with the development of the GCWMP, CAER will inevitably have a significant influence on the planning process and its outcomes. The plan provides a strategy for preservation of special resources, methods for pollution prevention, and suggestions for remediation at specific sites. **Figure 1** shows the structure of the plan, which begins by describing watershed-wide characteristics, and then analyzes specific problems at selected sites within the watershed. The plan concludes with general solutions for remediation and protection of the watershed.

Figure 1: Outline of Watershed Management Plan

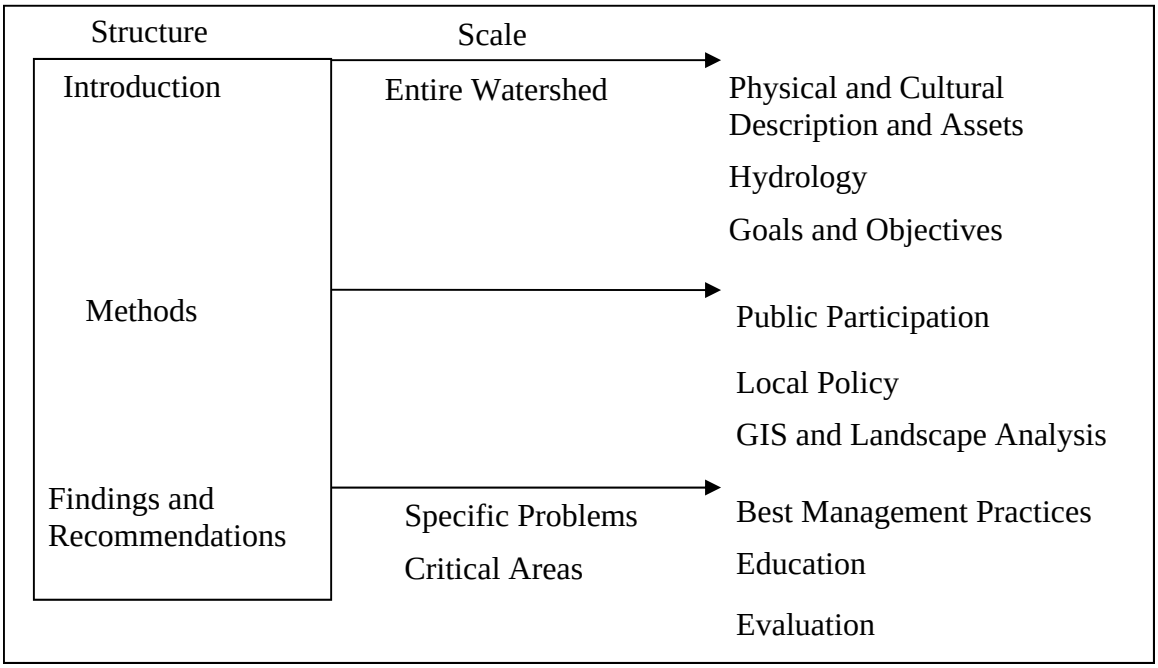
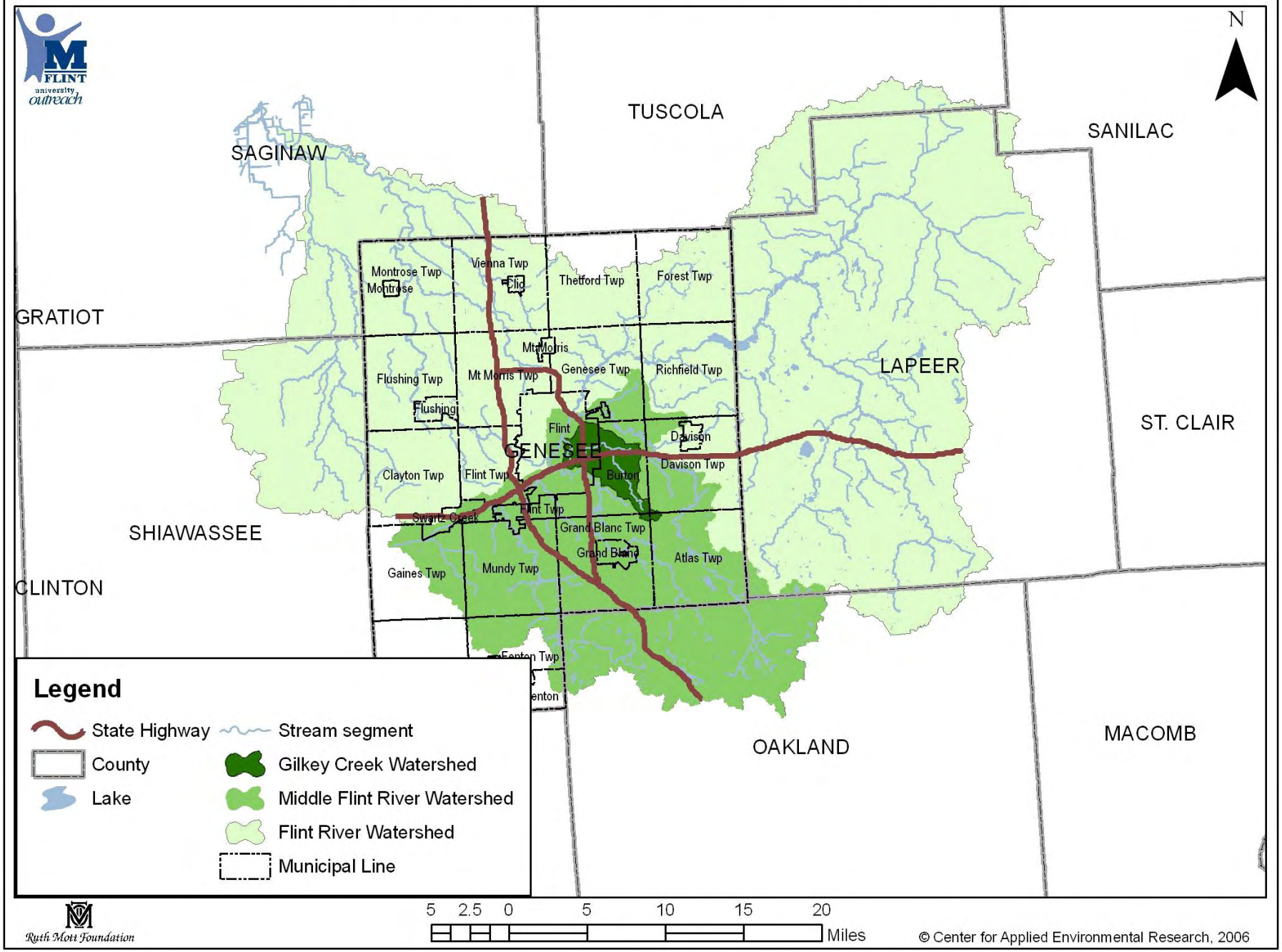


Figure 2: Location of Gilkey Creek Watershed



Watershed Description

Identifying priority pollutants, source areas, and specific causes of pollution affecting the watershed requires an understanding of the physical characteristics of a watershed. The following section of the watershed management plan is intended to provide specific information about the historic, current and future physical condition of the Gilkey Creek Watershed.

In order to characterize the physical condition of the GCW, CAER and its partners engaged in several activities including:

- Aerial photograph interpretation
- GIS analysis
- Stream road crossing surveys
- Windshield surveys
- Wading of creek

Geography

The headwaters of the Gilkey Creek begin near the intersection of Grand Blanc, Atlas, and Davison Townships. The Gilkey flows northwest through the cities of Burton and Flint where it joins the Flint River above Hamilton Dam. The Gilkey Creek has two main tributaries, Robinson Drain and North Branch, that flow into the Main Branch. **Figure 2** shows the location of the Gilkey Creek in Genesee County and the Flint River Watershed.

Based on the inventory and resulting recommendations the three sections of Gilkey Creek - Main Branch, North Branch, and Robinson Drain - have been further divided into nine segments based on management recommendations (**Figure 3**). Stream morphology, land use, pollutants are described for each stream segment in **Table 1**.

Figure 3: Stream Segments of the Gilkey Creek Watershed

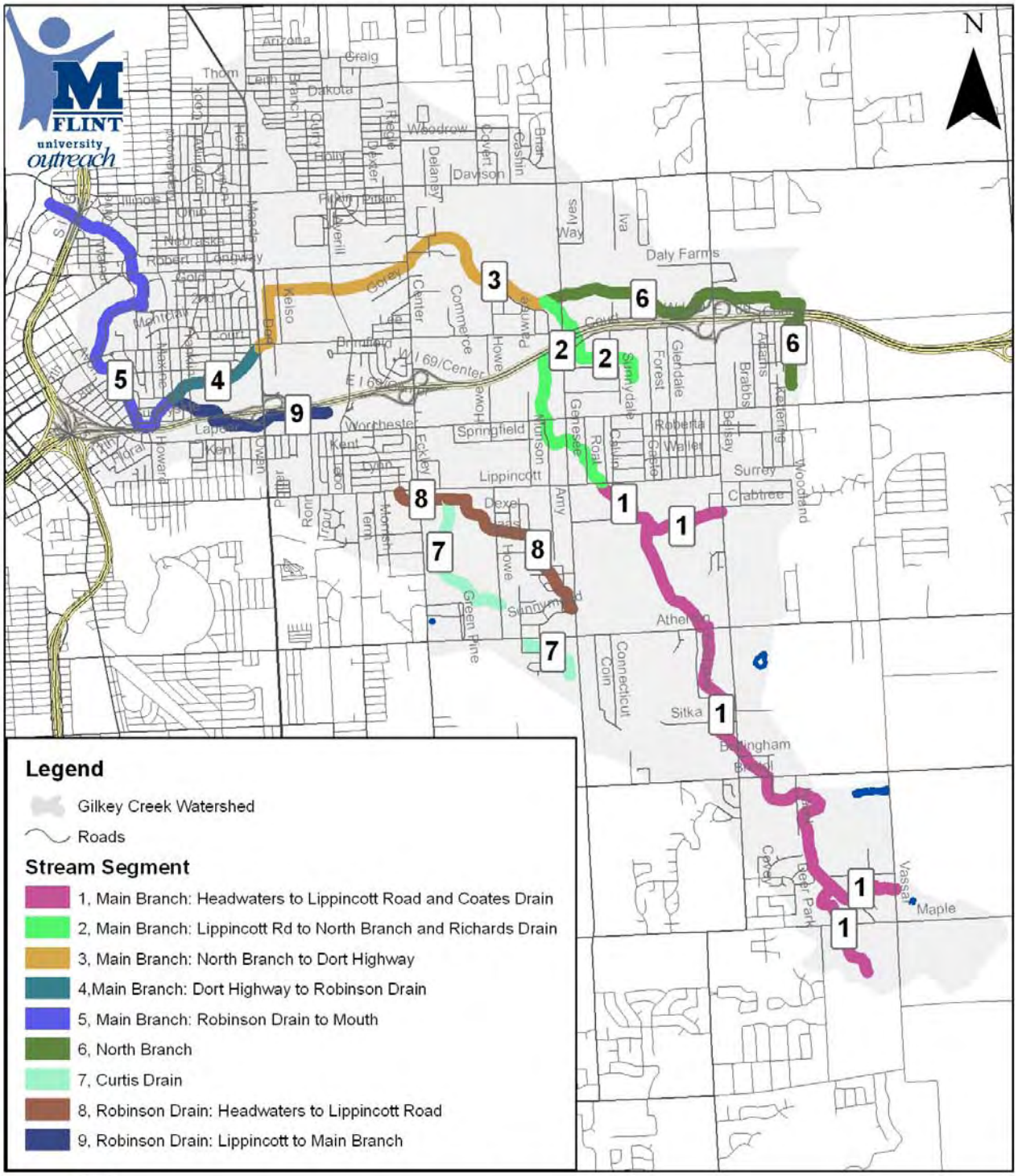


Table 1: Stream Segments of the Gilkey Creek.

Stream Segment	Morphology	Land Use	Pollutants
Main Branch			
Vassar and Maple Roads to Lippincott	Channelized, avg width less than 10 feet, avg depth 1-3 feet, low bank erosion until Dallas Road. Stagnant flow.	Developing residential, scarce agriculture, some green spaces.	Sediment, bacteria, nutrients.
Lippincott to confluence with North Branch	Channelized avg width of 15 feet, avg depth of 2 feet. High amounts of erosion, high water mark over 3 feet.	Residential and open space (Kelly Lake Park and MDOT land).	Sediment, nutrients.
North Branch confluence to Dort Highway	Channelized, avg width is 10-25 feet, avg depth 1-3 feet, high water mark 3-5 feet, low flow, moderate erosion.	Large industrial sites and commercial corridor.	Sediment, trash, nutrients.
Dort Highway to confluence with Robinson Drain	Underground approx. 1/8 mile, high banks, severe erosion, avg width 10-25 feet, avg depth 1-3 feet, high water mark 3-5 feet.	Decreasing commercial, older dense residential and Pierce Park Golf Course.	LUST, nutrients, and illicit connections.
Robinson Drain to confluence with Flint River	**Channelized**, avg width 10-25 feet, avg depth 1-3 feet, riffles near Robinson Drain, lined by concrete through MCC campus, underground around Visual Arts building, riffles in Kearsley Park.	Dense residential, MCC campus, Woodlawn, Burroughs and Kearsley Parks.	Sediment, nutrients, trash.
North Branch			
Headwaters to confluence with Main Branch	Channelized ditch, avg. depth less than 2 feet, avg. width 4-15 feet.	Residential in headwaters, undeveloped north of I-69, expanding commercial district.	Nutrients.
Robinson Drain			
Curtis Drain	Designated drain, avg. depth less than 1 foot, avg. width 10-30 feet.	Residential in headwaters, undeveloped west of drain, commercial east of drain.	Nutrients, trash.
Headwaters to Lippincott Road	Designated drain, avg. depth less than 1 foot, avg. width 10-30 feet. High water mark >2 ft.	Mainly residential with some commercial along Center Rd.	Sediment, nutrients, trash.
Lippincott to confluence with Main Branch	Underground from Lippincott to north of Lapeer Rd. Some sand bars and undercutting near Scott Elementary. Armored banks near confluence with Gilkey.	Underground high density residential neighborhood, through commercial / industrial along I-69, then through Pierce Park Golf Course.	Nutrients, trash, suspect metals from railroad, contaminated sediment.

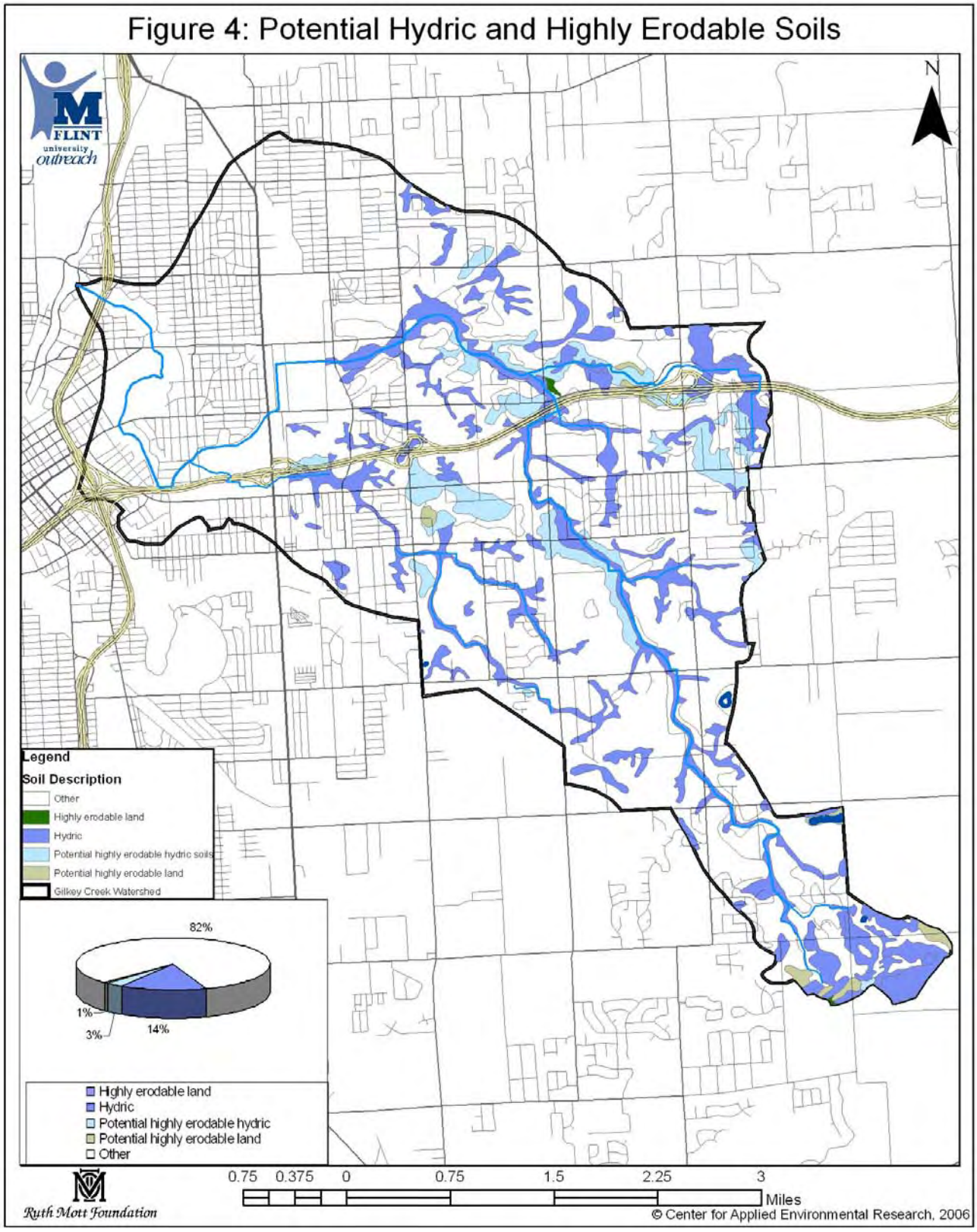
Geology and Soils

The geology and soils of a watershed influence the ability of watershed stakeholders to successfully implement BMPs. The types and location of soils often determine what activities are feasible. For example, specific geologic landforms and soils containing high levels of sand are more suitable for the installation of BMPs that function to increase infiltration. In this section of the watershed plan, information about the general geologic nature of the watershed is presented. This review does not provide the site-specific information required for the installation of specific BMPs. The information provided here is intended to provide individuals who are implementing recommendations of the WMP with a basis of information from which to begin a site-specific investigation.

Landforms in the Gilkey Creek are a result of the retreat and advancement of glaciers about 9,000 years ago. During the melting process large deposits of till were deposited in the Gilkey Creek Watershed. The majority of soils of the Gilkey Creek watershed are affiliated with the Conover-Brookston association. This association is on till plains and described as poorly drained level to gently sloping loams that have clay loam subsoil. The lower portions of the creek (downstream of Pierce Park Golf Course) are primarily Boyer-Spinks-Ceresco-Cohoctah association. This association is found on outwash plains and terraces. It is described as gently sloping well-drained loamy sands to very poorly drained fine loamy sands. Limitations of the data included no accurate soil survey for the city of Flint. It is also known that a large amount of the buildings in the lower reaches are on fill. This may present a problem if parts of the creek were de-channelized. Furthermore, till plains are not uniform; individual site investigation will need to be conducted for soils prior to any restoration.

Soils were further analyzed for hydric properties and erosion potential. Knowing these two factors may help determine where wetlands may be restored and where certain types of development should be avoided. Hydric soils comprise 14% of the watershed and are primarily located along the drainage network. Highly erodable land is mainly in the headwaters and comprises 4% of the watershed. **Recommendations for wetland restoration should occur in areas with existing hydric soils, however specific site conditions will determine specific BMPs**. **Figure 4** illustrates the location of these soil types.

Figure 4: Potential Hydric and Highly Erodable Soils



Natural Features and Cultural Assets

The Gilkey Creek is a highly urbanized watershed. Many of its natural features have been lost to residential, commercial, and industrial development. Several natural features in the Gilkey Creek have been preserved as park land, particularly in the City of Flint (**Figure 5**).

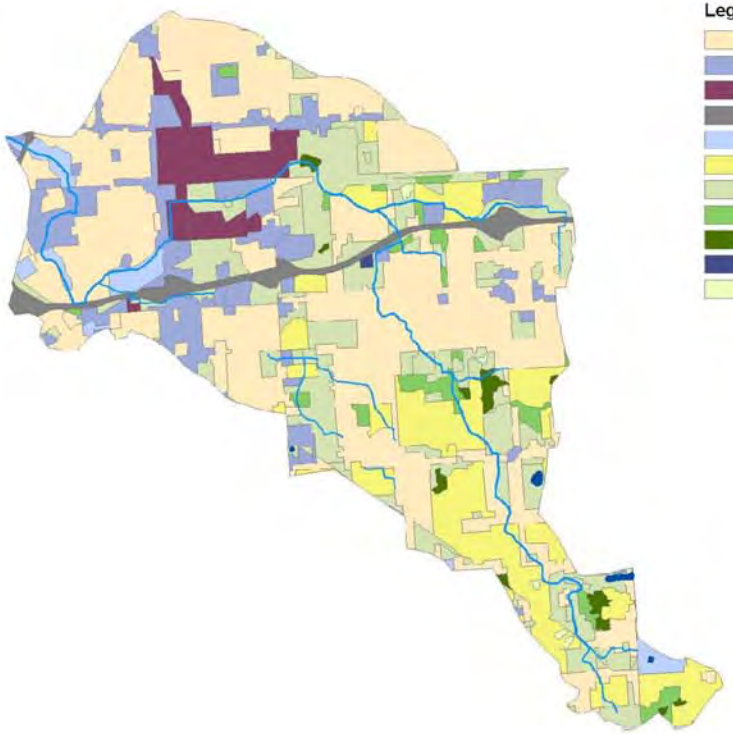
Figure 5: Flint River Trail along Gilkey Creek

Much of this park land is contiguous with the Gilkey Creek, providing important floodplain storage and wildlife habitat. The Gilkey Creek watershed also has cultural assets including the Flint Cultural Center, Applewood Estate and Mott Community College. These assets provide excellent opportunities for public education. These and many other important sites are incorporated into the landscape preservation section of this plan (**Figure 15**).

Land Use

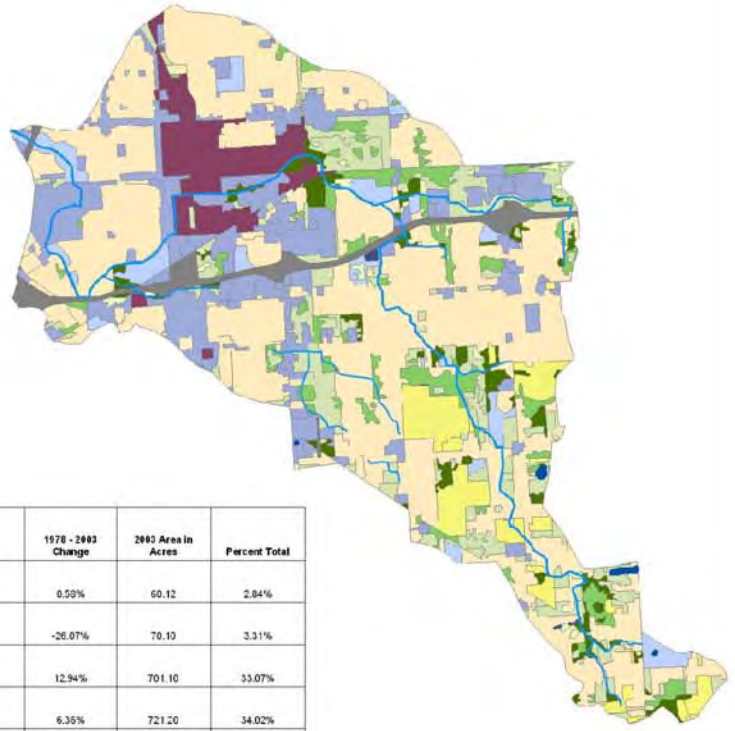
By definition a watershed is the area of land that drains to a particular water body. Given that definition, it is understandable how the way the land is used within a watershed will have a tremendous impact upon the water quality. Because of the importance of linkages between land use and water quality, the planning team felt it important to examine the historic, current and **future** potential land use makeup of the Gilkey Creek Watershed. This was facilitated by a watershed-wide land use change comparison. This was completed by interpreting 2003 aerial photography and comparing it to corresponding data from 1978. This comparison is presented in **Figure 6**.

Figure 6: Gilkey Creek Land Use Comparison 1978 and 2003



Legend

- Residential
- Commercial/ Institutional
- Industrial
- Transportation
- Community Use
- Agriculture
- Grassland
- Upland Forest
- Lowland Forest
- Water
- Herbaceous Wetland



Class	1978 - 2003 Change	2003 Area in Acres	Percent Total
Industrial	0.58%	60.12	2.84%
Agriculture	-26.07%	70.10	3.31%
Undeveloped	12.94%	701.10	33.07%
Residential	6.35%	721.20	34.02%
Commercial	2.65%	158.56	7.50%
Institutional	2.35%	161.44	7.61%
Other	1.18%	148.72	7.01%
Transportation and Utilities	0.02%	98.51	4.65%

1 0.5 0 1 2 3 4 Miles

Ruth Mott Foundation

GCW Land Use

In 1978, the land use was predominantly single family housing with commercial development along Davison Rd., Longway Blvd., Court St., and Dort Hwy. Delphi East, a large industrial center was and remains a dominate site in the watershed. Parkland exists along the Gilkey Creek in the City of Flint. Cropland and rangeland exist south of Lippincott and north of I-69, east of Genesee Rd.

About 63% of the watershed is developed (**Table 2**). The remaining areas are comprised of agriculture (3%) and undeveloped or un-developable (23%)*. Between 1978 and 2003, residential, public institutions, and commercial land uses increased 6.36%, 2.65%, and 2.35% respectively. 97% of residential growth was due to single family homes and duplexes, 81% of commercial growth was due to secondary neighborhood and rural businesses, and 58% of public institution growth was due to schools.

Over the past 20 years the land use categories of agriculture and undeveloped land lost area. Cropland, a sub-category of agriculture, decreased significantly losing over 800 acres. Undeveloped areas experiencing losses included grasses, forbs and shrubland totaling 883 acres. Some land use class types experienced increases including hardwoods and coniferous forest. This increase in forest land is likely due to farm field succession and better photo interpretation techniques used in 2003.

Table 2: 2003 Land Use in the GCW

Land Use	Acres	Percent of Total
Developed	9638.80	63.63%
Agriculture	70.10	3.31%
Undeveloped	701.10	33.07%

* Table 2: Developed land includes: residential, commercial, industrial, institutional, utilities, cemeteries, and lands under construction. Agricultural land includes: crops, pasture, and orchards. Undeveloped land includes: forested, grass and shrub land, wetlands, and lakes.

Riparian Corridor

The total amount of a particular land class impacts water quality in a watershed. Similarly, the location of that land use class will influence its impact on the health of the watershed. Research has shown that riparian lands, areas directly adjacent to the creek, are important in regulating flow, trapping sediment and providing critical and habitat. These riparian areas often extend beyond the boundaries of the floodplain and act as a transition between aquatic and terrestrial environments (Forman and Wilson, 1995).

The importance of riparian lands required an investigation of land use. A variable buffer based on Strahler's stream ordering was used on the Gilkey Creek. This identified an area of 3.3 square miles adjacent to the stream channels of the watershed. Land use change in the buffer emulates that of the watershed-wide statistics with the exception of an increase in undeveloped land (**Table 3**). This increase is mainly due to field succession to grassland and wetland.

Table 3: Land use change and totals within the riparian corridor

Class	1978 – 2003 Change	2003 Area in Acres	Percent Total
Industrial	0.58%	60.12	2.84%
Agriculture	**-26.07%**	70.10	3.31%
Undeveloped	**12.94%**	701.10	**33.07%**
Residential	6.36%	721.20	**34.02%**
Commercial	2.65%	158.96	7.50%
Institutional	2.35%	161.44	7.61%
Other	1.18%	148.72	7.01%
Transportation and Utilities	0.02%	98.61	4.65%

Summary

A review of the land use changes over the past 20 years illustrates that land use in the Gilkey Creek Watershed can generally be classified as stable. The Gilkey Creek watershed has been highly urbanized for more than 20 years. **Figure 6** illustrates that little undeveloped land existed in the GCW in 1978. The only concentrated "developable" land exists in the headwaters, which are currently experiencing residential and commercial development.

This pattern of increased development in the headwaters and stable land use in the lower stretches has direct impacts upon recommended BMPs and education strategies for the Gilkey Creek. Management in the headwaters must focus on education and BMPs that provide incentives for preservation. **Management in the lower stretches will need to focus on source control of runoff and retrofitting of structures (undersized culverts, and log jams) that restrict the flow of Gilkey Creek.** Residential and undeveloped land uses make up over 60% of the riparian corridor. This offers excellent opportunities for preservation in the undeveloped portions, but will require an intensive education/outreach effort geared towards riparian homeowners.

CAER's inventory has shown many areas classified as developed are unused (i.e. movie theatre parking lot) and may have potential for flood retention and infiltration (**Figure 7**).

Figure 7: Typical brownfield sites

Cultural History

The urban development in the Gilkey Creek tells a story about the history of the people in the watershed. There is extensive literature on the history of Flint and Genesee County. However, there is limited literature specific to the Gilkey Creek. Below is a timeline constructed from several sources that detail the rich cultural assets of the GCW. These assets could be incorporated into any preservation work done in the watershed. Much of this information also is useful for education efforts, specifically for watershed tours.

Gilkey Creek Timeline

Early History of Flint – pre-1800

The southern rim of the Saginaw Valley, of which the Gilkey Creek Watershed is a part of, was first occupied by the Sauk Tribe who were followed by the Chippewas. The Chippewas were known for their Chieftain Pontiac. During the War of 1812 the British and the Native Americans were defeated by General "Mad" Anthony Wayne.

At this time Michigan was part of the Northwest Territory and was governed by General Cass. General Cass set out to claim the valuable Native American-held lands for the Territory by transferring the tribes to reservations. Cass employed the influential Jacob Smith, a fur trader and friend to many of the tribesmen. One of the reservations promised to the Native Americans comprised eleven sections along the Flint River known as the Grand Traverse at the time. This area is now considered the center of Flint. Smith soon erected a log home at what is now the southwest corner of First Avenue and Lyons Street. [Smith's death in 1825 divided the former 'reservation' among his descendants.]

1819: Open council with General Lewis Cass. Treaty of Saginaw was signed.

1829: The area (of Flint) began platting and was titled the 'Village of Sidney.'

1831: Alexis de Tocqueville visited Flint

1831: Levi Gilkey took up residence in section 7 of Burton. Levi Gilkey, from Genesee County New York, resided at the mouth of the small stream that bears his name. He was the first settler in the surveyed township outside of the city limits. He was quoted as leaving after a few years "in disgust" due to many law disputes. The majority of Burton settlers (formerly Flint Twp.) came from Adams, Henderson, and Jefferson counties in New York to form the "Atherton settlement" (Philadelphia et al, 1879)

1833: by the time it (village of Sydney) was recorded the name had been changed to 'Village of Flint.' "The name of Flint is thought to have come from the Native American name of the river 'Pe-wan-i-go-see-be' meaning 'River of the Flints'"(City Plan, 1920).

1833: A highway from Detroit to Flint via Pontiac was completed. This sparked a boom in construction and immigration to the village. Many of Flint's early settlers came from western New York.

1833: Townships formed in Genesee County area (including Burton).

May 28, 1835: Genesee became a county in the legislature.

1836: First school was established in Atherton District (Burton).

1837: Michigan became a state, and Flint was named the seat of Genesee County.

1850s: Flint remained a farming center until H. H. Crapo chose the city for a place to start lumber operations.

1855: Flint incorporated as a city.

1856: first township meeting was held for Burton.

December 8, 1862: The Pere Marquette Railroad was completed from Flint to Saginaw.

January 1863: Emancipation Proclamation was signed.

May 1865: At the close of the Civil War, lumber from Flint was shipped to all parts of the world.

1866: William C. Durant and J. Dallas Dort start business in Flint.

1869: Demand for vehicles prompted William A. Patterson to open his wagon works.

1874: The population of Burton Township was 1,260.

1907: Flint Park Board consisted of: R.T. Longway, Charles A. Cummings, Arthur H. Sarvis, John G. Windiate, and George C. Kellar.

1908: General Motors Corporation was founded by William C. Durant.

1910: Population of Flint was around 38,000.

1913: Gilkey Brook Park, 16 acres, was given to the city by Mr. Dort. In 1929 it was used as the City Nursery. In 1918 the first small stock was planted. By 1929 it provided the city with all the shrubbery it needed. In 1927 the greenhouse was built and a caretaker's lodge began and completed in 1928. The nursery also supplied the city offices and hospital with cut flowers throughout the year.

March 27-30, 1916: The worst flood in 12 years (Flint Journal). Floodwaters rose 10.2 feet above normal between 11am and 1pm. Locals worried of a similar flood as 1904. Center pier of the Hamilton Dam broke, flooding large portions of the city. Flooding at Saginaw St. reached over 2 feet before waters started to recede.

1917: City Planning Board created.

1917: Kearsley Park, 60 acres, proclaimed "The Beauty Spot of the Dort Memorial Park System," was created by mostly a gift from the Windiate-Pierce-Davison Company. The largest gathering held there was the Silver Anniversary of Buick Motor Company drawing more than 90,000 people from around the world. The half-mile boulevard through the park was lined with shrubs and flowers. Swimming pool, head house, amphitheatre, tennis courts, children's wading pool and lagoon were offered there (Park Board, 1929).

1919: Mott Triangle, 1 acre gift.

1920: Population boom and the city plan was created.

1923: Burroughs Park, 12 acres, was a gift from Mr. J. Eddington Burroughs and Mr. Dort. The north end of park was used for lawn paths, shrubs and flower beds. South end of park had two tennis courts and a children's playground. A large skating rink was developed there each winter.

1924: Military Park was created by a 10-acre purchase.

February 14, 1927: (J. Dallas) Dort Memorial Park System ordinance was adopted.

April 6-9, 1929: Flint River floods caused sewer backups, property damage, and several road closures.

1930: Population of Flint was around 156,000.

Several of the sites mentioned above are incorporated into the education plan. A more detailed history could be comprised from personal interviews and photographs.

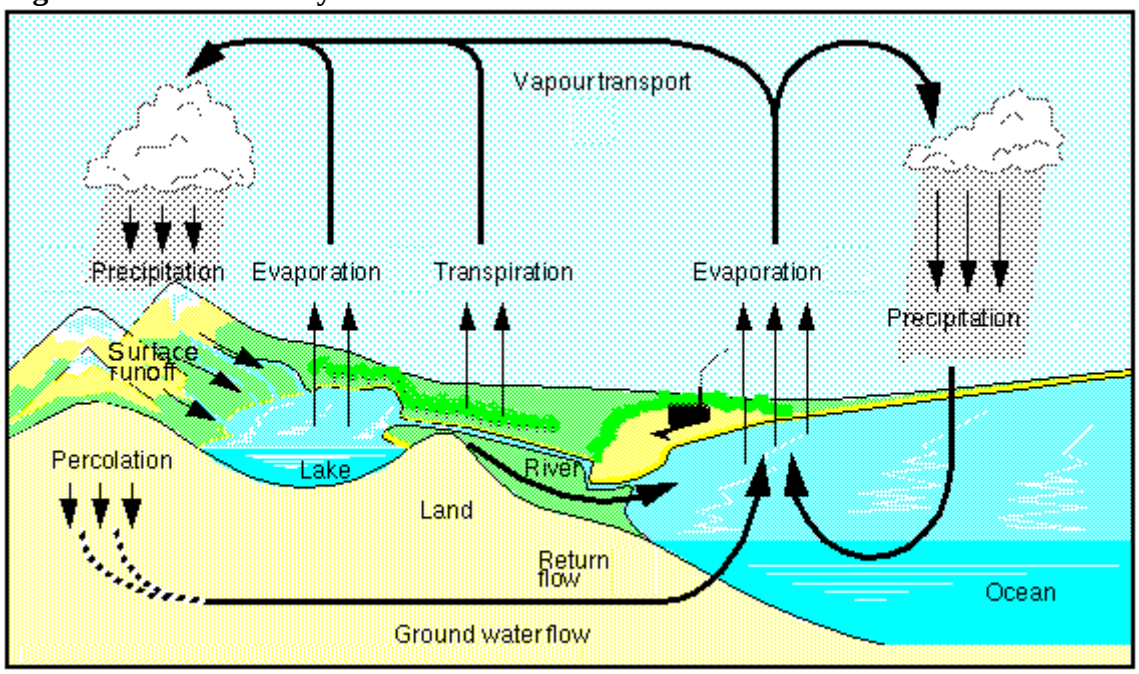
Hydrology

General

To understand the hydrology of the GCW one needs to know how water moves through the drainage system. Reviewing information about the volume and rate at which water travels through the system before, during and after rain events can help us understand how the hydrology of the GCW affects water quality.

Hydrology is the study of water, its properties, and how it interacts with other elements. The basics of hydrology are found in the water cycle. Water leaves the atmosphere by precipitation (rain, snow, and sleet), enters through evaporation (air) or through transpiration of plants, and moves through the system by runoff, groundwater and vapour transport. This process is demonstrated below in **Figure 9**.

Figure 9: The Water Cycle



Courtesy Erich Roeckner, Max Planck Institute for Meteorology

Source: www-k12.atmos.washington.edu

A watershed's health can be influenced by the amount of surface runoff and the rate of percolation (infiltration). Land use changes in a watershed redistribute how this water is delivered to the stream. For example, in undeveloped watersheds infiltration is relatively high while surface runoff is relatively low. Undeveloped and 'natural' areas have little paved surfaces that prevent water from soaking into the ground. Trees also act as an intercept for rain water and can reduce the overall amount that reaches the ground. Undeveloped watersheds also have more stable flows throughout the year due to the high amount of groundwater input.

Urbanized or developed watersheds have high amounts of surface runoff and low amounts of infiltration. This change is due to practices such as land clearing, introduction of impervious surfaces, and installation of ditches and storm sewers. The

increase in paved surfaces reduces the amount of water that can soak into the ground. This **increases volume** and increases the speed that the water reaches the stream.

A factor to take into account when trying to achieve watershed goals through implementing BMPs is the amount of impervious cover in a watershed. Impervious cover (rooftops, driveways, roads, sidewalks) convert rainwater immediately into stormwater **(stormwater = rainwater)**. The Center for Watershed Protection divides watersheds into three categories based upon percent of impervious cover. Impacted streams have less than 25% impervious cover, non-supporting streams have 25-60%, and urban drainage streams have greater than 60% impervious cover. Based upon indicators identified by the Center for Watershed Protection, Gilkey Creek is a non-supporting stream. These indicators include:

- 3 to 7 bankfull flood events each year
- Only 30-60% of riparian forest intact
- Stream habitat scores consistently fair to poor
- Trash and debris load of 2 to 5 tons per square mile per year
- Riparian plant community dominated by invasive species

The full list of indicators can be found in Manual 4, Urban Subwatershed Restoration, Center for Watershed Protection, 2004.

Urbanized watersheds often have extreme low and high flows throughout the year. Small rain events often cause flooding in urban watersheds due to the short amount of time it takes the water to reach the creek (concentration time). Humans have dealt with this phenomenon by deepening and straightening the channel to accommodate for large, quick increases in flow. However, these practices are not conducive to habitat formation, are not aesthetically pleasing, further increase the rate of flow through the channel, and require maintenance. **These practices are particularly problematic for riparian landowners. Furthermore, the high storm water flows in the lower portions of the GCW are suspected to impair water quality by delivering high amounts of sediment pollution and in-stream erosion.**

Gilkey Creek Hydrology

Due to the highly altered hydrology of Gilkey Creek and the effects it has on water quality the planning team wanted to understand the general hydrologic conditions. Hydrologic function of the Gilkey Creek was determined by the following methods:

- A review of existing hydrologic information.
- An investigation into the historic modifications made to the stream channel.
- Observing and recording hydrologic clues (channel form, substrate, habitat structure, geomorphic units, etc) **at several road stream crossings**.

Base flow, fueled by groundwater, is too low most of the year to support adult fish habitat or navigation (Leonardi, 1997). The Gilkey Creek and its tributaries are a designated drain from the headwaters to the City of Flint border at Center Road. This portion of the creek is channelized throughout with steep **and high** banks and a **narrow** V-shaped channel.

Throughout the City of Burton the Gilkey Creek is relatively uniform in channel width and depth. There is an absence of riffle pool sequence. Substrates vary from silt and sand to gravel and sand. Moderate bank erosion, relative to the rest of the watershed,

begins to occur near Lippincott Road. The Gilkey is routed underground from Commerce Street to Court Street and through the majority of Mott Community College campus. Robinson Drain is buried between Lippincott and Atherton Roads.

The Gilkey Creek appears less 'maintained' in the City of Flint. However, severe fluctuations in flow have created undercut banks in many locations. Undercut banks may serve as potential fish habitat but the sedimentation occurring in the Gilkey Creek **may be** destroying this habitat. **Sedimentation varies by stream stretch due to upstream drain practices and large expanses of impervious surfaces.** Overall the Gilkey Creek is separated from the floodplain until it reaches Woodlawn Park in the City of Flint. The creek is channelized again until it reaches Kearsley Park. **Table 4** characterizes the hydrology of the Gilkey Creek by stream segment.

Table 4: Gilkey Creek Hydrologic Descriptions	
Stream Segment	**Hydrology**
Main Branch	
Vassar and Maple Roads to Lippincott	Two first-order streams, stagnant flow. Few wetlands, channelized. Low bank erosion upstream of Dallas Road. Disconnected from the floodplain. Several undersized culverts between Atherton and Lippincott, **high sediment input** from **Coates Drain**.
Lippincott to confluence with North Branch	Creek is channelized. Moderate erosion. Undersized culverts. Severe flooding near Roat Court. Largely undeveloped floodplain.
North Branch confluence to Dort Highway	Low flow. Channelized. Undersized culverts. Buried creek ~1/8 mile.
Dort Highway to confluence with Robinson Drain	Lower portions disconnected from floodplain. High banks, severe **erosion**. Large stormwater flows from roads and urban areas.
Robinson Drain to confluence with Flint River	**Channelized** with portion buried on MCC campus. Several debris jams, 50% of stretch vegetated. Moderate flow, undercut banks. **Riffles** in Kearsley Park and near Robinson Drain.
North Branch	
Site 32 to confluence with Main Branch	**Channelized** ditch. Shallow and **narrow** stretch. Sparse riparian vegetation (< 25% shaded).
Robinson Drain	
Curtis Drain	Channelized. Low flow. Vegetated banks.
Site 58 to Lippincott Road	Channelized, vegetated channel. Low flow. Sparse riparian vegetation.
Lippincott to confluence with Gilkey Creek	Channelized. Approximately 1/2 mile buried. **Sand bars and undercut banks**. **Armored banks** at confluence.

The Gilkey Creek Watershed also has five small lakes.

Lake	Size	Location	Owner
Lake 1	.06 acres	northeast of Center and Atherton Roads	Private
Lake 2	2.6 acres	southeast of Belsay and Atherton Roads	Private
Lake 3	2.7 acres	southwest of Belsay and Vassar Roads	Private
Lake 4	.18 acres	northeast of Vassar and Maple Roads	Elks golf course
Kelly Lake		northwest of Genesee and Lapeer Roads	City of Burton park

Lakes 1, 2 and 4 are not accessible without property owner permission. Observation of 2003 aerial photographs indicates high amounts of plant growth in all lakes except Lake 3. The amount of detention basins has also increased with the amount of development in the watershed. Those are shown in the BMP section of the plan.

(Hydrology) History

Several studies have been commissioned over the last 30 years to assess the causes and solutions to **flooding** of the Gilkey Creek in the City of Flint. A majority of the studies focus on **fixing symptoms of the problem instead of addressing the cause.** Only one study, performed by Tomblinson Harburn Associates for Mott Community College in 1973 talked about the causes of the increased flooding (which emulate those of today).

Timeline of studies done on the Gilkey Creek (adapted from Gould, 1982)

1962 – Last major clean-out of the Gilkey Creek drain started and completed in 1963
1969 – Metcalf and Eddy engineering study for the City of Flint
1970 – United States Geologic Survey gauging station established for the City of Flint at the intersection of Arapaho and Arrowhead Drives
1973 – Consoer, Townsend and Assoc. publish engineering study for the Genesee County Drain Commission (GCDC)
1973 – Tomblinson Harburn Assoc. report on flooding, part of Mott Community College Capital Improvement Plan
1975 – Severe flooding occurred
1976 – Hubbell, Roth and Clark, Inc. and Carlson, Hohlock, Mitchell and Piotrowski, Inc. engineering studies for the City of Flint and the GCDC
1980 – Floodplain Insurance studies published by Federal Emergency Management Agency for the Cities of Flint and Burton
1981 – Severe flooding occurred
1982 – Gould Engineering Report to the GCDC concerning flooding in Burton and Johnson, Johnson & Roy report on the Gilkey flooding in 1981
1982 – Michigan Department of Transportation (MDOT) designs relief culvert under M-21 expressway
1983 – McNamee, Porter and Seeley Consulting do hydraulic analysis for Applewood Estate
2004 – Rowe Incorporated does preliminary floodplain study for Applewood Estate

2005 – CAER begins development of Watershed Management Plan for the Gilkey Creek Watershed
2005 – National Pollutant Discharge Elimination System (NPDES) Phase 2 watershed management planning for the Middle Flint River Watershed performed by the GCDC
2005 – Spicer Group started study on the Gilkey Drain for the GCDC

Summary

It is clear from the timeline that resources have been and continue to be spent on studies of the creek **flood events and drain maintenance needs (not water quality)**. Changes in water management philosophy have changed the studies from site-specific to a watershed-wide scale. Causes of the increase in flooding in the GCW as identified in past studies and CAER findings are:

- Upstream development: Subdivision of parcels, increase in impervious surface
- Stream channelization **and bank armoring**
- Floodplain removal and development **resulting in narrowed riparian corridors**
- Backwaters of the Flint River caused by the Hamilton Dam
- Constrictions through MCC campus, College Cultural Area, Delphi, and Applewood Estate
- Undersized culverts (watershed wide).

Recommendations

The Genesee County Drain Commission currently is studying the maintenance needs of their management section of the watershed. It is presumed that vegetation removal will occur and some culverts will be replaced. **This work is slated to begin in 2007 and may further alter the hydrology of the Gilkey Creek. Proper timing of restorative and preventive measures will require collaborative planning between the City of Flint and the Genesee County Drain Commission to save resources** as it did in 1976. Studies that focused on flooding in MCC and Applewood Estate suggested construction of a bypass channel or berm. **All studies agreed (but we don't) that development in the headwaters must reach its peak prior to any engineering solutions to be successful in the downstream reaches. Water quality improvements are focused on preventative measures in the headwaters, reduction of pollutant sources and causes, and reducing storm water runoff as opposed to increasing the flow capacity of the Gilkey Creek.**

In addition, through this plan's implementation Gilkey Creek stakeholders must address flooding in a way that does not conflict with water quality improvements

Further general recommendations that are detailed in the BMP section of this plan include:

- Focus initial BMPs in the headwaters to stabilize stream flows
- Coordinate with Drain Commissioner to stabilize upstream portions of creek to improve water quality for the entire watershed
- Retain **(and detain)** stormwater on site
- Reduce / remove in stream barriers (unnecessary culverts, log jams), **Figure 10**

- **Upgrade and maintain improperly-sized or misaligned road/stream crossings**
- Remove structures in floodplain **that prohibit infiltration**
- Restore floodplain where feasible
- **Wetland restoration where feasible based on land use and soils**

Figure 10: Log jam at unnecessary bridge between Lippincott and Atherton Roads

Goals and Objectives

The development of goals for the Gilkey Creek Watershed took place over the course of the planning project. Goals for the Gilkey Creek are aimed at restoring designated uses and achieving desired uses. Pollutants that prevent designated and desired use attainment are addressed in the objectives. **Best Management Practices (Table 10) were created to remediate pollutant sources and causes**. Final agreement on watershed goals was established at the February 23, 2006 stakeholder meeting. Objectives for these goals were determined and agreed upon at two meetings in March (22 and 29).

The development of goals, objectives to meet those goals and the tasks necessary to complete objectives are extremely important steps in the watershed planning process. A framework identifying goals, objectives and tasks ensures that there is a direct linkage between the numerous tasks outlined in the WMP and achieving the goals established to protect water quality. This framework provides numerous opportunities to measure achievements. Each of these levels of project completion provide opportunities for program monitoring and evaluation. Goals (in bold) and objectives for implementation are:

1. **Improve wildlife and other aquatic life habitat**
    - Reduce stormwater runoff
    - Reduce sediment loading
    - Reduce nutrient runoff (where is this discussed in the plan? **Table 7 and section on prioritization of pollutants**)
    - Increase wildlife corridors as indicated in the Landscape Preservation Plan for desired use
    - Increase shading of creek to reduce suspected thermal pollution

2. **Improve warm-water fishery**
    - Reduce stormwater inputs (from impervious surfaces)
    - Reduce sediment loading
    - Maintain temperature at or below WQS for warm-water fishery
    - Maintain dissolved oxygen levels at or above WQS for warm-water fishery
    - Minimize nutrient loadings

3. **Increase creek aesthetics, educational opportunities and recreation use (for partial and total body contact)**
    - **Bacteria levels to meet partial and full body contact WQS**
    - **Reduce amount of litter, trash and floating substances to meet desired use of the Gilkey Creek**
    - Reduce turbidity in creek to meet the WQS for physical characteristics
    - Increase visibility of creek along major thoroughfares **(signage)**
    - Promote current recreational and educational opportunities in watershed
    - Identify potential recreational and educational opportunities in watershed

- Reduce oil/gas sheen found on water **through IDEP program**
- Reduce nutrient levels
- Enhance in-stream habitat

4. **Reduce Flooding and Improve Navigation**
    - Reduce amount of stormwater runoff
    - Remove man made and natural in-stream barriers that promote flooding and hinder navigation
    - Facilitate no net loss of wetland areas
    - Increase width of riparian buffers to accommodate 100-year storm event
    - Improve stormwater management practices
    - **Bring together key agency, educational, technical and community stakeholders to facilitate solutions to flooding and protecting water quality.**

5. **Improve creek for public health and drinking water**
    - Support wellhead protection program
    - Bacteria levels to meet partial body contact water quality standards (WQS)
    - toxicant levels in the water column to meet the WQS for toxic substances **– these are suspected, many sites do not have LUSTs but have documented releases of toxic substances**

A guide for achievement of these goals is detailed in section 3 **Tables 10** (Best Management Practices) on page 57 and **11** (Target Audiences and Education Programs)on page 65.

Methods

Public Participation Process (PPP) and Results

Public participation is important in the watershed planning process. An open planning process allows stakeholders to provide direction to the process which increases the chances of "buy in" by those stakeholders. Public involvement gives value to the plan and ensures that stakeholders are comfortable with its recommendations. In the development of the GCWMP, CAER involved the public in several ways including:

- Public stakeholder meetings
- Visioning sessions
- Presentations at neighborhood meetings and conducted surveys
- Presentations to city councils
- Attendance at public events to promote project
- Steering committee meetings

A summary of these activities and outcomes is shown in **Table 5**.

Table 5: Methods and outcomes of public participation process

Location	Attendance	Activities	Outcomes
Flint Jazz Festival [8/19-21/05]	8	Sign up sheet, brochures, displays	**List of stakeholders**
College Cultural Neighborhood Association [1/24/06]	30	Presentation and Survey	**Survey results**
Fairfield Village Neighborhood Council [2/4/06]	10	Presentation and Survey	**Survey results**
Central Park Neighborhood Association [2/16/06]	10	Presentation and Survey	**Survey results**
Applewood Estate Stakeholder Meeting [11/28/05]	7	Presentation and Discussion	**Desired uses, history of the creek, vision, issues**
Applewood Estate Stakeholder Meeting [2/23/06]	11	Presentation and Discussion	**Ranked goals and pollutants, issues**
Committee Meeting CAER office [3/22/06]	7	Review of water quality summary, discussion, visioning session	**Objectives for goals, visioning outcomes**
Committee Meeting CAER office [3/29/06]	6	Discussion	**Recommendations for education plan and implementation**

August 19-21 CAER participated in the Flint Jazz Festival; CAER staff used this venue to find local Flint citizens that would be interested in the Gilkey Creek Project. CAER set up an information table with pictures of the Gilkey Creek and information on water quality and reducing pollution. Eight people were interested in the project of which two

remained active in the planning process. It was felt that this was not the best venue for gaining project support, but that we might have made contact with people who don't normally attend neighborhood meetings or are involved in environmental organizations.

Public participation was also solicited at neighborhood meetings in the City of Flint, including the College and Cultural Neighborhood Association (CCNA), Central Park Neighborhood Association (CPNA), and Fairfield Village Neighborhood Council (FVNC). The East Village Magazine reported CAERs presentation at the FVNC meeting in their February issue. However, Sara McDonnell was misquoted as one of the project goals making the Creek safe for swimming. A brief presentation was made at neighborhood meetings and a seven question survey was circulated. Survey questions were as follows:

1. What is your favorite place along the Gilkey Creek?
2. Whose responsibility is it to clean out the storm drains? The creek?
3. Would you adopt a storm drain (volunteer to sweep leaves, etc off)?
4. Would you participate in a clean-up of the Gilkey Creek?
5. Do you have any concerns/questions about the water quality of the Gilkey Creek?
6. Should your neighborhood association be involved in the watershed planning process?
7. Why didn't you attend the public meeting for the Gilkey Creek Watershed Management Plan in September?

Detailed summaries of the survey results are in the Appendix.

Stakeholder meetings were also held at Applewood Estate on September 28, 2005, and February 23, 2006, to solicit participation in a steering committee. The first public meeting was to tell people about the project and the watershed management planning process. The second public meeting was used to rank stakeholders watershed goals and pollutants.

Visioning sessions were held at the CAER office during March of 2006 to refine watershed goals and objectives. These meetings were also used to brainstorm educational opportunities in the watershed, talk about the history of the watershed, and identify potential sites for wetland restoration and flood control.

Gilkey Creek Stakeholder Committee

The stakeholder committee has guided the planning process by giving feedback and input on watershed issues and priorities**.** They have offered in-kind services, knowledge of the watershed, and served as liaisons.

Dave Miller, Applewood Estate
Deborah Elliot, Applewood Estate
Kay Kelly, City of Flint Parks Department
Ingrid Halling, Central Park Neighborhood Association, City of Flint
Sherry Hayden, College Cultural Neighborhood Association, City of Flint
Steve Wall, Court Street Village, City of Flint
Sue Kubic – Genesee County Drain Commission
Craig Nelson, riparian City of Burton

Sue Lossing, Mott Community College and former riparian in City of Burton
Brad Hill, City of Flint Water Pollution Control Division
Rebecca Gale-Gonzalez, Mott Community College
Jeff Nelson, riparian City of Burton
Leyla Sanker, CAER
Sara McDonnell, CAER
Jeff Threet, resident City of Burton
Michael Simon, Rep. Dan Kildee's Office

Gilkey Creek Steering Committee
Formed from the stakeholder committee, the steering committee was charged with providing historical information about the Gilkey Creek, insight into local issues, and recommendations for writing the plan. This dialogue occurred formally at **4 meetings** and informally through email and phone correspondence **and accompaniment during physical inventory.**

Craig Nelson, riparian City of Burton
Sue Lossing, Mott Community College and former riparian in City of Burton
Brad Hill, City of Flint Water Pollution Control Division
Rebecca Gale-Gonzalez, Mott Community College
Jeff Nelson, riparian City of Burton
Leyla Sanker, CAER
Sara McDonnell, CAER
Jeff Threet, resident City of Burton
Dr. Marty Kaufman, Earth and Resource Science Department, University of Michigan-Flint

Results

Survey results from the neighborhood groups were helpful in determining educational needs of the community, favorite places, stewardship ethics, and water quality concerns. **Stakeholder and steering committee meetings provided ranked goals, pollutants,** objectives, and history of the watershed. The group also worked together to identify causes of flooding in the watershed and ways to promote stewardship and public involvement in the future. **The following results were incorporated into the landscape preservation plan, BMP recommendations, and the education plan.** Recommendations from the public participation process included:

- Creation of a green roof demonstration project near AC Delco plant that could be promoted along with green roof demo at Applewood Estate
- Continued promotion of cleanups on MCC campus and within the city of Flint
- Identified sites for potential recreation: along Robinson Drain south of Lippincott and west of Center Road, along east side of Curtis Drain, unused Showcase Cinema parking lot off Court Street
- Identified sites for **potential flood control: undeveloped** west side of Kelly Lake Park, along Main Branch near Walker Farms and end of Dortch Drive
- Identified sites for **potential wetland restoration: unused Showcase Cinema parking lot off Court Street,** front yard of Wal-Mart, north of railroad line east

of Center Rd., land adjacent to Scott Elementary **(What about the hydric soil area map – esp in headwaters? This is recommended in the landscape preservation plan)**
- Suggested greenway along Gilkey Creek within the City of Flint
- Identified sites of major flooding: near Roat Ct., Lippincott Rd and Arrowhead Drive in Burton, near Woodlawn Park and Brookside Drive in Flint
- Identified sites of high algae growth in Woodlawn Park, Pierce Park, North Branch west of Belsay Road, Robinson Drive east of Howe Road, and Main Branch between Lapeer and Lippincott
- Further monitoring needs include: sediment testing, and water quality testing (dissolved oxygen, summer temperatures, and bacteria)
- **A barrier assessment for fish passage should be considered**

Continued involvement and expansion of the stakeholder and steering committees is necessary for successful implementation. Representatives from the Road Commission in addition to the Drain Commission must be active for successful plan implementation.

A technical committee must be formed to guide the public and stakeholders through implementation. The technical committee should be comprised of representatives from the following:

- Michigan Department Environmental Quality
- Michigan Department of Natural Resources
- City of Flint, Water Pollution Control Division
- City of Burton, Department of Public Works
- City of Flint, Department of Public Works
- Genesee County Road Commission
- Michigan Department of Transportation
- Genesee County Drain Office

The Education Plan and BMP sections provide more detail on how to continue to involve the organizations and individuals during implementation and future planning.

Local ordinance reviews and policies

Home rule is at the heart of land use decisions and local building ordinances in Michigan. This traditional control of land use decisions by local agencies and elected boards greatly complicates watershed management. Watersheds cross political borders and therefore require good communication between neighboring jurisdictions and county entities. In order to overcome this complication watersheds are often managed at the sub-watershed scale. This management of multiple smaller watersheds functions to limit the number of jurisdictions involved and reduces the chance of conflict around management decisions.

Watershed management plans have been developed by the Genesee County Drain Commission for larger watershed boundaries including the Middle, Lower, and Upper Flint River and the Shiawassee River. These plans focus on broad storm water management issues but fail to address specific policy concerns for individual municipalities because of their large size. For example, the Middle Flint River Watershed Management plan covers an area that contains 27 jurisdictional boundaries (**Figure 1**). By focusing on the Gilkey Creek we were able to reduce the number of jurisdictions involved to five. Coordinating land use decisions among the Gilkey Creek watershed's five jurisdictions is much more manageable when an intense inventory and stakeholder involvement are necessary for specific management recommendations.

The planning team examined the local land use policies and ordinances that influence land use and storm water management within the watershed. This examination was conducted to uncover opportunities for improvements in local policies and practices that will assist in protecting and restoring water quality in the Gilkey Creek Watershed. Zoning ordinances and policy were reviewed using methodology developed by Richard Norton and Christina Kelly at the University of Michigan, Department of Urban and Regional Planning. This method involves assigning communities a score based on their ordinances for resource protection. Reviews were performed for the cities of Flint and Burton. The master plan was not reviewed for Flint as it is currently being updated (last master plan was completed in the 1970's). The other communities were not evaluated due to the small amount of watershed they encompass.

Implementing progressive policies to protect water quality is important throughout the watershed. Protecting parks in the floodplain should be a top priority in the City of Flint; the city should look to working with a land conservancy to protect parks in the floodplain. Other findings included:

1. Strongest policies for floodplain protection exist in the City of Flint.
2. Encouragement for redevelopment in existing brownfields is strongest in the City of Flint.
3. Burton's policies are relatively weak for water resource protection. Specifically the city has **no policy on erosion control that prohibits clear cutting and stripping of lots for development, the drain office coordinates the soil erosion and sediment control for new development,** incentives for impervious surface reduction (parking or road width variances), parking lot runoff controls, landscape standards, or natural feature setbacks.
4. Watershed planning is not currently incorporated into other municipal planning efforts (parks, master, etc).

5. The **city of Burton** should consider a wellhead protection plan (briefly mentioned in master plan). This is based on the variable types of soil and infiltration rates found in the city.
6. Burton should consider allowing on site treatment of storm water in parking lots and reevaluate its minimum parking requirements.
7. Maintenance of on-site detention basins are neglected prohibiting them functioning properly.
8. Laws exist for sediment runoff control from construction sites and for catch basin maintenance but appear to not be enforced regularly.
9. There is little correspondence between communities on goals of water quality and quantity.

These findings are important to consider in the management of the Gilkey Creek Watershed. The lack of protective policies in the headwaters of the watershed presents an obstacle and a need for education prior to implementation of BMPs. The City of Burton is highest priority for implementing new policies that focus on stormwater management and riparian land management. The City of Burton in partnership with the Genesee County Drain Commission and **Road Commission** must a play a key leadership role in the implementation of the Gilkey Creek Watershed Management Plan. Preventative and restorative measures must occur first in the headwaters to stabilize stream flows before all designated uses can be fully attained. The Gilkey can be restored to attain all its designated uses only if the city of Burton and the Drain Commission work together to address sources of water quality pollutants and reduce structural impairments. These findings directly influenced the development of several education and managerial BMPs identified in the watershed plan.

Landscape Preservation Plan

One of the proposed goals of the Gilkey Creek Watershed management plan is to prioritize the elements of the physical landscape for protection and enhancement. This prioritization was completed by combining quantifiable landscape ecology measures with stakeholder input information. **The Landscape Preservation Plan combines areas important for protection including riparian lands and areas identified by landscape ecology tools, cultural landmarks, and stakeholder vision. Together, these components identify high priority locations for protecting the current water quality of the creek and important cultural and natural assets identified by stakeholders.**

Landscape ecology has developed a suite of tools that can be used to understand the ecologic significance of areas of land in the Gilkey Creek Watershed. When using landscape ecology, landscapes are treated as patches, corridors, and a matrix which consists of the dominant land use. This concept is illustrated in **Figure 11**.

Figure 11: Landscape Characteristics

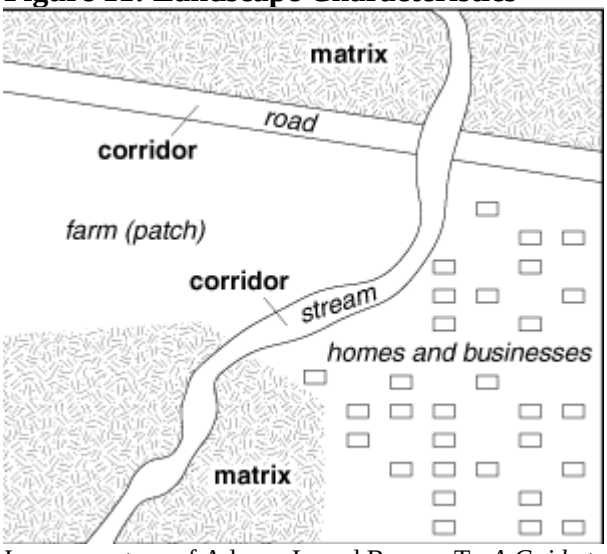


Image courtesy of Adams, L. and Barnes, T., *A Guide to Urban Habitat Conservation Planning*

With the landscape classified into these categories a number of tools can be used to determine the relative importance of each patch and/or corridor. These tools included measures of total size, core area, presence of streams, and proximity to other areas.

Landscape Analysis

Forest, grassland, and wetland patches were selected and combined, using a GIS, to create a layer of contiguous open space areas. These areas were then ranked based on the four landscape metrics identified above. An additive scale was built by segmenting the data into four groups based on natural breaks in the calculated metrics. Each was given a score and the total for all landscape metrics were summed to give each a final conservation rank. Areas with the highest rank are considered highest priority for protection.

In the Gilkey Creek Watershed the matrix, or the dominant land use, is urban. Interspersed within this urban matrix are a series of forested, grassland, and wetland

patches and corridors. These patches and corridors play an important role in the hydrologic function of the Gilkey Creek Watershed. For example, large upland patches typically allow for the infiltration of stormwater into the groundwater. Another example is forested and grassland corridors along stream segments that can trap sediments carried by stormwater. While these patches and corridors serve this important function for water quality they too have ancillary benefits, such as sites for recreation and non-motorized transportation.

Stakeholder vision

The stakeholder visioning process provided a description of the important places in the watershed for recreation, aesthetics, and flood control **(the desired uses)**. The stakeholder vision was centered around the goal of reduced flooding since many residents of the watershed reported they were affected by it. Stakeholders and CAER looked at opportunities in the watershed to decrease runoff, increase infiltration and promote recreation.

These opportunities include:

- Green roof demonstration project
- Wetland restoration
- Increase in recreational property

Green roofs are a method for decreasing runoff from a site by creating a layer of biomass for rainwater to nourish. Green roofs have an initial high capital cost (cost per square foot) but are a good investment in that they reduce heating and cooling costs, and reduce stormwater impact; hence having less impact on the creek. Stakeholders agreed that a good site for this would be around the AC Delco plant in the City of Flint (**Figure 12**). The plant itself may not be a good choice for the demonstration project given that it maybe vacant within a couple of years. Another stakeholder, Applewood Estate, has installed a green roof on their garden shed. Staff at Applewood Estate taught a workshop at the 2007 Keep Genesee County Beautiful Conference on the benefits of green roofs and installation. Implementation at a larger scale could serve as model for the entire Flint River Watershed and offer broader educational opportunities.

Wetlands may offer flood retention in addition to wildlife habitat**.** There are four potential sites in the watershed that stakeholders identified for wetland enhancement and restoration. All sites correlate with hydric soils, and are identified in the landscape preservation plan. The first site would involve removal of pavement of the north parking lot of the Showcase Cinema along the North Branch. This lot is not used and is currently being reclaimed by weeds. The North Branch also runs through the front yard of Wal-Mart, which is another potential opportunity for a wetland demonstration project (**Figure 14**). Both of these sites are highly visible and could provide educational opportunities as well. **Where wetland restoration is not feasible, infiltration may be increased by removing the unnecessary pavement (impervious surfaces).**

Figure 12: Delphi East

Figure 13: West side of Kelly Lake Park

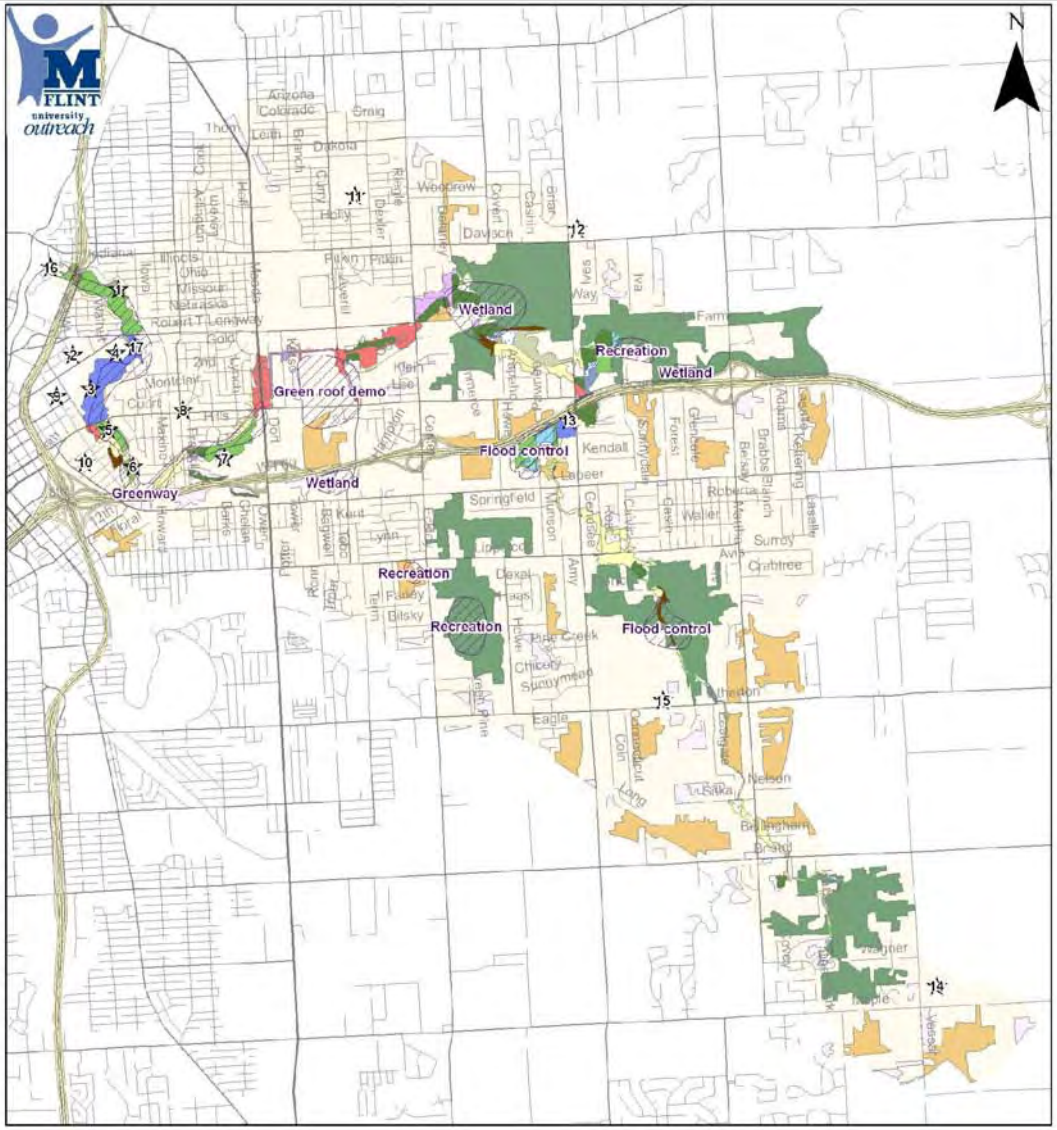
Figure 14: Front yard of Wal-Mart

The next two sites would involve enhancement of current wetlands. The first site is on the Main Branch, east of Center Road and north of the railroad line. The second site is adjacent to Scott Elementary on the Robinson Drain. The Robinson Drain emerges behind Scott Elementary; the site is currently fenced off for safety reasons. With careful planning, this site could provide a great opportunity for outdoor education in the area.

There are also many opportunities for recreation in the watershed such as fishing, wildlife viewing, and trails. Stakeholders agreed that the site along Robinson Drain, south of Lippincott and west of Center, and the east side of Curtis Drain are both good potential sites. Bank stabilizations structures would need to be installed to minimize sedimentation caused by bank erosion. Both sites would require a zoning change. A proposed greenway along the Gilkey through the City of Flint also would increase aesthetics and recreational opportunities in the watershed.

In summary, the landscape preservation plan, shown in **Figure 15**, identifies locations where stakeholder vision overlaps with ecologically important sites. By utilizing both sets of information it is possible to focus on both socially and ecologically important areas of the Gilkey Creek Watershed. **These locations are critical for the protection of the cultural history of the GCW. An ancillary benefit from protecting and enhancing these land resources is improved water quality.** Results from this process serve as a guide for potential locations for BMPs. Implementation of the landscape preservation plan and the entire watershed management plan relies heavily upon education of stakeholders about the known pollutants and threats to Gilkey Creek and the appropriate steps (Best Management Practices) for restoring and protecting water quality.

Figure 15: Landscape Preservation Plan



Legend

- Cultural Landmarks
- Visioning Session
- Roads
- Gilkey Creek Watershed

Land Use

Class

- Multi-Family-Medium to High Rise
- Single Family, Duplex
- Secondary/Neighborhood Business
- Institutional
- Indoor Cultural, Assembly
- Industrial
- Industrial Park
- Road Transportation
- Utilities
- Outdoor Rec
- Under Construction
- Cropland
- Orchards, Vineyards
- Grasses and Forbs
- Shrubs
- Central Hardwood oak
- Lowland Hardwoods
- Lakes
- Shrub Swamps
- Non-forested Wetlands

Potential Preservation Sites

Priority

- Low
- Medium
- High

No.	Name
1	Kearsley Park
2	Cultural Center
3	Mott Community College
4	Applewood Estate
5	Burroughs Park
6	Woodlawn Park
7	Pierce Park Golf Course
8	College Cultural Neighborhood
9	Central Park Neighborhood
10	Fairfield Village Neighborhood
11	Longway Park
12	ForMar Nature Preserve
13	Kelly Lake Park
14	Elks Lodge and Golf Course
15	Walker Farms
16	Former Levi Gilkey Residence
17	Former Gilkey Brook Park

0 0.25 0.5 1 1.5 2 Miles

Ruth Mott Foundation

Findings and Recommendations

Designated Use Status and Desired Uses in the Gilkey Creek Watershed

Several designated uses in the watershed are threatened or impaired. **Table 6** lists the status of the designated and desired uses for the GCW. Pollutants that are impairing or threatening these uses are listed as known or suspected. The status of these designated and desired uses provide the framework for which goals and objectives are established. Pollutants identified as suspected need further investigation in order to determine their affects on use attainment. A clarification of designated uses is described below:

- **Agriculture – water that is used to irrigate crops or water livestock**
- **Public Water Supply – surface water that is used for drinking water at a designated point of intake (not to confuse with well water and aquifers)**
- **Wildlife and Other Indigenous Aquatic Life –Aquatic life and Wildlife can thrive and reproduce**
- **Total and Partial Body Contact – water is used for recreation (swimming, fishing, boating) all waters protected for recreation shall not exceed specific levels of E.coli (to avoid confusing with swimming in algae or being able to fish and canoe, etc)**
- **Navigation – water is navigable by watercraft by being free of obstructions and pollutants that impede boat function**
- **Warm Water Fishery – water supports warm water fish species reproduction and can thrive and reproduce**
- **Industrial – water is usable by industry and able to pass through intakes**

Desired uses are those defined by stakeholders of the watershed that **are not necessarily tied** directly to improving water quality, **but are reflective of factors important to the watershed community and gains their support**. Throughout the watershed planning process and public input sessions stakeholders expressed concerns and a vision for the future of the watershed. This vision is detailed in the Landscape Preservation Plan and is tied to community goals and desired uses. A clarification of desired uses is described below:

***Reduced Flooding* – flooding is a reality that threatens the property and livelihood of many riparian owners in the watershed. Many residents and stakeholders primary purpose of involvement in the watershed planning process was to reduce flooding on their property. Potential sites for increased infiltration are shown in Figure 15.**

Model / Educational tool – specific sites (identified in landscape preservation plan) can be used for education of students and decision-makers about the Gilkey Creek Watershed and water quality. In the future, watershed restoration sites (possibly Applewood Estate) can serve as a model for other communities and sub-watersheds of the Flint River.

Increased Aesthetics – beautification of the creek and the immediate surrounding area including less trash, oil residues, and algae and more natural riparian plantings will increase pride and sense of ownership in the watershed.

Enhanced Recreational Use – better signage along the Gilkey Creek and the existing trails, and expansion of existing trail in Kearsley Park will provide more stream side recreation and make the creek more visible. This use does not refer to in-stream recreation such as boating or swimming (covered in designated uses).

Table 6: Designated and Desired Uses for the Gilkey Creek Watershed
Status of designated and desired uses are either not applicable (N/A), threatened (T) or impaired (I) ***A = Attained***
based on pollutants that are known (K) or suspected (S)

Designated Use	**Status**	**Pollutant**	**Notes**
Agricultural Water Supply	A	--	never used, low base flow
Public Water Supply	**N/A**	**--**	never used, low base flow
Other Aquatic Life	I	nutrients (S), sediment (K), thermal (S)	drain maintenance upstream of Center Road
Wildlife	A	--	--
Total Body Contact (May 1 – October 31)	T	bacteria (S)	old infrastructure
Navigation	N/A	--	debris / log jams (K)
Industrial Water Supply	A	--	
Warm Water Fishery	I	sediment (K), nutrients (K), thermal (S)	portions of creek are buried limiting fish passage, drain maintenance upstream of Center Road
Partial Body Contact	T	bacteria (S)	old infrastructure
Desired Use	**Status**	**Impairments**	**Notes**
Model / Educational tool			**See Education Plan**
Increased Aesthetics	I	trash (K), oil and grease (K), nutrients (K), invasive species (K)	**See Education Plan**
Enhance Recreational Use			**See Education Plan**

Water Quality

Assessment of the biological habitat and communities of the Gilkey Creek Watershed was necessary to characterize water quality and to make recommendations on the management of the watershed. Water quality of the Gilkey Creek was assessed by:

- Sediment test results,
- Fish community,
- Invertebrate community, and
- Known and suspected pollutants determined by physical inventory and local knowledge

The Gilkey Creek is characterized by extensive urban runoff, low gradient, and low groundwater inflow (Leonardi, 1997). Results from this process guided in the designation of critical areas and implementation strategies.

The Gilkey Creek is listed as not attaining designated uses by the MDEQ per the requirements of Section 303(d) of the Clean Water Act. Typically, the MDEQ will establish a Total Maximum Daily Load (TMDL) for pollutants so that a water body can meet and maintain water quality standards for designated use attainment. For example, if the use of warm-water fishery is impaired by sediment, the MDEQ would establish an amount of sediment (TMDL) that could not be exceeded to support fish. However, in Gilkey Creek's case it is listed as impaired due to channel modification and drain management practices. Therefore, the MDEQ **has** not prescribed a TMDL given that the main impairment to designated use attainment is insufficient habitat due to drain management practices.

Pollutant sources and causes can be addressed in the watershed but the Gilkey Creek will still not be able to attain all designated and desired uses until drain practices are modified to support fish and other aquatic life habitat. A strategy for attaining all uses is outlined in the Best Management Practices and Education sections.

Previous Research

Sediment

Sediment testing performed in 1998 indicated excessive nutrient loading in the Flint River Watershed. The mouth of the Flint River had the highest concentrations of: total phosphorous, ortho-phosphorous, Kjeldahl nitrogen, and ammonia nitrogen in the Saginaw Bay and tributaries. Locally, petroleum products are present in the sediment of the Gilkey Creek (Leonardi and Gruhn, 2001). The Robinson Drain is highly suspected of being contaminated due to smells noticed by residents doing cleanups and the history of spills occurring there. The Main Branch also is suspected to be contaminated near the Dort Highway and Court Street intersection where two leaking underground storage tanks **(**LUST) is suspected to be leaking free product (gasoline) that is undergoing abatement.

In addition to be a carrier of pollutants, sediment is a pollutant itself in many areas of the watershed. Specific impacts from sediment include covering of fish habitat, fish eggs and other aquatic habitat, extreme sedimentation can also block sunlight plants need to photosynthesize and create oxygen.

Fish

The Gilkey Creek is classified as a second order warm water stream (Michigan stream classification, 1967). This classification is based on temperature, water characteristics, and sport fish characteristics (Leonardi and Gruhn, 2001). The fish community in the Gilkey Creek is considered poor (impaired) by GLEAS procedure 51 (Leonardi and Gruhn, 2001). A single site (Court Street) sampled in 1997 collected five fish species with creek chub and white sucker comprising 90% of the catch. Adult fish habitat is limited by low base flow and flashy flow indicated by bank scouring. Flashy flow is a result of high amounts of stormwater and drain maintenance in the City of Burton. However, spawning fish often ascend the Gilkey offering some angling opportunities (Leonardi, 1997).

Invertebrates

Benthic communities are an indicator of overall water quality. Benthic monitoring is inexpensive and accurate way of monitoring long term trends and is a good evaluation tool. The macro-invertebrate (benthic) community of the Gilkey Creek was rated acceptable by GLEAS procedure 51. A total of 13 taxa were collected including: roundworms, crayfish, caddisflies, damselflies and mites (Leonardi, 1997). The Flint River Watershed Coalition trains volunteers and sponsors bi-annual benthic monitoring throughout the watershed. Sites are ranked based on the number and type of invertebrates found. Two sites have been monitored by volunteers in the Gilkey Creek. One site is located in the headwaters in the City of Burton, and the other is located in Burroughs Park in the City of Flint. The City of Flint site has fluctuated from 'Fair' to 'Poor' since 1999. The headwater site, monitored once each year from 2002-2005, has gone from 'Fair' to 'Good' ratings. The biggest impediment to improved invertebrate habitat is drain maintenance in the City of Burton.

Findings and Recommendations based on previous research

- Overall, water quality of the Gilkey Creek has improved overall on surveys done in 1972, 1989, and 2000 by the MDNR.
- Based on state agency surveys, aquatic communities have become more diverse while algae growth has declined indicating reduced nutrient loading.
- Restoration of fish habitat and the resulting community is not feasible until the flow is made more stable.
- Contaminated sediment may be affecting aquatic communities and other designated uses. Technical assistance is needed to assess the extent of contaminants. (see BMP table)
- Support of the FRWC and their monitoring programs should continue in the Gilkey Creek and the Flint River Watershed at large. (see Education Plan and Evaluation)

Physical Inventory and Local Knowledge

In addition to reviewing previous research related to use attainment of the Gilkey Creek Watershed, CAER engaged in several activities to identify the current water quality and condition of the GCW. These activities included data collection at road stream crossings, wading of inaccessible sections of creek, review of historic land use,

public input sessions and conversations with watershed residents, and observation of uses within the watershed.

Based on results of these activities CAER confirmed previous research done by MDNR regarding pollutant sources and causes, angling opportunities, and stream bank conditions. It is important to note that while previous research indicated reduction in nutrient loadings, high amounts of algae are found throughout the watershed. Residents also stated that it was common practice to dump lawn clippings and leaves into the creek. Stormwater is the greatest cause impeding water quality and is compounded by the drain management practices occurring in the upper stretches of the creek**.** Drain management practices do attempt to remediate flooding caused by excessive stormwater but are preventing the formation of habitat for fish. Sedimentation is occurring at several locations due to human causes including poor management of stormwater and removal of riparian vegetation and large areas of impervious pavement. Oil sheens and trash were also present at many locations. Due to the high amounts of stormwater input and the removal of riparian vegetation, thermal pollution may also exist.

Prioritization of Pollutants, sources, causes and identification of critical areas

The process of prioritizing pollutants in the GCW is necessary to ensure the watershed is restored using limited resources efficiently. Pollutants, sources, and causes were ranked based on their impairment to designated and desired uses. CAER conducted physical inventory, land use analysis, relied upon local knowledge, assessed hydrologic clues and relied upon professional judgment to determine these rankings. Based on these methods, it was determined that stormwater is the greatest cause of pollution into the creek. As shown in Table 2, 63% of the watershed is developed land. This land use predicts the hydrology of the GCW to have high amounts of stormwater input and low base flow (page 21). **Stormwater flows must be reduced to alleviate flooding and attain desired uses.**

After we discussed our findings with stakeholders at the February 23 meeting, they stated that flooding was a major issue in the watershed and felt it caused several pollutant problems in the watershed. Stakeholders were mainly concerned with protection of their property, increased aesthetics, and public health. Though important and valid concerns , the MDEQ requires that pollutants be ranked according to their greatest impairment or threat to water quality. Again it is important to note that drain management and maintenance, though not a pollutant, but a cause, limit the Gilkey attaining all designated uses. The pollutants, sources, causes, and critical areas are discussed briefly here and identified in **Table 7**. Steps to address the pollutant sources and causes are outlined under Best Management Practices for designated and desired uses.

Hydrology (cause)

Hydrology is the primary suspected cause of pollutants in the Gilkey Creek, due to the high amount of volume and velocity of water in the channel after storm events. The hydrology witnessed by CAER staff also increases erosion leading to sediment pollution. Drain maintenance in the creek from the headwaters to Center Road has altered the

hydrology of the Gilkey Creek. The drain maintenance has modified habitat in the creek impacting the warm water fishery and other aquatic life. Development of the watershed has increased the amount of water that drains to the creek through storm drains and ditches. A hydrologic study must be conducted to confirm that hydrology is not a pollutant and to identify best management practices that improve water quality and reduce flooding. Effects of altered hydrology are illustrated in **Figure 16**.

1. Sediment

Sediment buries habitat and makes it difficult for fish to navigate and find food and reproduce. Sediment pollution sources were identified during the physical inventory near gullies, eroding outfalls, road stream crossings, construction sites, roads and stream banks. High fluctuations in flow (hydrology) cause erosion from stream banks and road stream crossings. Improper construction site controls also increase the amount of sediment entering the system. High amounts of sediment also come directly from roadways and parking lots. Causes include inadequate street sweeping, leaf removal and pickup practices, and stormwater flows (**Figure 16**). Sediment is impacting the warm water fishery and other aquatic life habitat.

Sediment Critical areas

CAER identified several locations where sedimentation is occurring. The Main Branch from Dort Highway to Kearsley Park and Robinson Drain downstream from Atherton Road are receiving sediment primarily from stream banks and stormwater. Coates Drain and the Main Branch from the headwaters to Lippincott Road appear to be receiving sediment runoff primarily from construction sites and stream banks.

2. Nutrients and Sediment Born Nutrients

Sediment is capable of transporting nutrients, particularly phosphorus into the creek. Nutrients negatively impact water quality by creating excessive plant growth. When plant material breaks down it decreases the amount of oxygen in the water available to fish and other wildlife. Nutrients are suspected due to high concentrations of algae and plant growth found in portions of the watershed during physical inventory. Nutrients also come from a variety of sources including fertilizers, leaves and lawn clippings, detergents, leaking sewers, and failing septic. Local knowledge confirmed that several watershed residents use commercial lawn services for lawn fertilizing and many dump leaves and lawn clippings into the creek. Nutrients deposited from sediment or stormwater threaten the designated uses of warm water fishery and other aquatic life habitat and desired uses.

Nutrient Critical Areas

Critical areas for sediment born nutrients are the North Branch and Curtis Drain sub-watersheds due to high levels of plant and algae growth observed there, the Main Branch through from Dort Highway to Robert T. Longway and Bristol Road to Lapeer Road.

3. Bacteria

Bacteria are suspect pollutant that is caused by pet, and wildlife feces. Bacteria have the potential of impacting partial body and full body contact designated uses. Pets (in dense

residential areas in the City of Flint) that have unrestricted access to the stream greatly have the potential to contribute bacteria in a creek. The riparian land management technique of manicured lawns, observed in several parts of the watershed, attracts high densities of waterfowl which also increase potential for bacteria growth. The suspected bacteria also derives from human and animal wastes, and is caused by failing septic, broken sewer lines, improper disposal of pet waste, and the storm drain system creating a direct path to waterways. Monitoring of bacteria levels would need to be performed to fully assess the sources and threats to recreation in the Gilkey.

Bacteria Critical areas
The suspected critical area is along the Main Branch from Dort Highway to Court Street.

4. Oil and Grease associated with stormwater

Due to the high density of roads in the watershed, it is not surprising that oil and grease are pollutants in the GCW. These types of pollutants harm aesthetic quality of the watershed. Oil and grease create unsightly sheens on the water. Main sources of this are impervious surfaces such as roads and parking lots. Causes of this pollutant are lack of education, poor car maintenance and the lack of oil catchments / filters in storm drains and the design practice of directing road and parking lot runoff directly into the creek. It is also suspected that illicit connections may be present due to the concentrations of oil found near industrial and commercial land uses. Illicit connections are addressed through the Phase I and Phase II stormwater IDEP program.

5. Suspected Toxins (heavy metals, compounds associated with historic land use)

Historic land use in the watershed and soil testing performed by the Environmental Protection Agency and the MDEQ had prompted the University of Michigan to compile health risks associated with brownfield sites throughout Genesee County (2005). The study compiled historic data and produced a GIS layer of probable brownfield sites. Based on this study, CAER has determined that several parcels in the GCW may affect water quality of the Gilkey Creek. Specific toxins identified include lead, naphthalene, BTEX, and PCB's. A known leaking underground storage tank is also located in the floodplain of the Gilkey Creek. These sites should be prioritized based upon their potential to contaminate the Gilkey Creek and groundwater. Suspected clean brownfield sites were considered for redevelopment and are incorporated into the landscape preservation plan.

Toxin Critical area.
A leaking underground storage tank is located on the Main Branch at Court Street and Dort Highway and maybe a risk to surface water contamination. Several brownfield sites are suspected of negatively impacting water quality and are shown in **Figure 17**.

6. Trash / debris

Trash and debris are a priority concern in the watershed because of their prevalence throughout the watershed and its effect on attaining desired uses. Trash and debris are broad terms that include everything from fast food containers, log jams, household trash, and household hazardous materials.

During the physical watershed inventory high amounts of trash and debris were noted throughout the watershed. Residents also noted it as an eyesore and impediment to attaining the desired use of increased aesthetics, educational and recreational use. Trash comes from littering and is transported by stormwater into the creek. Poor stewardship ethic is the main cause of littering. Littering can be addressed through education and sponsored cleanups and possible enforcement of litter laws. Cleanups are currently sponsored by the Flint River Watershed Coalition. 2006 was the first year the Coalition held a clean up on the Gilkey Creek.

Trash / Debris Critical Areas

Trash is most prevalent in the lower more heavily populated areas of the watershed. Critical areas for trash and debris are the Robinson Drain and the Main Branch from Dort Highway to Robinson Drain.

7. Thermal

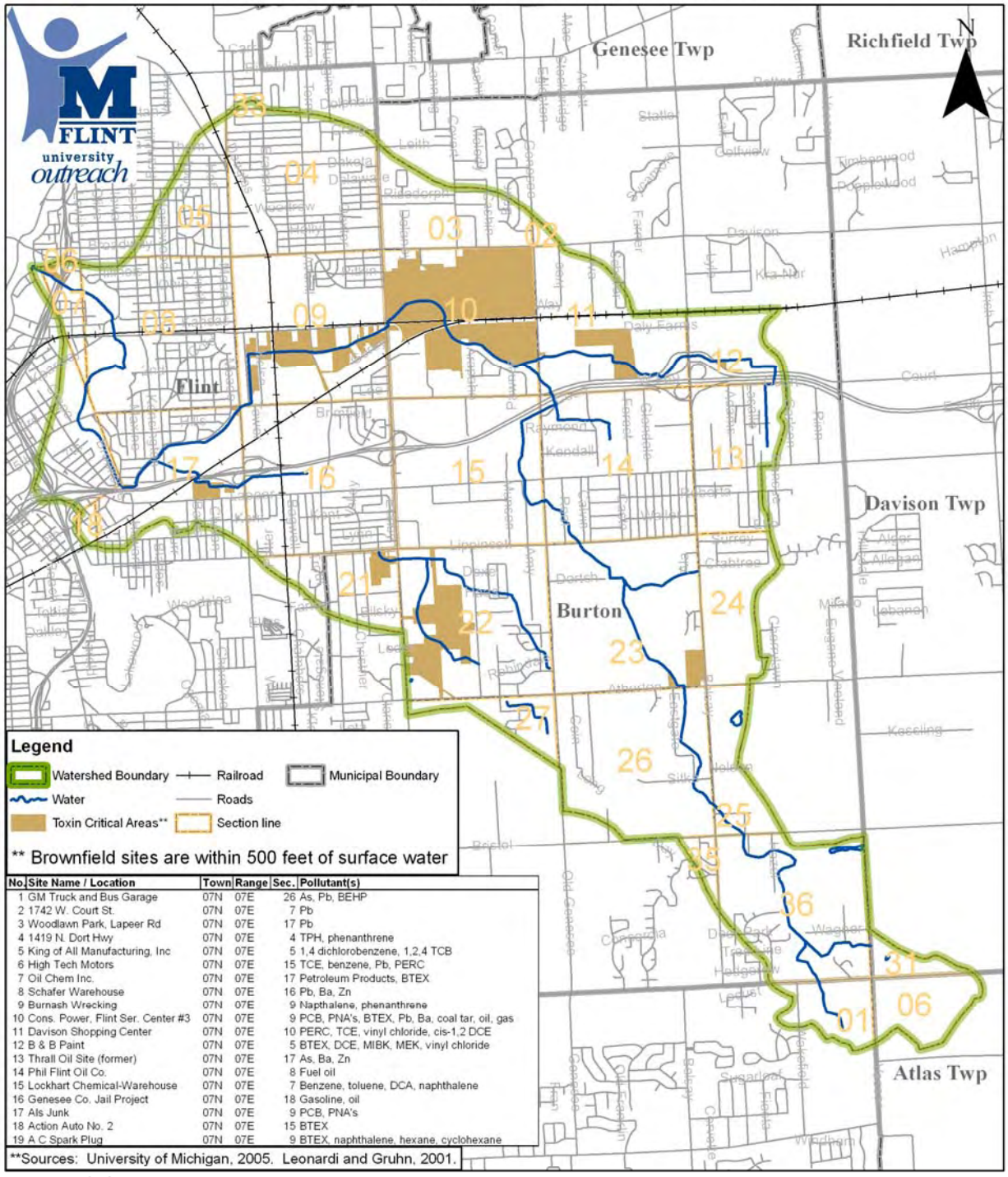
Thermal pollution is suspected due to the removal of riparian vegetation and increases in stormwater runoff in the watershed. Removal of riparian vegetation has increased the amount of direct sunlight that reaches the creek allowing it to warm up quicker. Stormwater runoff is warmer than rainwater, altering the in-stream chemistry and dissolved oxygen in the lower reaches of the watershed. Due to lack of data, an assessment of creek temperatures is needed before critical areas can be defined.

8. Invasive species (desired use)

Invasive species such as burdock, purple loosestrife, and phragmites were identified during field inventory in the headwaters of the watershed and are mainly associated with new construction. Invasive species are introduced by accident from the unknowing gardener or through natural dispersion. Invasive species take hold quickly and are capable of out competing native plants. This creates a monoculture which can harm other uses such as wildlife habitat. Invasive plants are controlled mechanically or chemically, and prevented through education. The highest concentrations of invasive species were found in the headwaters of the Main Branch, North Branch, and Robinson Drain.

Figure 16: Effects of altered hydrology: flooded road (top), high eroding banks (middle), flooded Kearsley Park (bottom).

Figure 17: Suspected Toxin Critical Areas



No.	Site Name / Location	Town	Range	Sec.	Pollutant(s)
1	GM Truck and Bus Garage	07N	07E	26	As, Pb, BEHP
2	1742 W. Court St.	07N	07E	7	Pb
3	Woodlawn Park, Lapeer Rd	07N	07E	17	Pb
4	1419 N. Dort Hwy	07N	07E	4	TPH, phenanthrene
5	King of All Manufacturing, Inc	07N	07E	5	1,4 dichlorobenzene, 1,2,4 TCB
6	High Tech Motors	07N	07E	15	TCE, benzene, Pb, PERC
7	Oil Chem Inc.	07N	07E	17	Petroleum Products, BTEX
8	Schafer Warehouse	07N	07E	16	Pb, Ba, Zn
9	Burnash Wrecking	07N	07E	9	Napthalene, phenanthrene
10	Cons. Power, Flint Ser. Center #3	07N	07E	9	PCB, PNA's, BTEX, Pb, Ba, coal tar, oil, gas
11	Davison Shopping Center	07N	07E	10	PERC, TCE, vinyl chloride, cis-1,2 DCE
12	B & B Paint	07N	07E	5	BTEX, DCE, MIBK, MEK, vinyl chloride
13	Thrall Oil Site (former)	07N	07E	17	As, Ba, Zn
14	Phil Flint Oil Co.	07N	07E	8	Fuel oil
15	Lockhart Chemical-Warehouse	07N	07E	7	Benzene, toluene, DCA, naphthalene
16	Genesee Co. Jail Project	07N	07E	18	Gasoline, oil
17	Als Junk	07N	07E	9	PCB, PNA's
18	Action Auto No. 2	07N	07E	15	BTEX
19	A C Spark Plug	07N	07E	9	BTEX, naphthalene, hexane, cyclohexane

**Sources: University of Michigan, 2005. Leonardi and Gruhn, 2001.

Ruth Mott Foundation

0 0.375 0.75 1.5 2.25 3 Miles

TABLE 7 (3 PGS, INSERT EXCEL TABLE)

Table 7

TABLE 7

Pollutant Loading

The purpose of the pollutant loading calculation in a watershed management plan is to standardize the progress in reporting so water quality impacts and state-wide advancements can be systematically represented. Calculations were conducted according to the Pollutant Controlled Calculation and Documentation for 319 Watersheds Manual (MDEQ 1999). It is recognized that this system has limitations, but does provide a uniform system of estimating relative pollutant loads. In the following section we have provided pollutant loading calculations for sediment and sediment-borne phosphorus and nitrogen. This method does not account for nutrients that are dissolved in solution and transported by runoff.

During the physical inventory of the GCW, specific locations were identified where pollutants are entering the stream. Sites included in the calculations for pollutants controlled are:

1. Gully Erosion Sites
2. Eroding Stream Banks
3. Over-falling Culverts/Outfalls

Gully Erosion Methods

Twelve gully erosion sites were identified during the physical inventory portion of the Gilkey Creek Planning Process. The Gully Erosion Equation (GEE) was used to calculate the amount of sediment being delivered from those locations.

Gully Erosion Equation:
Sediment Reduction = **[Top Width (ft) + Bottom Width (ft)/2 * Depth (ft) * Length (ft) * Soil Weight (tons/ft^3)] / Number of Years**

The gully erosion equation requires us to know or estimate several variables including the volume of the gully, the dry density weight of the soil eroded and the number of years a gully took to form. In inventorying gully erosion sites, a system was developed to rank them depending on their size and delivery of sediment to the stream channel. The system consisted of giving gullies a ranking of 1 or 2, with 1 representing the lowest and 2 the highest sediment delivery. Below is a description of each class of gully erosion sites and their average dimensions.

- Gully 1 (**Figure 18**): Gullies with a 1 ranking are small partially vegetated gullies that appear to be delivering sediments eroded from the uplands to the stream during rain events. Mitigation at these sites would likely require only minimal effort to install BMPs such as grassed waterways to trap sediments eroded from the uplands. The average size of these gullies was estimated to be 1 ft wide at bottom, 2 ft wide at the top, 5 ft in length and formed over the course of two years.

Figure 18: Gully 1

Figure 19: Gully 2

- Gully 2 (**Figure 19**): Gullies with a 2 ranking are more severe than those with a rank of 1. These gullies would require some earth moving to install BMPs. The average dimensions of these were estimated to be 2 ft wide at the bottom 3 ft wide at the top, 10 ft in length and formed over the course of three years.

In order to calculate the sediment loadings the dry density of the eroded soil must be known. To identify the dry density of the eroded soils, a geographic information system was used to overlay the known gully location with a soil layer. This overlay allowed for the identification of the specific soil type and associated soil class texture. It was estimated that soil types in the City of Flint emulate those of Burton where land uses were similar due to lack of an accurate soil survey. Dry density soil weights were interpreted based on the soil texture class according to the MDEQ procedures (MDEQ 1999). Microsoft Excel was used to conduct the calculations and produce a table of the loadings. According to our calculations displayed in **Table 9** gully erosion sites are responsible for depositing approximately 11 tons of sediment per year while over-falling culverts are contributing approximately 9.4 tons of sediment to the Gilkey Creek per year.

Bank Erosion Method

There are several stretches throughout the creek that have eroding stream banks. The degree of erosion was ranked for each site relative to the entire watershed. The following three categories were developed for eroding stream banks:

- Mild: Banks were undercut but not failing providing habitat for some species of wildlife. Lateral Recession Rate (LRR) is described as slight (MDEQ, 1999).
- Moderate (**Figure 20**): Banks undercut with some slumping. LRR is described as moderate.
- Severe: Bank failure, major loss of property. LRR is described as severe.

Figure 20: Bank with moderate erosion

Approximately 1900 linear feet of stream bank are eroding. Most of the stream banks experiencing erosion in the Gilkey are in the Moderate category. A small percentage downstream of Center Road is in the Severe category. The Channel Erosion Equation (CEE) was used to calculate the annual average sediment delivery associated with stream bank erosion.

Channel Erosion Equation:

CEE = Length (ft) * Height (ft) * LRR * Soil Weight (tons/ft^3)

The CEE requires us to know or estimate several variables including the length, height, lateral recession rate, and dry density soil weight for the segments of stream bank. The length and height of the areas in need of stream bank mitigation were based upon observation, the use of aerial photography, and GIS measuring tools. According to our calculations in **Table 9** approximately 56.6 tons of sediment is entering the Gilkey Creek from stream bank sources.

Nutrients

The amount of attached phosphorus and nitrogen is calculated using information collected by USDA-ARS researchers (Frere et al., 1980). The estimate starts with an overall phosphorous concentration of 0.0005 lbP/lb of soil and a nitrogen concentration of 0.001 lbN/lb of soil. Then a general soil texture is determined, and a correction factor is used to better estimate nutrient holding capacity. A loamy soil has a correction factor of 1.0, while clay and mulch soils are greater than 1.0 and sandy soils are less than 1.0. This correction factor reflects the fact that soils with higher clay and organic matter contents have a higher capacity to hold nutrients, while sandier soils have a lower nutrient capacity. The phosphorus reduction is calculated by multiplying the phosphorus concentration by the sediment reduction and correcting for the soil texture. The same method is used to calculate the nitrogen reduction. A soil phosphorus concentration of 0.0005 lbP/lb soil, and a soil nitrogen concentration of 0.001 lbN/lb soil (Frere et al., 1980) were used in our calculations.

Nutrient Reduction Equation:

Nutrient reduced (lb/yr) =
Sediment reduced (T/yr) x Nutrient conc. (lb/lb soil) x 2000 lb/T x correction factor

According to our calculations in **Table 9** sediment is responsible for contributing 77 tons of phosphorus per year and 154 tons of nitrogen per year. Detailed calculations are shown in the Appendix. Though this equation does not account for it, non-soil related inputs of nutrients also are present in the GCW. Other nutrient inputs include soaps, fertilizers, animal waste and human waste.

Table 9. Pollutant Loadings for the Gilkey Creek Watershed

Sediment Source	**Tons / Year**
Gully Erosion Sites	11
Over-falling Culverts	9.4
Stream Banks	56.6
Total Sediment	**77**
Nutrients	**Estimated Reduction (tons /yr)**
Phosphorous	77
Nitrogen	154

Best Management Practices

BMPs are implemented as systems. Rarely does one BMP solve all water quality problems at a site. It is more common to implement a combination of types at each site. For example, an eroding stream road crossing might require a culvert replacement, re-vegetation of banks, and a storm drain retrofit for stormwater treatment.

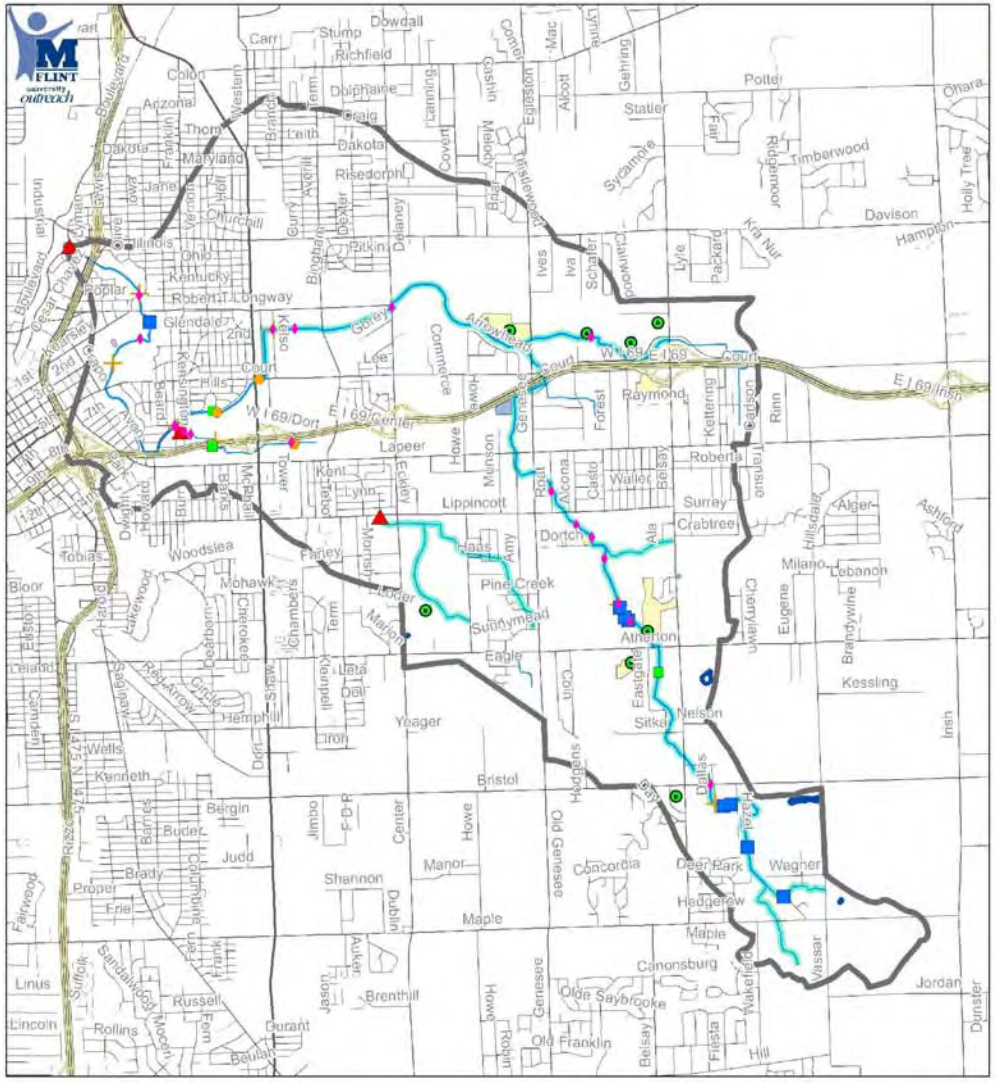
About 70% of the Gilkey Creek Watershed is urban land use. This includes pervious surfaces such as lawns. For the purpose of this plan, it is assumed, based on land use and in-stream indicators that impervious cover is less than 60%. Keeping this in mind, the watershed goal to improve fishery habitat can only be achieved in isolated portions of the watershed (CWP, 2004). The remaining goals are feasible, depending on individual reach characteristics. **Table 10 prioritizes recommendations for BMPs within the Gilkey Creek Watershed to reduce and prevent pollution sources and causes. BMPs are also prioritized to attain desired uses in the watershed. Figure 21 shows specific locations for BMP implementation.**

Table 10 and Figure 21 are to be used in conjunction with recommendations from the Landscape Preservation Plan (**Figure 15**), and the Education Plan (**Table 11**). Education is required for successful BMP implementation. Most often education is required prior to successful structural and policy BMP implementation. Together these three items detail important areas for conservation, recommendations for improvements in the watershed, and outline educational activities to coincide with on-the-ground work.

Implementation

Implementation of the overall plan should be coordinated by a Gilkey Action Team. The Gilkey Action Team will provide guidance on the implementation of the GCWMP. Key partners are identified under Action Item 2 of **Table 10**. Continued communication among these partners is necessary for water quality in the Gilkey Creek to be improved and for desired uses to be attained. Communication should consist of meetings, email correspondence, etc. The minimum frequency of communication should be monthly.

Figure 21: Sites for Best Managemnet Practices



Legend

- Pervious Pavement demo
- Undersized Culverts
- Existing Detention Basins
- Stormwater Infiltration Retrofit Sites
- Eroding Culvert
- Eroding Outfall

Gully

Rank

- 1
- 2
- Log Jams
- Watershed Boundary
- Drain maintenance
- Construction Sites

Roads

- interstate
- non-interstate
- ramp
- rest areas/weigh stations
- divided hwy
- undivided hwy
- service drives
- Principal arterial
- minor arterial
- residential
- non certified
- res

Gilkey Creek

- Lake
- Stream
- Stream
- Drains and Tributaries

N

Map Description:
This map denotes specific sites for BMP implementation. Data presented were gathered during July 2005 through Spring 2006. Locations were re-verified in March 2007.
Sites recommended for BMPs are based on physical inventory (see appendix), public input (see Methods section), and professional judgement.
Priority stream segments are identified in Table 7 according to specific sources and causes.
As indicated in the BMP section of the plan, upland runoff controls and progressive drain maintenance need to occur prior to stream bank restoration.

0 0.45 0.9 1.8 2.7 3.6

Miles

Data Sources:
Michigan Center for Geographic Information, version 6
Center for Applied Environmental Research, 2006

Ruth Mott Foundation

Education Plan

An effective community outreach and education plan is necessary in implementing and sustaining the GCWMP to improve water quality in the Gilkey Creek. **Table 10**, Best Management Practices for the Gilkey Creek Watershed, refers to the Education Plan under several BMP system recommendations. **Education efforts are based on prioritized BMP's (see Table 11, column 1 "Action Items from Table 10 Best Mangement Practices). As stated in the BMP section, BMP's are prioritized based on prioritized pollutant sources and causes.**

Education programs were also developed as Best Management Practices to improve water quality by focusing on prioritized pollutants, sources and causes and to achieve desired uses. A successful education plan is important because reducing the pollutants affecting water quality in Gilkey Creek will require increases in knowledge by the community and voluntary behavior changes by residents and decision makers. As watershed managers we must have an understanding of the learning process and current stakeholder knowledge before a successful education plan can be implemented.

The learning process involves four basic steps: experiencing/awareness phase, building knowledge, processing of information, and application of knowledge (NVPDC, 1996). The GCW education plan will be structured around theses processes by providing:

- Public education to increase **Experiences / Awareness** of issues in the watershed
- **Building knowledge** base of stakeholders
- Allowing stakeholders to **Process Information** through community dialogue and interactive learning
- Encourage stakeholders to **Apply** their knowledge

It is critical to emphasize the large amount of residential properties in the GCW and a resident's overall impact on water quality. The Gilkey Creek Watershed education plan includes the following:

1. A review of existing watershed education activities
2. Education plan goals, objectives, and actions
3. Target audiences for each pollutant reduction objective
4. Delivery mechanisms including adapted and developed materials

Existing watershed education efforts

Currently, there are several watershed education efforts ongoing in the GCW and adjoining watersheds. A brief discussion of these programs is provided here to identify opportunities and to minimize duplication of efforts.

Phase II Stormwater Education

The Genesee County Drain Commissioner's (GCDC) office has been working with the municipalities of Genesee County to develop and implement a Public Education Plan (PEP) as required under Phase II of the NPDES program. The focus of this broad campaign is on basic watershed education topics including defining a watershed and illustrating the impacts of storm water pollution. The plan also focuses on several topics required under the NPDES program including:

1. The encouragement of people reporting the presence of illicit discharges or improper disposal of materials into separate storm water systems
2. Education of the public regarding the proper disposal of household hazardous waste, travel trailer waste, chemicals, grass clippings, leaf litter, animal wastes and motor vehicle fluids
3. Acceptable application and disposal of pesticides and fertilizers
4. The use of preferred cleaning materials and procedures for car washing
5. Education of the public regarding the ultimate discharge point and potential impacts of separate storm water drainage systems serving their places of residence
6. Stewardship of local watersheds
7. Education of the public regarding management of riparian lands to protect water quality

Implementation of the Phase II public education program uses a number of methods and techniques to educate the public concerning the topics outlined above. These formats include radio and television announcements, speaker circuits, billboards, newspaper articles and other mass media promotions. The implementation of the Phase II Stormwater Education program began in early 2006.

The Phase II program provides many of the basic elements required for the implementation of a public education program for the GCW. The education activities associated with Phase II programs, however, do not address all the issues identified as affecting designated uses within the GCW. The program outlined here will complement the Phase II program by providing specific education activities based on target audiences and specific pollution problems identified in the planning process.

Other Watershed Education Activities

In addition to the activities underway as part of the Phase II Stormwater program, education activities also will be underway in the Kearsley Creek and Swartz Creek Watersheds. **These watersheds have different issues than Gilkey but are currently undergoing watershed planning and watershed education plan development.** Efforts will be made to coordinate the sub-watershed management plans to ensure that learning, collaboration, and resource sharing can continue over the course of the projects.

Education goals

The Gilkey Creek Planning Team developed the following campaign to focus on specific problems identified in the physical, hydrologic and policy analysis conducted during the planning phase. Focusing education efforts will provide a long-term solution to the problems associated with non-point source pollution in the Gilkey Creek Watershed. This program targets specific audiences to address the pollutants, sources and causes that are impacting water quality in the Gilkey Creek Watershed. **Table 10** references the Education plan as a BMP system for several action items required to achieve watershed goals. **Table 11** details the target audience that needs to be reached, key message, deliver mechanism (tools), desired behavior change, and potential evaluation.

Below are the four education goals recommended by the Gilkey Creek Steering Committee. Goals are shown in *italics* followed by a brief description.

1. Establish and facilitate a working Gilkey Education sub-committee of the Action Team

The Gilkey Education Committee will provide guidance on the implementation of education activities described in this plan. This subcommittee should include representatives from local educational institutions, Flint River Watershed Coalition, and local civic leaders.

2. Assess current attitudes and behaviors in regard to water quality in the GCW: A Baseline

Analysis and Expansion of Phase II Stormwater survey includes a watershed behavior survey that can be used as a demonstration project for the Flint River Watershed and to gauge effectiveness of the Public Education Campaign. The survey performed under the Phase II Stormwater program was a regional effort and surveyed only five individuals in the GCW. Expansion of this effort will survey more residents in the GCW on their issues relating to water quality and attempt to gauge their level of understanding.

Preliminary surveys conducted during the planning process revealed many residents did not know the Genesee County Drain Commission does not have jurisdiction in the City of Flint and that is the city's or homeowner's responsibility for storm drain upkeep.

3. Educate target audiences about specific sources and causes of water quality in the GCW

Goal 3 focuses on key stakeholder groups in the GCW. Recommendations for education are detailed in **Table 11**. These programs will raise awareness of the GCW, and build knowledge of stakeholders. It is anticipated that these programs will motivate stakeholders to become active in watershed restoration and protection efforts. Outcomes of information found in the survey recommended in Goal 2 will further guide Goal 3.

4. Increase stewardship ethic of watershed stakeholders

Goal 4 is a desired outcome from Goal 3 and will be measured by survey instrument from Goal 2. It is practiced theory that once stakeholders are educated about water quality issues and given the tools, they can become active in their watershed's restoration. Outcomes addressed in this education campaign that promote stewardship include: stream cleanups, storm drain stenciling, street sweeping, and community / volunteer monitoring.

Table 11 (page 1 of 2)

Table 11 (page 2 of 2)

Delivery Mechanisms (Tools)

Conducting a public education campaign requires the use of numerous tools and educational aides. This section provides a description of the tools that have been mentioned in the education plan.

Table 10, Action 2 Facilitate Gilkey Action Team and subcommittees

Stream Habitat and Drainage Maintenance Course (Developed)

Developed and hosted by the American Fisheries Society this course gives participants working knowledge of the effects of channelization on environmental quality. Particpants also learn the economic costs and benefits of drainage, and methods of protecting and restoring stream habitat.

Designing for Aquatic Organism Passage at Road-Stream Crossings Course (Developed)

Developed and hosted by the American Fisheries Society, particpants learn necessary skills to design stream-crossing structures that accommodate aquatic organism passage, provide more natural stream processes and channel function, and maximize the long-term durability and stability of the structure. This is an intensive interdiscipliary workshop.

Table 10, Action 5 Provide trainings for alternative stormwater runoff controls

Watershed Tours (not developed)

A series of tours of the Gilkey Creek watershed will be conducted for local planning and elected officials. The purpose of these tours will be to familiarize local officials with the geographic location, physical appearance and water quality of various parts of the watershed. These tours also will provide opportunities for stakeholders to visit various BMP implementation sites. The goal of these tours will be to demonstrate why there is a water quality problem, why it's important, and lead into next steps (trainings) to improve the Gilkey Creek.

Alternative stormwater runoff controls trainings (not developed)

This training would be targeted at local planning commissions, city councils, engineers and developers. Regional experts would demonstrate best practices to increase infiltration on-site including retrofitting sites and for new builds. These best practices include alternative site designs by engineers and developers, sample ordinances and incentives provided by planning commissions and boards.

Filling the Gaps (developed)

Filling the Gaps is a document produced by the Michigan Department of Environmental Quality to assist local governments in protecting their natural resources. This document provides a comprehensive overview of relevant enabling legislation, example ordinances and case studies of their application. This tool will be extremely useful in most education activities involving local elected and appointed officials.

Green Roof Demonstration project (developed)

Demonstration projects offer an interactive way for stakeholders to view installed BMPs and to ask questions pertaining to: difficulty of installation, cost and funding support, and effectiveness in watershed protection. Applewood Estate currently has a green roof installed on one of their garden sheds.
**

Table 10, Action 9 Educate riparian owners on proper stewardship
Riparian stakeholder list (developed)

A riparian stakeholder list was generated using a Geographic Information System (GIS). This GIS system inexpensively produced a mailing list of residents who own property adjacent to Gilkey Creek. These stakeholders were identified in the physical inventory as a primary target audience. This list provides an effective way to disseminate information to this key target audience.

Residential Guide for the Gilkey Creek Watershed (developed)

A brochure that describes the Gilkey Creek Project, and lists ways residents can reduce pollution in the watershed was developed by CAER and Dr. Marty Kaufman.

Riparian Stewardship Brochure (not developed)

Similar to the Residential Guide, this brochure would focus on retaining and restoring vegetative buffers, improving stream banks, and reducing runoff pollution.

Speaker Circuit / Workshops (not developed)

Workshops offer a way to educate stakeholders more directly and to offer them feedback immediately. Some suggested workshops pertaining to stewardship are:

- Back to the Birds: Participants would learn ways to make their homes bird-friendly through landscaping, and how water quality impacts birds
- Bring back the frogs: Focus of workshop would be on frog friendly landscaping, and frog identification
- Bats for bugs: Encourage stakeholders to rely on bats for mosquito control, and building bat boxes as opposed to using insecticides

**

Table 10, Action 14 Change policy on raking leaves into street for pick up
Residential Guide for the Gilkey Creek Watershed (developed)

A brochure that describes the Gilkey Creek Project, and lists ways residents can reduce pollution in the watershed was developed by CAER and Dr. Marty Kaufman.

Trainings on how to start and maintain a compost pile

Horticulturalists would host workshops on composting for gardens. This would include methods for picking a compost site, what materials to compost, maintenance, and uses for compost.

Gilkey Creek Action Team (not developed)

This would provide the opportunity to educate City of Flint participants about issues associated with current leaf removal practices and ways to implement solutions in

their Phase I SWPPI**, meetings would include presentations and discussions on the negative effects on water quality and best practices for remediation. A similar format would be used with the Genesee County Drain Commission for incorporating standards for water quality in management of the Gilkey Creek.**
**

Table 10, Action 15 Enforce soil and sediment BMPs at construction sites
Mud Busters Program (developed but needs to be adapted to local region)
See existing program for Chesapeake Bay
http://www.cbf.org/site/PageServer?pagename=exp_sub_state_stormwater_mud

Brochure (in development with FRWC)

A brochure explaining why excess sediment is bad, pictures of sediment runoff, and phone numbers on who to report to can be mailed to active groups in the Gilkey Creek Watershed.

Website (in development)

Provide a space on the website for program and ways to get involved. The website is set up to familiarize watershed residents with the Gilkey Creek and the watershed plan. As part of implementation, the website will include contact information and meeting times for the Action Team and subcommittees. Marketing of the website is also needed as part of the implementation of the GCWMP.
**

Table 10, Action 19 Educate on proper application of fertilizer application
See Phase II Stormwater Education

More information is available at www.cleargeneseewater.org
**

Table 10, Action 20 Reduce dumping of leaves, grass, and other organic debris into ditches, storm drains, and creek
See Phase II Stormwater Education

More information is available at www.cleargeneseewater.org
**

Action 22 Improve pet waste disposal
See Phase II Stormwater Education

More information is available at www.cleargeneseewater.org

Pet waste receptacles (not developed)

During physical inventory of the watershed a common behavior observed was not cleaning up of pet waste near the creek and the adjacent land. Because of the dense residential land use and potential impact from their pets, a pet waste collection system should be installed. **These could serve double duty and allow for general trash to reduce littering.**
**

Action 24 Improve car maintenance practices

See Phase II Stormwater Education

Brochure available at www.cleargeneseewater.org

Car Care Guide (not developed)

Brochure on non-point source pollution could be used county-wide that entails the best way to wash a car, where to recycle oil, and where carwashes are located in the watershed.

**

Action 31 Offer alternatives for parking lot and road design

Demonstration project (in development)

Demonstration projects offer an interactive way for stakeholders to view installed BMPs and to ask questions pertaining to: difficulty of installation, cost and funding support, and effectiveness in watershed protection. Applewood Estate is currently planning on retrofitting an existing parking lot in the floodplain of the Gilkey Creek with pervious pavement.

Alternative stormwater runoff controls trainings (not developed)

See explanation above for Action 5

Development incentives (not developed)

Incentives created for developers to retain stormwater on-site and increase infiltration as determined by the Gilkey Implementation Committee. **Examples may be density increases per the municipality, variances for decreased road widths, driveway and parking requirements and free marketing materials that promote the benefits of the development design. The marketing materials could be incorporated with the advertising done by the developer or realtor to entice the buyer.**

**

Action 34 Improve stewardship ethic of watershed citizens

Storm Drain Stencils (developed through NPDES Phase II program)

Storm drain stenciling was identified as a way to promote stewardship in the watershed. A stencil should be developed that is specific to the watershed.

Classroom Presentations (not developed)

Tailor Keep Genesee County Beautiful Anti-litter campaign for local schools, expand Project GREEN (Global Rivers Environmental Education Network) activities in school districts in the Gilkey Creek Watershed to familiarize students with the watershed and establish baseline-monitoring data.

Water Quality Report (not developed)

A water quality report based on the findings of the Gilkey Creek Watershed plan will be developed to be used with watershed stakeholders. This report will summarize

the findings of the management plan in a format that will be more user-friendly than the long and complex watershed plan. Key information will include:

- A map of the watershed
- Summary of the findings
- Contact information about the plan
- Photos and descriptions of critical areas
- How to get engaged in present activities
- Website

Watershed Maps (developed)

The ability to identify one's location within a watershed is fundamental to understanding individual impacts on the watershed and the impacts the watershed has on individuals and communities. A series of simple maps was generated that identifies the location of municipal boundaries, watershed divide, cultural landmarks such as township offices, and historical locations.

Watershed Signage (developed through NPDES Phase II program)

These signs will be designed and developed in coordination with the Genesee County Road Commission and be placed around the watershed to increase identification of the Gilkey Creek Watershed.

In addition to applying for education grant dollars from MDEQ, several other sponsors have been identified that would likely fund portions of the education plan for the Gilkey Creek. Below are several other sources that should be used in the education plan implementation.

**

Action 35 Educate homeowners about invasive species
The Gardener's Stewardship Brochure (not developed)

Similar to the Residential Guide, this brochure would focus on identifying and removing invasive species. Would also include contact information of local conservation organizations that remove invasive species.
**

Action 37 Educate local planning officials about green infrastructure
GLS Greenlinks Communications and Marketing Plan (in development)

A communications and marketing plan for green infrastructure is being developed for Genesee, Lapeer, and Shiawassee counties under the GLS Greenlinks project funded by the Ruth Mott Foundation. Use of this tool is necessary for implementation of the Landscape Preservation Plan, **Figure 15**.
**

Action 41 Work with existing property owners to preserve wetlands
Clearinghouse

Identify agency to create and advertise local clearinghouse for organizations with existing wetland preservation and restoration programs. **Potential organizations are the Flint River Watershed Coalition, Genesee Conservation District or the Center for Applied Environmental Research. Promotion of the clearinghouse will be through the Genesee County Conservation District, website and media outreach.**
**

Funding Sources

In addition to applying for education grant dollars from MDEQ, several other sponsors have been identified that would likely fund portions of the education plan for the Gilkey Creek. Below are several other sources that should be used in the education plan implementation.

Clean Michigan Initiative

The Clean Michigan Initiative (CMI) is a $675-million bond approved by Michigan voters to improve and protect Michigan's water resources. These funds are available for contaminated sediments, lead, non-point source pollution, and pollution prevention among others. The program is administered through the MDEQ, MDNR and Community Health.

Local Foundations

The Ruth Mott Foundation services the greater Flint community by providing funding for projects that range in focus. As part of the Foundation's Beautification Program, several watershed planning activities have been funded that include educational components. Concept papers are accepted by the foundation three or four times a year. A proposal that focuses on the education activities to accomplish desired uses should be submitted to the foundation in the early phases of a project.

EPA-Five Star Program

The Five Star Restoration Program brings together students, Conservation Corps, other youth groups, citizen groups, corporations, landowners and government agencies to provide environmental education and training through projects that restore wetlands and streams. The program provides challenge grants, technical support and opportunities for information exchange to enable community-based restoration projects. Funding levels are modest, from $5,000 to $20,000, with $10,000 as the average amount awarded per project. However, when combined with the contributions of partners, projects that make a meaningful contribution to communities become possible. At the completion of Five Star projects, each partnership will have experience and a demonstrated record of accomplishment, and will be well-positioned to take on other projects. Aggregating over time and space, these grassroots efforts will make a significant contribution to our environmental landscape and to the understanding of the importance of healthy wetlands and streams in our communities.

Great Lake Aquatic Habitat Network Fund (GLAHNF)

The mission of the Great Lakes Aquatic Habitat Network and Fund (GLAHNF) is to foster and support a vital, effective grassroots sector working locally to protect aquatic

habitats throughout the Great Lakes Basin. GLAHNF provides financial resources, shares information, and fosters communication between citizens and organizations working to protect aquatic habitats. The GLAHNF grants program is designed to increase the ability of grassroots groups and individuals to succeed in advocacy projects to protect rivers, lakes, and wetlands in their areas.

The goal of GLAHNF's grants program is to provide financial support to advocacy activities that strengthen the role of individuals and community groups working locally to protect and restore shorelines, inland lakes, rivers, wetlands, and other aquatic habitats in the Great Lakes Basin. Advocacy work, as defined here, involves local community members actively promoting aquatic habitat protection by influencing community and/or individual behavior or opinion, corporate conduct, and/or public policy.

Great Lakes Basin Program for Soil Erosion and Sediment Control

The focus of this program is on water quality, land use, and agricultural productivity. The Basin Program is coordinated by the Great Lakes Commission in partnership with the U.S. Department of Agriculture (Natural Resources Conservation Service), U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers. In Michigan, projects have focused on a variety of areas including agricultural, streambank, urban and forest-based erosion. Over 107,000 acres are under some form of Best Management Practice, thereby preventing the loss of more than 325,000 tons of soil annually. Benefits include improved water clarity and fish spawning habitat.

Non Point Source Implementation Grants (319 program)

Federal funding authorized under the Clean Water Act is available through the EPAs Region 5 for implementing approved watershed management plans. The program support activities that

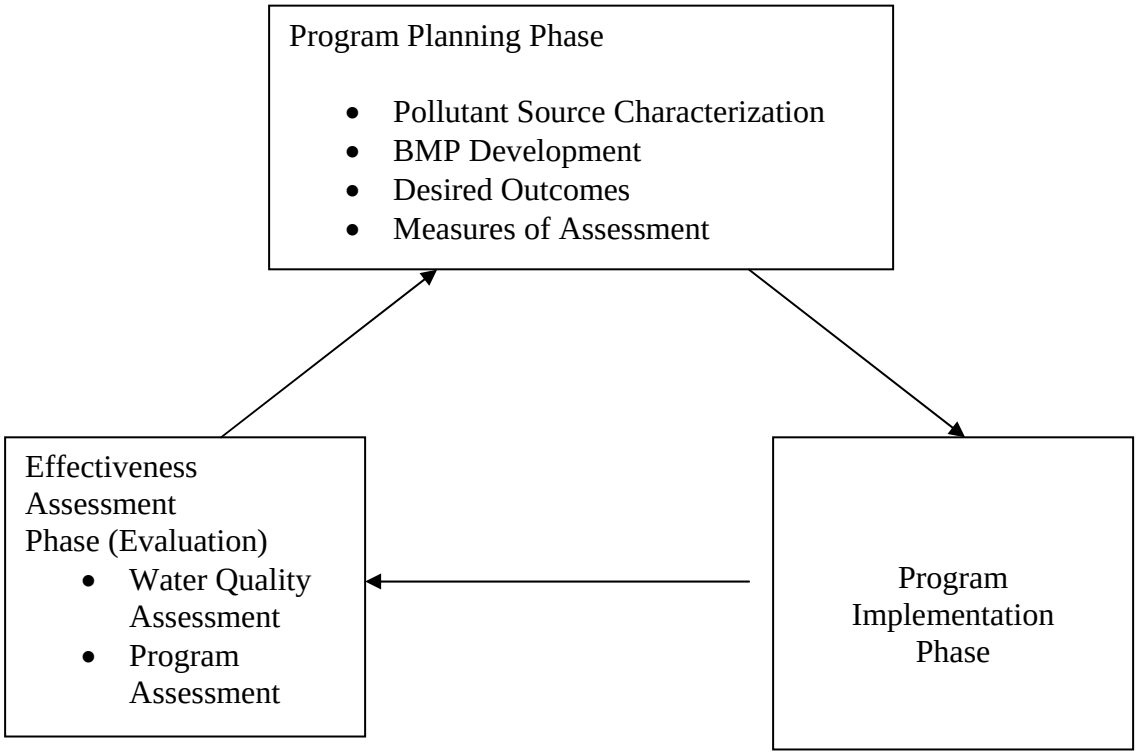
- address impaired waters through the TMDL program (currently not developed for the Gilkey Creek)
- address water quality issues by improving habitat
- focus on the primary water quality problems of sediment and nutrient impairment and habitat loss
- utilize funds for monitoring and measurement

Evaluation

Program Process and Goals

The primary goal of the Gilkey Creek Watershed Planning Project was to develop a watershed plan that when implemented could protect and restore the designated and desired uses of the GCW. A comprehensive watershed management process involves working though a number of phases that ultimately leads to water quality protection. Watershed management can be generally divided into three phases including watershed planning, plan implementation, and effectiveness assessment (evaluation). **Figure 21** illustrates the relationship between the three phases of watershed management.

Figure 21. Watershed Management Cycle taken from the Genesee County Phase II Middle Flint River Watershed Plan.



Currently the Gilkey Creek Watershed Planning team has completed the steps associated with the program planning phase of the watershed management process including:

1. The identification of pollutants, source areas and causes of non-point source pollution in the watershed
2. The identification of Best Management Practices (BMPs) that need to be implemented to protect water quality
3. The identification of specific desired outcomes related to water quality
4. The identification of evaluation tools

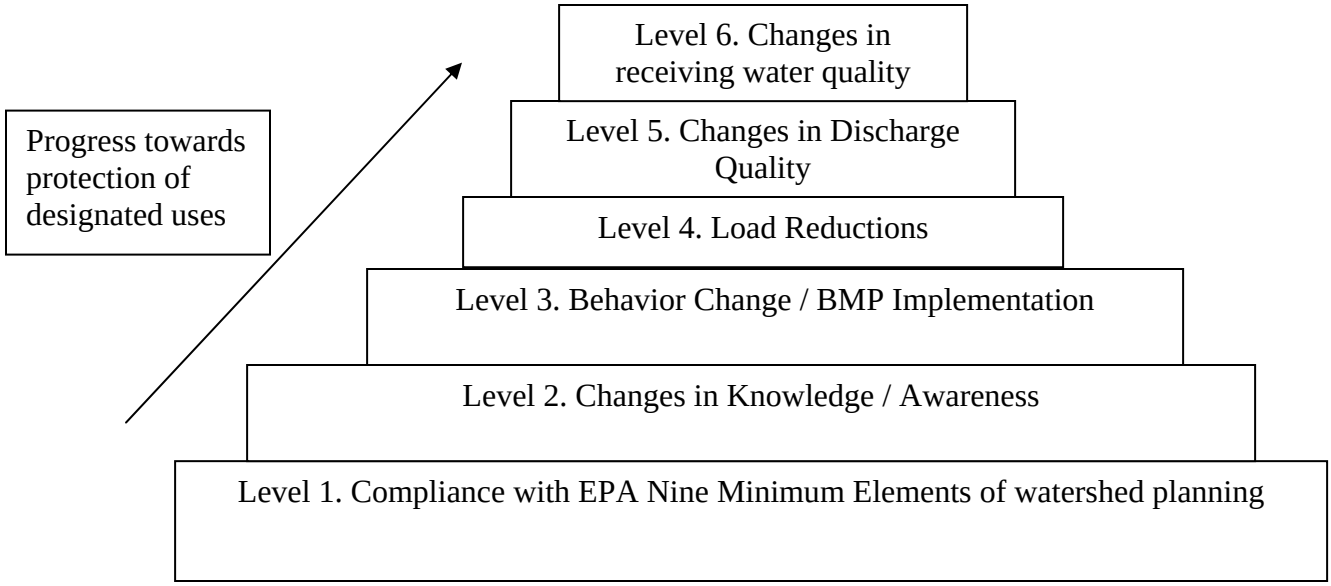
With the Gilkey Creek Planning process complete, the next step in watershed management involves implementing the watershed plan. As the program implementation is started activities will need to begin that provide information to evaluate the watershed plan.

Evaluating the success of the Gilkey Creek Watershed Plan is a complicated task. This section outlines specific tools and methods for evaluating the plan as it is written. The difficulty in assessing program outcomes is primarily a result of the complex interactions between watersheds, land use, water quality and human society. Understanding that watershed management is a cyclic process that is iterative in nature, the primary evaluation question for the program outcome/impact evaluations is: Are advancements towards protecting the designated uses of the Gilkey Creek Watershed being made because of the watershed plan implementation? Answering this primary evaluation question will require a considerable amount of resources by the watershed management team.

Similar to the way that achieving objectives can lead to goal achievement, several sub-questions must be answered to address the broader question above. These additional questions are directly related to what are described as levels of success in the watershed management process. These include:

- Is the watershed plan in compliance with EPA requirements of watershed plans?
- Are changes in knowledge taking place because of the watershed plan?
- Are behavioral changes taking place as a result of the watershed plan?
- Are reductions in the amount of pollution delivered to the stream reduced because of the watershed plan?
- Are changes in the water quality of the Gilkey Creek being achieved because of the watershed plan?

Figure 23: Levels of success necessary to protect the designated uses of the Gilkey Creek Watershed (taken from the Middle Flint River Watershed Plan, Genesee County Drain Office spring, 2004)



Measures of success are critical to assessing the effectiveness of the Gilkey Creek Watershed planning effort. Identification of quantifiable measures provides measurability and accountability throughout the six levels of the program. Because of the hierarchical nature of the protection of water resources standards, data collection and analysis will be developed for each of the levels of success necessary to protect the water quality of the watershed. **In the next section evaluation measures and data gathering methods are detailed for each level of success.**

Level 1: Compliance with EPA nine minimum elements of watershed planning
Evaluation Tool: Review of watershed plan for needed revisions should EPA requirements change.

Compliance with the EPAs minimum standards to watershed planning is a requirement of all watershed plans funded using federal dollars. A description of each element is included in the Appendix. The nine required elements are included in the Findings and Recommendations section of the plan.

Level 2: Changes in Knowledge / Awareness
Evaluation Tool: Survey 2 years and 5 years into implementation

Increasing knowledge and awareness of watershed residents are targeted through the information and education campaign that will be conducted as part of the watershed plan implementation. Measures and data collection for this level of success would likely take place in two ways including a social survey and pre- and post-testing targeted individuals involved in education activities. Due to region wide watershed education efforts, a control group outside of the Gilkey Creek Watershed should be compared to an experimental group within the watershed. The hypothesis would be that those residents who are exposed to both the Gilkey Creek Education plan and other general watershed education would have an increase in knowledge greater than the control group. Focus

also should be on identifying changes in knowledge related to specific issues targeted in the Gilkey Creek Education Plan. The standards for changes in knowledge should be based on statistical significance that will need to be established by a professional evaluator.

Included with this recommendation is an adapted survey from the Phase II Stormwater Watershed Management Plan. This survey, developed by the Office of Research at UM-Flint, was conducted in the spring of 2004 to assist in the development of a Genesee County watershed education campaign.

Additional measures of knowledge change should be conducted on individuals who are specific targets of education efforts, including local elected officials. Data collection methods with these target individuals will include pre- and post-tests at conferences or workshops focused on specific water quality issues in the Gilkey Creek Watershed. Surveys funded by the Michigan DEQ have to go through Quality Assurance Program Protocol (QAPP) review and approval.

Level 3: Behavior changes / BMP Implementation

Evaluation Tool: Tracking of BMP implementation with and without funding incentive.

The intended outcome of this level of success is a change in behaviors as a result of changes in knowledge. Similar to Level 2, changes in behavior across a population will be relatively difficult to monitor because of the other ongoing education campaigns in the area. As a result, behavior change should be monitored through action change (Levels 5 and 6), e.g. water quality is improving. Improved water quality is a result in part of changing behaviors. Therefore, activities performed must be documented to demonstrate successful implementation.

Targeted samples of changes in behavior also can be incorporated into the assessment of changes in behavior and BMP installation. This portion of the evaluation design should focus on identifying and tracking individuals who are known to be involved in the planning process and instrumental in implementing BMPs. Data about the implementation of BMP can be gathered simply through tracking the number of BMPs installed as a result of the plan's implementation. Data gathering should be done by project implementers with specific individuals as behavior changes and BMP installations are identified. An example of this may include documenting the adoption of a particular policy by a local planning commission after an educational seminar (managerial BMP) or by mapping the location of structural and vegetative BMPs. Standards for evaluating the success of these efforts are based on the specific measurable objectives outlined in the plan including the number of sites identified for BMPs or the number of policy changes recommended.

Level 4: Reduction in pollutant loadings to the Gilkey Creek

Evaluation Tool: Reduction of pollutant loading estimates because of reduced pollutants, sources and causes.

A pollutant loading is a qualitative amount of pollution that is being deposited in a river. Pollutant loads are based on an amount of pollutant that enters a stream in a given unit of time. An example could include a statement such as 500 pounds of nitrogen enter the stream per day from a specific site. Pollutant loads can be calculated based on the

ability of an installed BMP to reduce the targeted pollutant. Loadings are best used at specific sites where detailed data about the reduction of pollutants can be gathered. Pollutant load reductions should be calculated for each installed BMP. Standards for pollutant loads are generally calculated on a cost-effectiveness basis. These are expressed in terms of the dollars spent to reduce a particular unit of pollution. MDEQ has specific standards established for BMPs and pollutants.

Level 5 and 6: Changes in water quality
Evaluation Tools: Benthic monitoring, habitat surveys, stream profiling

The evaluation of achievements in Levels 5 and 6 include activities that directly measure the water quality the Gilkey Creek and the Flint River. The monitoring of water quality in these systems is an extremely complex task that involves gathering data from a number of sources. Periodic assessments of the water quality of the Gilkey Creek and Flint River are conducted as part of several federal, state and local water quality monitoring programs. These programs use both randomized and purposeful sampling based on recommendations from local water quality experts. The data gathered from these sampling procedures are compared to the State of Michigan Water Quality Standards. This complex set of standards is based on both quantitative and some qualitative standards. Data analysis is conducted and published by experts at MDEQ and USEPA. The Flint River Watershed Coalition has intermittently monitored two sites in the Gilkey Creek over the last 10 years, and will be utilized for the evaluation of this plan. Combining data gathered under these programs, with periodic water quality assessments conducted as part of the watershed planning, will provide the best picture of existing water quality in the watersheds.

Evaluation Tools

Level 1: Compliance with EPA nine minimum elements of watershed planning
Evaluation Tool: Review and update of watershed plan for needed revisions should EPA requirements change.

Compliance with the EPAs minimum standards to watershed planning is a requirement of all watershed plans funded using federal dollars. A description of each element is included in the Appendix. The nine required elements are included in the Findings and Recommendations section of the plan.

Level 2: Changes in Knowledge / Awareness
Evaluation Tool: Survey 2 years and 5 years into implementation
Adapt survey conducted for Phase II Stormwater in Genesee County that targets audiences identified in the Education section of the plan (see Appendix).

Level 3: Behavior changes / BMP Implementation
Evaluation Tool: Tracking of BMP implementation with and without funding incentive. Database to be available on website

Level 4: Reduction in pollutant loadings to the Gilkey Creek
Evaluation Tool: Reduction of pollutant loading estimates because of reduced pollutants, sources and causes.

Recalculate pollutant loading estimates based on reduced pollutant sources.

Level 5 and 6: Changes in water quality
Evaluation Tools: Benthic monitoring, habitat surveys, stream profiling.

Benthic Monitoring – consistent and improved quality of biannual monitoring of two sites along Gilkey Creek by the Flint River Watershed Coalition(FRWC) continued monitoring of sites by the MDNR every 5 years.

Habitat Surveys – conducted as part of benthic monitoring, expand habitat surveys to focus on natural areas identified in the Landscape Preservation Plan. Potential surveyors are the FRWC, students from the University of Michigan – Flint, Mott Community College, and public schools.

Stream Profiling – Train local stakeholders how to create and use stream profiles as a tool to measure flow variability and indicate watershed health. University of Michigan – Flint students may create stream profiles to establish a baseline as part of the GEO 303, surveying class in Fall 2007. Additional training is available through Huron River Watershed Council and the American Fisheries Society.

APPENDIX

Sources	78
Glossary	80
USEPA Nine Minimum Elements of Watershed Planning	82
State of Michigan Rule 57 Water Quality Standards	83
Public Survey Results	84
Pollutant Loading Calculations	88
Field Inventory Notes	97

SOURCES

Carlson, Hohloch, Mitchell & Piotrowski, Inc. Drainage Study Gilkey Creek Hydrology Phase I, August 1976.

Carlson, Hohloch, Mitchell & Piotrowski, Inc. Gilkey Creek Basin Drainage Study Phase II Hydraulics & Proposed Improvements, August 1976.

Federal Emergency Management Agency. Flood Insurance Study for the City of Flint, July, 1980.

Forman, R., and Wilson, E. *Land Mosaics: The Ecology of Landscapes and Regions*, Cambridge University Press, U. K., 1995.

Frere, M.H., Ross, J.D., and Lane, L.J. (1980). The Nutrient Submodel. In: *Knisel, W.G. (ed.)1980. CREAMS: A Field Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems*, USDA, Cons. Research Report No. 26, pp. 65-86.

Genesee County Drain Commission (GCDC), Middle Flint River Watershed Stormwater Management Plan, March 1, 2005.

Gould Engineering, Inc. Report to the Genesee County Drain Commissioner Regarding the Flooding along the Gilkey Creek Drain in the City of Burton, Sections 10, 11, 14, 15, February 1982.

"History of Genesee County, MI" Published by Philadelphia, Everts and Abbott, 1879. Reproduced Unigraphic, Inc., Evansville, Indiana, 1976.

Hubbell, Roth & Clark, Inc Facility Plan for the City of Flint, Michigan, March 1976.

Johnson, Johnson & Roy, Inc. Gilkey Creek Flooding Conference Report, April 1982.

Leonardi, J.M. and W.J. Gruhn. Flint River Assessment. Michigan Department of Natural Resources, Fisheries Division, Special Report.27, Ann Arbor, Michigan. 2001.

Leonardi, J. M. Flint River fish community assessment, a collection of individual fisheries assessments of the Flint River and selected tributaries. Michigan Department of Natural Resources, Fisheries Division, Ann Arbor, Michigan. 1997.

McNamee, Porter and Seeley Consulting Engineers. Mott Applewood Estate Hydraulic Analysis, January 1983.

Michigan DEQ, Pollutant Controlled Calculation and Documentation for 319 Watersheds Manual, 1999.

Michigan Department of Natural Resources (MDNR) Gilkey Creek, Land and Water Management Division.

Norton, Richard and Christina Kelly. Smart Growth Audit results for local units of government in Genesee County, Michigan from May, 2004 - September, 2004. Unpublished research completed under the direction of Prof. Richard Norton at the University of Michigan, Department of Urban and Regional Planning, Ann Arbor, MI.

Northern Virginia Planning District Commission (NVPDC), Nonstructural Urban BMP Handbook: A Guide to Nonpoint Source Pollution Prevention and Control through Nonstructural Measures, December 1996.

"Park Board History & 22nd Annual Report, City of Flint, Michigan," 1929.

Rossi, P., Lipsey, M., Freeman, H. *Evaluation: A Systematic Approach* (Seventh Edition). Thousand Oaks, California: Sage Publications, 2004.

Rowe Incorporated, Flint, MI Preliminary Floodplain Study Report for The Applewood Estate, Flint, Michigan, Project Number 04C0352, October, 2004.

The City Plan of Flint, Michigan. Published by The City Planning Board 1920.

The Flint Journal, March 27-30, 1916; April 6-9, 1929.

"The Flint Journal Picture History of Flint" Edited by Lawrence R. Gustin, Published by The Flint Journal 1976.

Tomblinson Harburn Associates (THA), Flint, MI. Gilkey Creek Improvement, year unknown.

University of Michigan, Department of Urban and Regional Planning 2005. *New Directions for Vehicle City: A Framework for Brownfield Reuse*, Ann Arbor.

Glossary

Bankfull: Rain or flood event when stream level rises to edge of stream bank

Brownfield: A vacant or abandoned property that may be contaminated

CAER: Center for Applied Environmental Research, a unit of University Outreach at the University of Michigan - Flint

Center for Watershed Protection: Founded in 1992, the Center for Watershed Protection is a non-profit 501(c)3 corporation that provides local governments, activists, and watershed organizations around the country with the technical tools for protecting some of the nation's most precious natural resources: our streams, lakes and rivers. More information is available at the center's website www.cwp.org

Channelized: Process of artificially straightening and deepening of a stream channel for flood control

Designated Use: Use that all waters of the state should be capable of (i.e. swimming, navigation)

Desired Use: Use that stakeholders of a watershed would like creek to be used for (i.e. tourism, education)

Genesee County Drain Commission (GCDC): County agency responsible for flood control and maintenance of county drains

GLEAS procedure 51: Great Lakes and Environmental Assessment Section, a methodology developed by the Surface Water Quality division of the Michigan Department of Environmental Quality; systematically measures the impacts from non-point source pollution on living creatures.

GLS Greenlinks: A conservation planning effort in Genesee, Lapeer, and Shiawassee counties that recommends protection of key natural and cultural assets

Green Roof: A roof that is partially or completely covered with plants; useful in retaining stormwater on-site

Gully: Ditch formed from running water

Headwaters: Upper reaches of a stream; beginning of a stream

Hydric: Requires or associated with water

Kjeldahl nitrogen: Organic nitrogen (N) and ammonia (NH_3)

MDEQ: Michigan Department of Environmental Quality

Moraine: A hill or ridge of rocks, soil and debris deposited by a glacier during the melting process

Outwash Plain: A flat to gently sloping plain deposited from glacial meltwater

Restoration: Attempt to restore natural system to pre-development conditions

Riffle Pool Sequence: Pattern in stream of deep pools and riffles (shallow areas), occur in unaltered streams

Riparian Lands: Area adjacent to water, associated with specific types of plants and floodplains

Stakeholder: Individual or group concerned with the success of a plan or issue

Strahler's Stream Ordering: 200 meters (656 ft) for 1^{st} order streams, and 100 meters (328 ft) for 2^{nd} – 4^{th} order streams

Stream Order: A method of numbering streams as part of a drainage basin network. The smallest unbranched mapped tributary is called first order; the stream receiving the tributary is called second order, and so on. It is usually necessary to specify the scale of the map used

Substrate: Surface on which plant or animal grows

Till: Poorly sorted, nonstratified sediment carried or deposited by a glacier

Urban: Area that is developed; commercial, industrial, and residential land uses

Watershed: All the land that drains to a particular water body

Watershed Management Plan: The product that addresses the water quality concerns of a watershed in an integrated, cost-effective manner.

United States Environmental Protection Agency (USEPA)
Nine Minimum Elements of Watershed Planning

1. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed based plan (and to achieve any other watershed goals identified in the watershed based plan.

2. An estimate of the load reductions expected for the management measures described in element 3 below.

3. A description of the NPS management measures that will need to be implemented to achieve the load reductions estimated in element 2 above, and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

4. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or sources and authorities that will be relied upon, to implement this plan.

5. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.

6. A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

7. A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed based plan needs to be revised.

9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item 8 immediately above.

State of Michigan Part 4 Water Quality Standards

The following section was developed by CAER staff and watershed stakeholders. Brad Hill, from the City of Flint Water Pollution Control Division, condensed information on Michigan water quality standards for the Gilkey Creek for use in reducing pollutants. Stakeholders interpretated water quality standards for the Gilkey Creek and are as follows:

Physical Characteristics

The waters of Gilkey Creek shall not have unnatural turbidity, color, oil films, floating solids, films, foam, settleable solids, suspended solids, or deposits in injurious quantities to a designated use.

Dissolved Solids

The waters of Gilkey Creek shall have a monthly average total dissolved solids concentration of not more than 500 mg/L and not more than 750 mg/L at any time as a result of controllable point sources.

Hydrogen Ions

The waters of Gilkey Creek shall have a pH of not less than 6.5 and not more than 9.0.

Toxic Substances **(Rule 57)**

The waters of Gilkey Creek shall not have toxic substances in amounts that are or may become injurious to public health, safety or welfare or to plant and animal life.

Plant Nutrients

Plant nutrient concentrations shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the waters of the state.

Bacteria – Partial and Total Body Contact

For Partial Body Contact, the waters of Gilkey Creek shall have not more than 1000 E. coli bacteria per 100 milliliters of water. For Total Body Contact, the waters of Gilkey Creek shall have not more than 130 E. coli bacteria per 100 milliliters of water, as a 30-day average and 300 E. coli per 100 ml water at any time.

Dissolved Oxygen

The daily average dissolved oxygen concentration shall equal or exceed 5 mg/L, and the minimum dissolved oxygen concentration shall equal or exceed 4 mg/L at all times.

Temperature

Gilkey Creek shall not receive a heat load that would warm the water (at the edge of the mixing zone) to temperatures greater than the following...

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
41	40	50	63	76	84	85	85	79	68	55	43

Public Survey Results

College Cultural Neighborhood Association
January 24, 2006 Meeting

5 minute presentation on status of Gilkey Creek Project and upcoming stakeholder meeting to be held February 23rd, 2006 at Applewood Estate.

Resident Survey Results

13 respondents

1. What is your favorite place along the Gilkey Creek?
a small landing right off of Burroughs Park that is somewhat secluded
no favorite in particular
pierce park, Burroughs park
the corner of Kensington and Brookside - all along Brookside - I like the whole creek
around pierce park
pierce park
bridge at court sty
Burroughs park
along pierce park

2. Whose responsibility is it to clean out the storm drains? The creek?
not sure, city of flint utilities dept
probably no one, which means anyone willing to
? But I check the ones on my block of 2020 Glendale
Genesee County for both
the cities I think, but neighbors can help
Not sure, persons who live near the drain. Neighborhood and/or city if large stuff
city of flint, drain commission
city of flint, citizens (voluntary)
The city?
Genesee county, drain commission
neighborhood
City?

3. Would you adopt a storm drain (volunteer to sweep leaves, etc off)? Yes / No
10 Yes, 2 No, 1 no response

4. Would you participate in a clean-up of the Gilkey Creek? Yes / No
13 Yes

5. Do you have any concerns/questions about the water quality of the Gilkey Creek?
some, but I know it has improved over the years
nothing specific

What is the current eco status of the creek?
wouldn't it be great if it were cleaner
yes, sometimes it smells
Is it safe?
Is it polluted? are species present (fish, turtles, frogs, etc)
not expressly, I hope the water is clean
yes
no
no

6. Should your neighborhood association be involved in the watershed planning process? Why or Why not?

yes, the creek is in the heart of our neighborhood
I would need to know more to answer this
yes
I don't know enough about it
yes, so we don't do bad things
yes, take ownership of creek, maintain it
I am not certain what the watershed planning process is
yes, goes through heart of neighborhood
yes, it is our neighborhood
I don't know, should we?
only with good leadership

7. Why didn't you attend the public meeting for the Gilkey Creek Watershed Management Plan in September?

9 didn't know about it
Missed it, busy, had to prioritize and couldn't do it

Questions Asked

What is the *relative* water quality in the Gilkey creek?
Comment – thank you for doing this, 'they've' been dumping stuff in that creek since I was a little kid and now we see frogs there and ducks.

Fairfield Village Neighborhood Council
February 4th, 2006

10 minute presentation on what a watershed is, what the Gilkey Creek project is, and upcoming stakeholder meeting on February 23rd, 2006 at Applewood Estate.

Resident Survey Results
5 respondents

1. What is your favorite place along the Gilkey Creek?
When in college I used to attend keggers in Burroughs Park, I have some good memories!
don't have one
along Burroughs Park and the FVNC nbrhd
Fairfield Neighborhood Assoc. area - Lapeer Rd Avon/Park

2. Whose responsibility is it to clean out the storm drains? The creek?
individuals-to the greatest extent public, then the city
county
city of Flint and DEQ
the city
Flint community, our neighborhood

3. Would you adopt a storm drain (volunteer to sweep leaves, etc off)? Yes / No
2 yes, 2 no

4. Would you participate in a clean-up of the Gilkey Creek? Yes / No
4 yes, 1 no (unable)

5. Do you have any concerns/questions about the water quality of the Gilkey Creek?
Yup! It's damn near dead
none
yes, lawn clippings being dumped in creek
yes
no

6. Should your neighborhood association be involved in the watershed planning process? Why or Why not?
Yes
yes, because it borders our neighborhood on the east
of course
yes, because this is part of our mission statement

7. Why didn't you attend the public meeting for the Gilkey Creek Watershed Management Plan in September?
But I did!

didn’t know about it
wasn't aware of it
conflict with scheduling
didn’t know about it

Questions Asked

Comment – stench by Woodlawn Park
Is there penalties for dumping?
Comment – Kurtz Cement dumps cement water into creek
Where does Gilkey start?
Does people dumping affect us?
Who do I call to report dumping?
Is there a fine/law for dumping?

Pollutant Loading Calculations

Gully Erosion Sites

Site #	Gully Type	Soil Type	Soil Texture Cass	Dry Density (Tons/ Cubic Ft)	Top Width (ft)	Bottom Width	Depth	Length	Number of Years (3 years assumed)	(Top + Bottom /2)	Total Numerator	Reduction
0	Gully2	M	silt loam	0.0425	3	2	3	10	3	2.5	3.1875	1.0625
1	Gully1	M	silt loam	0.0425	2	1	2	5	2	1.5	0.6375	0.31875
2	Gully1	M	silt loam	0.0425	2	1	2	5	2	1.5	0.6375	0.31875
3	Gully2	Bw	loam	0.045	3	2	3	10	3	2.5	3.375	1.125
4	Gully2	Bt	sandy loam	0.0525	3	2	3	10	3	2.5	3.9375	1.3125
5	Gully2	Bt	sandy loam	0.0525	3	2	3	10	3	2.5	3.9375	1.3125
6	Gully2	CwB	sandy loam	0.0525	3	2	3	10	3	2.5	3.9375	1.3125
7	Gully2	CwB	sandy loam	0.0525	3	2	3	10	3	2.5	3.9375	1.3125
8	Gully2	Bw	loam	0.045	3	2	3	10	3	2.5	3.375	1.125
9	Gully2	CvA	loam	0.045	3	2	3	10	3	2.5	3.375	1.125
10	Gully1	Bw	loam	0.045	2	1	2	5	2	1.5	0.675	0.3375
11	Gully1	Bw	loam	0.045	2	1	2	5	2	1.5	0.675	0.3375
											Total	**11**

Overfall Erosion Sites

Site #	Erosion Cause	Soil Type	Soil Texture	Dry Density	Radius of Pool	Depth of pool	Cubic Ft	Numerator	Estimated age	Sediment Load
0	Outfall	M	silt loam	0.0425	3	3	84.78	3.60315	3	1.20105
1	Outfall	Bw	loam	0.045	3	4	113.04	5.0868	3	1.6956
2	Outfall	M	silt loam	0.0425	4	3	84.78	3.60315	3	1.20105
3	Overfalling Culvert	Bw	loam	0.045	3	5	141.3	6.3585	3	2.1195
4	Overfalling Culvert	M	silt loam	0.0425	6	5	141.3	6.00525	3	2.00175
5	Overfalling Culvert	M	silt loam	0.0425	3	3	84.78	3.60315	3	1.20105
									Total	**9.42**

Stream Bank Erosion Loadings

Location	Soil Type	Soil Texture Class	Dry Density Weight	Length (ft)	Height	Lateral Recession Rate	Sediment Load (tons/year)
Vassar and Maple to Lippincott	Bw	loam	0.045	237.6	2	0.03	0.64152
Vassar and Maple to Lippincott	Bt	Sandy loam	0.0525	277.2	5	0.4	29.106
Lippincott to North Branch	Bw	loam	0.045	237.6	2	0.03	0.64152
North Branch to Dort Hwy	Cp	silt loam	0.0425	224.4	3	0.1	2.8611
Dort Hwy to Robinson Drain	Cp	silt loam	0.0425	224.4	5	0.4	19.074
Robinson Drain to Flint River	Cp	silt loam	0.0425	224.4	2	0.1	1.9074
North Branch Robinson Drain - Lippincott to Main Branch	CvA	loam	0.045	237.6	1	0.03	0.32076
	Bw	loam	0.045	237.6	2	0.1	2.1384
						Total	**56.6907**

Nutrient Loading Reduction

Nutrient Load Reductions	Sediment Reduced (Tons)	Nutrient Concentration	Correction Factor	Nutrient Reduction (lb/year)
Phosphrous Reductions	77	0.0005	1	**77**
Nitrogen Reductions	77	0.001	1	**154**