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A partnership between The Washtenaw County Drain Commissioner, The City of Ann Arbor, and Pittsfield Township.

EXECUTIVE SUMMARY

Introduction to Malletts Creek

Malletts Creek is located in eastern Washtenaw County, primarily in the City of Ann Arbor and Pittsfield Township. The Malletts Creek watershed is 11-square miles in area and flows into the Huron River. Most of the creek is a Washtenaw County drain, which means the Drain Commissioner is responsible for maintaining these portions of the drainage course. In the last 40 years, the watershed has seen extensive development, including shopping malls, new subdivisions, apartment complexes, homes, parking lots, businesses, stores, churches, and industrial buildings.

Because much of the land is heavily developed (37% of the land is covered with impervious surfaces), Malletts Creek is considered an urban watershed.

Background of Malletts Creek Restoration Project

Malletts Creek is a Chapter 20 County Drain and natural stream that is in need of maintenance and improvement. The Washtenaw County Drain Commissioner, City of Ann Arbor, and Pittsfield Township, have recognized structural, water quality and flow capacity problems, and wish to restore Malletts

Creek. In addition, the Michigan Department of Environmental Quality (MDEQ) has mandated a 50% phosphorus reduction to protect the Huron River and downstream impoundments and has specified the need to improve the creek's habitat (fisheries) value.

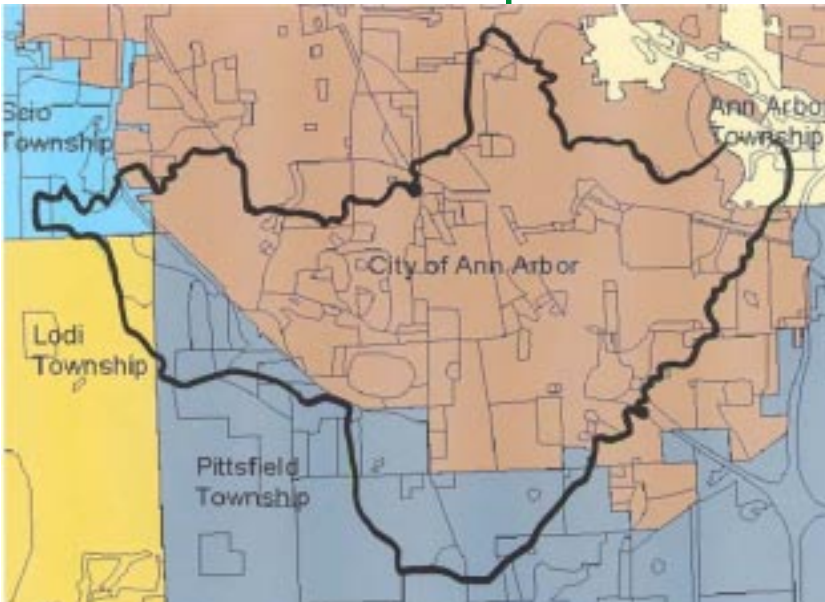
In order to begin the process of restoration and repair of Malletts Creek, the project sponsors contracted with a consultant team to undertake a comprehensive assessment of the Creek and to develop an overall plan to guide the restoration work.

The consultant team worked closely with staff from the office of the Washtenaw County Drain Commissioner, the City of Ann Arbor and Pittsfield Township, to study Malletts Creek, identify the underlying problems and provide an innovative, long-range, staged, practical, cost-effective approach to solving these problems. The

final plan was required to reflect community input, have significant public support, and the approval of the City of Ann Arbor and Pittsfield Township.

Restoration Team

In January of 1999, the consultant team of Environmental Consulting & Technology, Inc. (ECT), Applied Science, Inc. (ASI) and Tilton & Associates, Inc. (TAI) was chosen to study the problems in Malletts Creek and prepare a restoration plan.



Area location



Research Park



Key Problems

Several key problems were identified in previous work performed by the Office of the Drain Commissioner, the City of Ann Arbor, Pittsfield Township, the Michigan Department of Environmental Quality, the Huron River Watershed Council and the Malletts Creek Association. These included:

Water quantity problems:

- Increased peak quantity and peak velocity in the creek
- Channel and bank erosion resulting from high velocities
- Isolated flooding associated with increased flow and culvert restrictions

Major water quality problems:

- High phosphorus
- Erosion and sedimentation
- Increased water temperature

Structural Problems

- Repairs to headwalls/endwalls
- Repairs to bridge abutments

Diminished habitat:

- Lack of bank vegetation
- Degraded stream beds
- Frequent and severe peak flows

Consequences of the Problems

As a consequence of the urbanization and the resulting flashy flow characteristic of the creek, the view of the creek as a community amenity was diminished. The resulting sediment and associated phosphorus loads from Malletts Creek degrading the downstream impoundments, leading the Michigan Department of Environmental Quality (MDEQ) to require a 50% reduction in the phosphorus loading. In addition, the MDEQ recognized that the Malletts Creek fish and wildlife habitat had been severely impacted. This, coupled with isolated flooding issues, caused the local units of government to initiate this comprehensive restoration project.

Goals of the Restoration Project

The project team analyzed the creek and its watershed, with the goal of developing plans and implementation activities to achieve the following:

- Address structural repairs as needed
- Reduce phosphorus pollution by 50%
- Increase habitat for fish and wildlife
- Control stream velocities and flow rates
- Establish an educated and involved public

Throughout the project, the team aggressively sought and obtained input, advice and preferences of the public, to learn about its perception of problems and acceptable strategies for restoration.



Severe bank erosion at Chalmers Road



Use a safe lawn fertilizer



Detention Pond by I-94

Data Collection Activities

The team began to study the watershed by collecting existing data on water quality, quantity, and benthic populations. To supplement the existing data, new water quality testing, and a benthic study were conducted. The team performed a limited detention pond inventory, surveyed cross sections, and performed a physical survey by walking the stream and reporting on the vegetation and habitat as well as needed structural repairs.

Best Management Practices (BMPs)

Previous studies of the watershed indicated that sources of its problems are largely “non-point” sources of pollution. Best Management Practices (BMPs) are methods to prevent or mitigate such pollution. Categories of BMPs that were reviewed included management methods, treatment methods, and source controls. BMPs were evaluated by the project team and at public meetings.

Three categories of BMP’s were identified and evaluated:

Source controls, such as changing lawn fertilization and landscape practices, are proactive, keeping water runoff clean and using it as a resource. These measures can save money and are particularly useful in residential areas but they need to happen throughout the watershed and require public education and buy-in by the public.

Treatment methods, such as detention ponds, are reactive, cleaning up and slowing down polluted storm water runoff from developed lands. Since they require initial capital investment and long term maintenance, treatment methods can be implemented by government alone, or in partnership with private land owners. Existing ponds can be retrofitted to improve quantity and quality performance

Management methods include revising local ordinances to reduce runoff and improve storm water management and protecting key flood-prone land.

Modeling Study

A detailed computer modeling study was performed. This study enabled the team to predict flow rates and flood elevations as well as phosphorus levels in the creek. Simulation of future land use assumed full development of the watershed. Because future development projects will be required to adhere to modern ordinances, the differences are minimal between the existing conditions and the model predictions for future land use. The modeling study components are described below:

Hydraulic Study

- Installed and collected data from a USGS flow gage at Chalmers Road and a rain gage at the U.S. Army Reserve Base on Industrial Highway
- Input data into the EPA Storm Water Management (SWMM) model
- Identified areas of potential flooding and suggested solutions

Phosphorus Study

- Reviewed existing water quality data
- Collected water samples at six locations across the watershed during the year
- Input this data into a phosphorus loading model
- Predicted likely sources of high phosphorus loading by subwatershed, and identified anomalies suggesting unknown sources of phosphorus, such as illicit discharges



Malletts Creek Subwatersheds

Hydraulic and Hydrologic Analysis Results

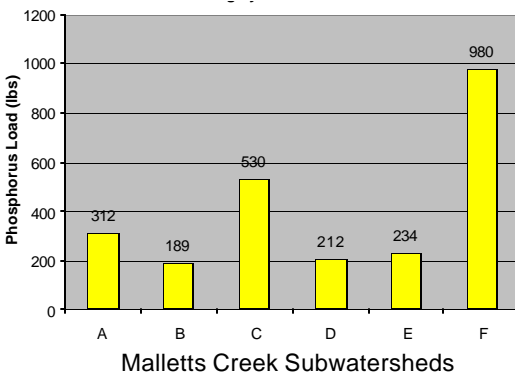
This portion of the modeling study showed that Malletts Creek is experiencing extreme peak flows, most likely attributable to the fact that 22% of the land area in the watershed is impervious surface directly connected to the storm water system and creek. Half of the flow of Malletts Creek is from the Burns Park residential neighborhood (shown as area “C” on the map displayed to the left), which represents 20% of the watershed.

Analysis of the 10-year storm and the 100-year storm showed 5 specific points of concern along Malletts Creek resulting from changes in hydrology, or improperly sited,

designed or constructed buildings or private storm water management facilities:

- Eisenhower Office Park (100-year storm)
- Eisenhower Parkway west of State St. (100-year storm)
- Oakbrook Drive east of Main St. (10-year storm)
- Lansdowne residential area (10-year storm)
- Cranbrook Tower area upstream of Briarwood ponds (100-year storm)

Existing Phosphorus Loading by Subwatershed



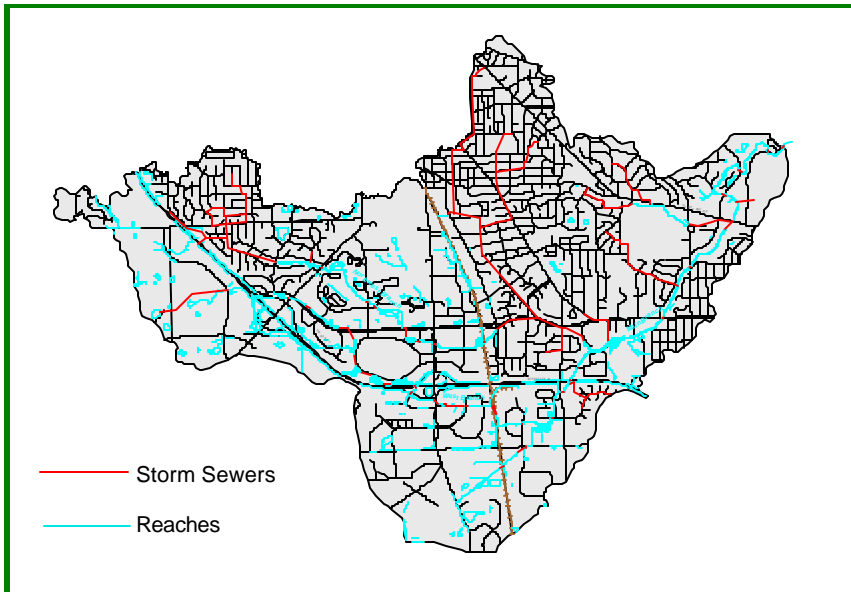
Phosphorus Analysis Results

From the water quality data, it was determined that the majority of the phosphorus pollution washes off of the land, entering the Creek in rainstorms.

The team divided the watershed into 6 subwatersheds for a detailed analysis, and the phosphorus model enabled the team to distribute the contribution of phosphorus among the 6 different subwatersheds.

The phosphorus contribution varied between the subwatersheds which is a significant finding and means that different management activities are appropriate in the subwatersheds. Creative source controls need to be implemented, and treatment methods or detention areas need to be constructed where possible.

To reduce the total phosphorus in the creek by 50% the following activities are recommended:



- Modify existing detention basins to detain and treat smaller storms
- Add 5 in-system storage structures to 3 storm drains (County Farm, Lansdowne and Burns Park areas)
- Promote landowner participation in creek-safe lawn maintenance (target 25% participation)
- Increase street sweeping in residential and commercial areas
- Renovate Brown Park pond, which is owned by the Malletts Creek Drainage District
- Create a new wetland pond at County Farm Park

If these recommendations are implemented, the MDEQ requirements will be fulfilled for the Malletts Creek Watershed.

Malletts Creek hydrology

Habitat Analysis Results

Malletts Creek is under an MDEQ mandate to improve habitat quality. Excessive water velocities are undermining fisheries and species habitat. The following are recommendations from the habitat analysis.

- Increase detention in the watershed to reduce peak velocities
- Remove logjams and sediment islands
- Create meandering low flow channels between pools
- Stabilize stream bank with plantings to provide food and cover for wildlife
- Protect and create riparian wetland areas

The team completed a thorough reconnaissance of Malletts Creek and identified locations where structures and streambanks were in need of repair. Structures such as culverts and headwalls were in some cases found to be deteriorated and will need to be repaired or replaced. Structural streambank stabilization approaches such as rip rap may be needed where vegetative methods are not feasible.

Public Involvement

To be effective, the restoration planning and implementation process must continue to include all the groups that live and work in the watershed. One of the project goals was to establish an educated and involved public. To accomplish this, the team identified a list of stakeholder groups, including elected and appointed officials, environmental groups, public and private schools, business associations, homeowners associations, commercial, residential and riparian landowners and lawn care companies.

Several mechanisms were used to reach and involve these stakeholders. These included a web page, four community-wide meetings, interacting with the Malletts Creek Association (a citizen based creek protection group), conducting focus groups and telephone surveys.

The restoration activities included in this report come from the community as well as the staff of the Washtenaw County Drain Commissioner's Office, City



Malletts Creek at Highland Drive



of Ann Arbor, Pittsfield Township, and the consultant team. The full range of problems in Malletts Creek can only be addressed by including actions that involve the people who live, work and visit the watershed; government alone cannot achieve full success.

Key Findings that Direct Restoration Activities

The study's findings, consisting of direct observation, sampling and analysis, modeling and community involvement, have directed the team to recommend a restoration strategy. The key findings are as follows:

- Peak discharge and velocity exceed acceptable levels
- 97% of the phosphorus pollution occurs from storm water runoff, not dry weather flow
- The urbanized areas, such as most of subwatersheds C and F that are built without detention ponds, contribute more to the Creek's high peak flows velocity and phosphorus problems than others
- With control of discharge and velocity, habitat can be improved

Recommended Restoration Activities

Based on the key findings, the team and stakeholders formulated activities and strategies to accomplish the reduction in peak flows and velocities, reduction in phosphorus concentration and improvement in fish and wildlife habitat.

Treatment Controls

- Institute both public and private solutions for flood concerns
- Retrofit detention basins
- Add in-system storage structures on large storm drains
- Renovate Brown Park pond
- Create wetland pond at County Farm Park
- Create new wetland ponds and extended detention basins
- Install catch basin restrictors

Structural Repairs

- Repair failed endwalls and outlet structures
- Repair broken culverts
- Repair cracked headwalls
- Remove large sediment islands
- Stabilize sections of the streambank

Source Control Activities

- Reduce lawn fertilizer use, increase native landscaping
- Implement related public education and technical assistance program
- Conduct illicit discharge elimination program
- Provide extra resources to strengthen soil erosion and sedimentation control enforcement
- Increase street sweeping
- Revise local government ordinances to reduce runoff and improve storm water management
- Modify residents yard waste and leaf handling practices



Habitat Restoration

- Remove logjams
- Remove sediment islands
- Restore streambank corridor and stabilize erosion
- Make in-stream improvements, the addition of low flow channels, ponds and riffle pools.

The Malletts Creek Restoration Plan also recommends ongoing periodic monitoring to measure program success.

Restoration Plan Activities and Costs

The recommended restoration activities are presented on Table 1. The activities are described and have been given project numbers for tracking of costs and scheduling during a restoration plan period of 6 years. It is further recommended that some activities continue to occur after the 6 year restoration period. These activities are given on Table 2 as on-going activities. The estimated cost of the on-going activities also is given on Table 2.

On Table 3, the costs of the restoration are summarized by year, for the 6 year restoration plan is about \$19 million, with about \$11.5 million in capital costs for: the construction of a new wetland pond in County Farm Park; improvements of the wetland in Brown Park; streambank stabilization; structural repairs to headwalls, endwalls, bridge abutments, detention pond modifications and construction of in-system storage structures in large storm drains. The remainder of the costs are for finance costs, operation and maintenance (O&M) costs, and public involvement programs.

The current apportionment for drain improvement projects requested by petition to the Drain Commissioner is given on Table 4.

Beneficial Impacts of Restoration Activities

The recommendations of this restoration plan will:

- Reduce peak discharge
- Reduce flow velocity
- Reduce total phosphorus to the Huron River by 50%
- Provide habitat improvement along 7 miles of the Creek
- Increase aesthetic enjoyment of the Creek
- Control flooding for the ten-year storm along the main channel.

Table 1: Restoration Activity Schedule and Estimated Costs

Restoration Activities		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total Estimated Costs
Project #	SCHEDULE							
1	Illicit Discharge Elimination Program							\$212,700
2	Sampling for Bacteria & Phosphorus							\$27,720
2a	Sampling for Benthics							\$9,900
3	USGS Stream Gage - Continue Operation							\$54,000
4	Enforce Existing Ordinances							\$450,000
5	Ordinance & Code Revisions for Stormwater Quality & Management							\$360,000
6	Stream Maintenance (routine)							\$195,000
7	Public Education Program							\$720,000
8	Design In-System Storage Structures for Large Storm Drain Outlets							\$75,000
9	Remedy 10-yr. Storm Flooding Problem - Design Solution for Oakbrook Drive Crossing							\$10,000
10	Investigate 100-yr. Storm Flooding Problems - Determine Responsibilities							\$20,000
8a	Construction of In-System Storage Structures							\$1,198,214
9a	Remedy 10-yr. Storm Flooding Problems - Start Construction							\$42,600
11	Start Detention Pond Study Throughout The Watershed (Survey & Design 40 ponds/year)							\$696,360
12	Design Structural Repairs to Stream -To be done by petition.							\$150,000
11a	Start Detention Ponds Retrofit - Outlet Structures, Wetlands and Sediment Forebay							\$2,218,250
12a	Structural Repairs to Stream -Start Construction							\$4,837,815
13	Residential Street Sweeping - Phase 1 - Area F							\$10,100
14	Brown Park Pond Improvements - Design							\$250,000
15	County Farm Park Wetlands - Design							\$50,000
13a	Residential Street Sweeping - Phase 2 - Area F & C							\$27,000
14a	Brown Park Pond Improvements - Start Construction							\$2,244,163
15a	County Farm Park - Start Construction							\$263,600
13b	Residential Street Sweeping - Phase 3 - All Areas							\$134,800
14b	Brown Park Pond - Monitoring							\$35,000
15b	County Farm Park Wetland Pond - Monitoring							\$35,000
16	Sweep Commercial Streets on a Monthly Basis							\$68,800
17	Stream Bank Stabilization - Design							\$208,000
18	Habitat Improvements - Design							\$22,000
19	Pilot Project - Catch Basin Restriction							\$1,169,329
20	Catch Basin Cleaning - Clean 2x/year							\$944,300
17a	Stream Bank Stabilization - Implement							\$2,211,311
18a	Habitat Improvements - Implement							\$174,000

\$19,124,962

Table 2: On-going Restoration Activities and Estimated Costs

	Restoration Activities	Estimated Costs/Year
Project #		
2	Sampling for Bacteria & Phosphorus	\$9,360
2a	Sampling for Benthics	\$3,300
3	USGS Stream Gage - Continue Operation	\$9,000
4	Enforce Existing Ordinances	\$75,000
5	Ordinance & Code Revisions for Stormwater Quality & Management	\$60,000
6	Stream Maintenance (routine)	\$32,500
7	Public Education Program	\$120,000
13b	Residential Street Sweeping - Phase 3 - All Area	\$67,400
14b	Brown Park Pond - Monitoring	\$17,500
15b	County Farm Park Wetland Pond - Monitoring	\$17,500
16	Sweep Commercial Streets on a Monthly Basis	\$34,400
20	Catch Basin Cleaning - Clean 2x/year	\$472,150
	TOTAL	\$918,110

**Table 3: Malletts Creek Restoration Plan
Estimated Costs Summary**

	Capital Costs	Finance Costs	O&M Costs	Public Involvement Costs	Total Estimated Costs
Year 1	\$ 105,000	\$0	\$ 323,760	\$ 53,000	\$ 481,760
Year 2	\$ 1,117,600	\$294,814	\$ 324,900	\$ 66,000	\$ 1,803,314
Year 3	\$ 2,206,500	\$698,522	\$ 337,060	\$ 103,000	\$ 3,345,082
Year 4	\$ 3,597,500	\$1,315,285	\$ 269,800	\$ 178,000	\$ 5,360,585
Year 5	\$ 2,729,580	\$963,651	\$ 965,930	\$ 181,000	\$ 4,840,161
Year 6	\$ 1,807,160	\$613,151	\$ 758,750	\$ 115,000	\$ 3,294,061
Totals	\$ 11,563,340	\$3,885,422	\$ 2,980,200	\$ 696,000	\$ 19,124,962

Note: Finance costs are assumed to be 6.5% over 10 years
Finance costs were calculated on capital projects over \$500,000

**Table 4: Malletts Creek Drainage District
Apportionment %**

Ann Arbor City	74.54
Pittsfield Twp.	18.85
State	5.62
Washtenaw County	0.99

INTRODUCTION

Malletts Creek is a Chapter 20 county drain and natural stream located in an area that has experienced substantial development over the past 40 years. Urbanization has caused the water quality of the creek to become degraded. Fast moving water destroys habitat, damages stream banks and causes erosion. Much of the floodplain is no longer available for capturing sediment, slowing flows and providing habitat. Many areas are bare of trees and other vegetation that are needed to provide food, moderate stream temperatures and stabilize the soil. In its current state, Malletts Creek carries a large amount of phosphorus to South Pond and the Huron River. Water quality sampling conducted by the Michigan Department of Environmental Quality (MDEQ) identified Malletts Creek watershed as among the most significant contributor of phosphorus to the Huron River System.

The success of the restoration of Malletts Creek depends on the ability to overcome two major challenges: 1) excessive flows and the resulting erosion and habitat degradation, and 2) pollutants associated with urbanization. A third issue that is also addressed is isolated areas of flooding. These challenges are a direct result of urbanization and the impact of increased impervious surfaces on the hydrology.

The first challenge is to slow the rate of flow during wet weather events. Increases in the amount of impervious area act to deliver runoff very rapidly to the nearest drainage course. There are some ways to decrease the rate and volume of these discharges on a site-by-site basis, but most often these considerations must be instituted at the time of development. This rapid rate of storm water discharge causes channel instability and habitat degradation in several reaches.

The second challenge is to reduce the amount of pollutants carried by the storm water into the river system. In Malletts Creek, the primary pollutant of concern is phosphorus. MDEQ has mandated a 50% phosphorus load reduction to protect the Huron River and downstream impoundments and has specified the need to improve the creek's habitat and fisheries as well. Urban storm water is the major source of phosphorus as well as a number of other pollutants. A secondary source of phosphorus is the streambank erosion resulting from the high discharge velocities. Because phosphorus leads to frequent algal blooms in the downstream Ford and Belleville Lakes, it is the target parameter on which all control programs were evaluated. It should be noted that many of the proposed control measures are based on the capture of suspended solids, therefore, these methods will also capture other pollutants (other nutrients and heavy metals) associated with the solids.

A third issue is to reduce the flooding potential of the Creek during extreme high flow events. This must be done in a way that does not shift the flooding problem further downstream. Some of the flooding problems are caused by the increased flow that resulted from the upstream urbanization. Others are the result of structures being improperly placed in the floodplain, or improperly designed and constructed. The study identifies areas of potential flooding and recommends a means to address the sites.

The control of flow, phosphorus and sediment are key to the success of the restoration effort.

Restoration Challenges

- *Decrease wet weather flow rates*
- *Reduce phosphorus contributions in storm water*
- *Reduce flooding potential*

These major concerns also lead to secondary concerns, such as diminishing groundwater reserves and increased water temperature, factors that also affect habitat and the potential for a healthy fishery.

In addition to the regulatory mandates, the public has demanded that the creek be restored and that the existing impairments be removed. The desire for a clean and healthy Malletts Creek is well documented in earlier studies completed by the Huron River Watershed Council (HRWC) ⁽¹⁾ and the Malletts Creek Association (MCA) ⁽²⁾.

What is the Malletts Creek Restoration Project?

The Washtenaw County Drain Commissioner (WCDC), the City of Ann Arbor and Pittsfield Township have chosen to work together to implement a pragmatic approach to address the many problems facing Malletts Creek. These agencies focused on the Malletts Creek watershed because the public is keenly interested in the resource and because the size of the watershed (11 square miles) allows detailed planning and implementation with a high likelihood of success. As a guide for the implementation process, the Malletts Creek Restoration Plan was commissioned to build upon the earlier work performed by these public agencies as well as the work performed by the HRWC and MCA. The resulting plan addresses water quality issues as well as flooding, habitat, drain maintenance and infrastructure needs. The plan provides the level of detail required for elected officials to evaluate the costs of implementation and the associated benefits and make informed decisions regarding implementation.

Significantly, the recommended actions presented in this plan will fulfill the requirements of the MDEQ and provide the results desired by the general public as verified through a series of public meetings and focus groups.

Potential Funding Opportunities and the Clean Michigan Initiative

The cost of implementation will be borne by a number of public agencies as well as private landowners, developers and businesses. Fortunately, there are sources of grant funding that can ease the financial burden on the community. A summary of the applicable grant or loan programs is provided in Appendix A. The summary for each funding source includes the due date, match requirement, maximum grant amount, duration, type of project, as well as identifying who can apply and appropriate contact information. Many of the most applicable grant programs are administered through the MDEQ Surface Water Quality Division, Nonpoint Source Program. Some of these programs require a "State-approved Watershed Plan." The WCDC and the HRWC have developed a comprehensive management plan for the Middle Huron River Watershed. ⁽³⁾ The Malletts Creek Restoration Plan is an extension of this earlier work.

The authorization of the Clean Michigan Initiative (CMI) provides substantial funding for the implementation of the recommended restoration activities. One of the objectives to be met in completing this report is to assist the communities in obtaining CMI funding. Following the guidance presented in "Developing a Watershed Management Plan for Water Quality, an Introductory Guide."⁽⁴⁾ Table 1 lists the CMI requirements with the corresponding page numbers of the required information in this report.

Clean Michigan Initiative (CMI)

- \$50 Million for nonpoint source pollution control
- \$90 Million for water quality improvement
- \$50 Million for local parks and recreation

**Table 1
Requirements for a State-approved Watershed Plan**

CMI Requirements	Page Reference
Define the process including watershed steering committee, lead organization and technical committee	4
Define the geographic scope of the watershed including: a map showing the watershed boundaries, location of surface waters, and a description of the watershed	6, figure 2
List the designated uses that are not being met, designated uses that are threatened and a list of desired uses for the watershed	9
List the known and suspected pollutants for the watershed	14
Identify the causes for each known and suspected source of pollution	14
List the water quality improvements or protection goals for the watershed based on designated uses	10
Define a critical area that geographically narrows the scope of your project by focusing attention on the parts of the watershed that contribute the greatest pollution to the water body	6
Summarize the methods used to conduct the inventory	12
Prioritize the designated uses, pollutants, sources and causes for the watershed and describe the method used to prioritize them	23, Appendix N
Provide a table showing objectives for each of your watershed goals	39
Provide a table showing the system of BMPs needed for each source or cause of pollution and estimated cost	Appendix N
List the tasks needed to implement the system of BMPs for each source in your watershed and their estimated costs	42, Appendix O
Summarize the local projects, programs and ordinances within the watershed and have tasks, responsible parties, milestones and a timeline for improving or adding to those projects, programs and ordinances	42
Provide an implementation/education strategy and a summary of the public participation process that was used, showing the opportunity for public comment and partners involved in developing the plan	Appendix C
Provide an evaluation process that will be used to evaluate the effectiveness of implementing the plan and achieving its goals	44
Identify tasks needed to institutionalize watershed protection	45

Goals of the Restoration Project

The charge to the team was to analyze the creek and its watershed and to develop plans and implementation activities to achieve the following goals:

- Reduce stream flows and velocities.
- Reduce the phosphorus load from Malletts Creek to the Middle Huron River and improve water quality in the creek to an acceptable level.
- Improve habitat for fish and wildlife.
- Identify needed structural improvements along the creek to limit flooding and reduce phosphorus loads as well as improve the aesthetics of, and habitat in, the creek.
- Establish and educate an involved public.
- Ensure the sustainability of the restoration effort by making any long-term commitments (e.g., maintenance) reasonable and workable; and
- Ensure that the restoration project is affordable for the communities.

In 1996 the HRWC, in partnership with 21 communities in the middle Huron River watershed and the MDEQ, completed the first community-driven total maximum daily load (TMDL) calculation for the middle Huron River in Washtenaw and Wayne counties.⁽⁵⁾ This effort identified the Malletts Creek watershed as a significant source of phosphorus contributing to the degradation of Ford and Belleville Lakes. The project identified a “5-year phased strategy to meet the TMDL targets for the Huron River” with the objective of reducing the current phosphorus loadings by 50% over the next five years. These reductions could come from either point sources or nonpoint sources. Because the cost of further reducing the phosphorus load from point sources alone was extremely high and unlikely to achieve the required loading levels, the WCDC, the City of Ann Arbor and Pittsfield Township chose to initially target the control of nonpoint sources of phosphorus in Malletts Creek.

In addition to excess phosphorus loadings, the habitat of Malletts Creek is substantially degraded as a result of high velocities, excess sediment loadings and streambank erosion. While a TMDL for the habitat concerns has not been completed for Malletts Creek, the creek is currently a listed non-attainment area and was submitted by MDEQ to the USEPA on the 303d list. Submission on this list will require the completion of a TMDL calculation in the future; TMDL development for Malletts was scheduled to begin in 1999.

Besides these environmental concerns, the project team was charged with prioritizing flooding concerns and infrastructure needs.

Decision Making Process

A Technical Advisory Committee (TAC) was formed that included decision-makers who can bring about change in the watershed. The Malletts Creek TAC included the WCDC, City of Ann Arbor personnel from Engineering, Planning, Parks, Building Inspection and Water Utilities, Pittsfield Township representatives, the HRWC and the MCA. The City of Ann Arbor accepted this restoration plan and the management plan submitted by MCA as the basic planning documents for the restoration of Malletts Creek. The Ann Arbor City Council approved resolution R-105-3-00 on March 6, 2000 (found in Appendix B) that requires an action plan for the City and the formation of a watershed

coordination committee. The purpose of this committee will be to assure that implementation efforts are coordinated and provide assessments of on-going data about conditions in the watershed.

Public Involvement

The Malletts Creek watershed has a highly educated and committed group of citizens. Their involvement in watershed planning preceded the restoration project and is expected to continue through the implementation process. The restoration project team augmented the list of stakeholders for the watershed to include the diverse groups required for successful implementation including:

- elected and appointed officials;
- environmental groups;
- public and private schools;
- business associations;
- homeowners associations, and
- lawn care companies.

The team then identified several mechanisms that would be used to involve and reach out to these stakeholders. These mechanisms included:

- an informative web page;
- four community-wide meetings;
- collaboration with the MCA, and
- focus groups with lawn care companies, homeowners, other large land owners and the science curriculum directors of Ann Arbor Public Schools.

In order to gain the understanding and support of some of the larger commercial landowners and real estate management companies, several telephone interviews were also conducted as part of the public involvement process. Summaries of these meetings are provided in Appendix C.

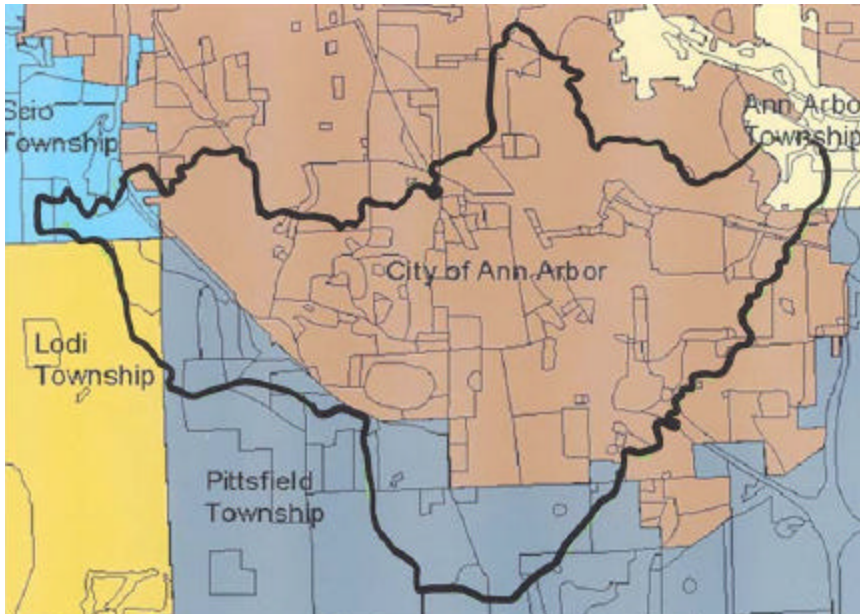


Figure 1: Malletts Creek Watershed

BACKGROUND AND CURRENT CONDITIONS

Location

Malletts Creek (see Figure 1) is located in eastern Washtenaw County and drains to the Huron River. The watershed covers 11 square miles and lies almost entirely within the southern portion of the City of Ann Arbor but also includes portions of Pittsfield Township, Lodi Township, Ann Arbor Township and Scio Township. Malletts Creek is also a publicly-owned county drain and is maintained by the WCDC.

The Main Branch of Malletts Creek is the most easterly branch draining areas south of I-94 including the Ann Arbor Airport (see Figure 2). The West Branch drains the west-

erly portion of the watershed and extends east of I-94 past Ann Arbor-Saline Road. The West Branch includes the Briarwood commercial area as well as residential and commercial development in Pittsfield Township. The Northwest Branch drains the Dicken, Lansdowne and Briarwood neighborhoods. Several other tributaries to the Northwest Branch have been enclosed and serve the Ann Arbor Hills, Burns Park, Georgetowne and the Allen School neighborhoods. These storm sewer systems are depicted as red on Figure 2.

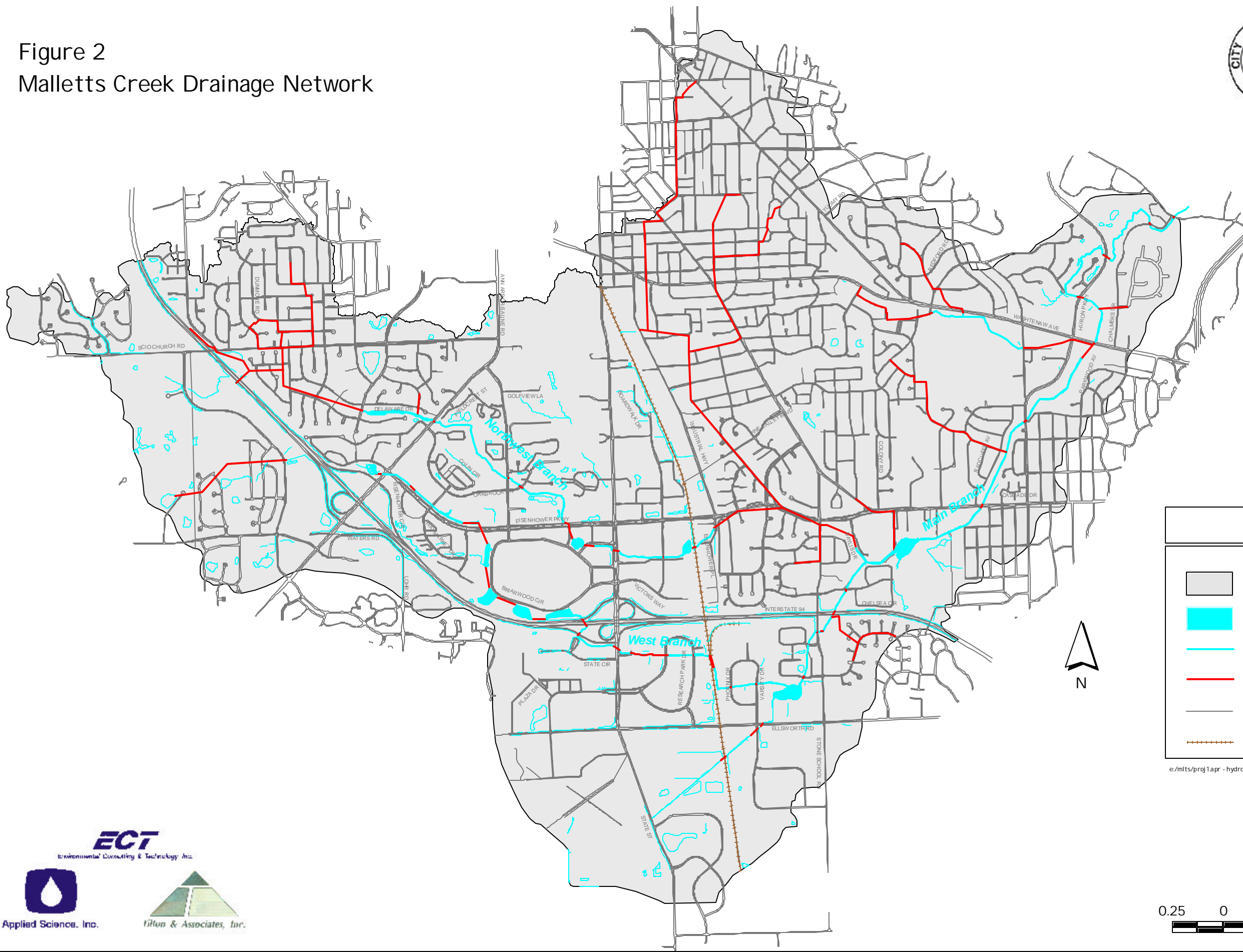
Land Use

The current land use in the watershed is shown on Figure 3 and given on Table 2. The land use map indicates that there is little open space left in the watershed to be developed. The watershed is nearly completely developed with the largest land use category being residential. The open space category on table 2 includes the Ann Arbor Municipal Airport in Pittsfield Township.

Table 2: Land Use Conditions

Land	Existing Conditions Area (acres)	Future Conditions Area (acres)
Residential	3,183	3,483
Commercial	820	1,442
Industrial	888	799
Open Space (airport)	2,016	1,183
TOTAL	6,907	6,907

Figure 2
Malletts Creek Drainage Network



LEGEND	
	Malletts Creek Watershed
	Inline Ponds
	Main Branches
	Storm Sewers
	Highways and Roads
	Railroad

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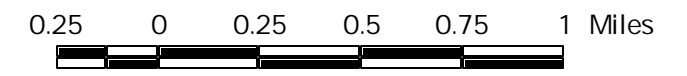
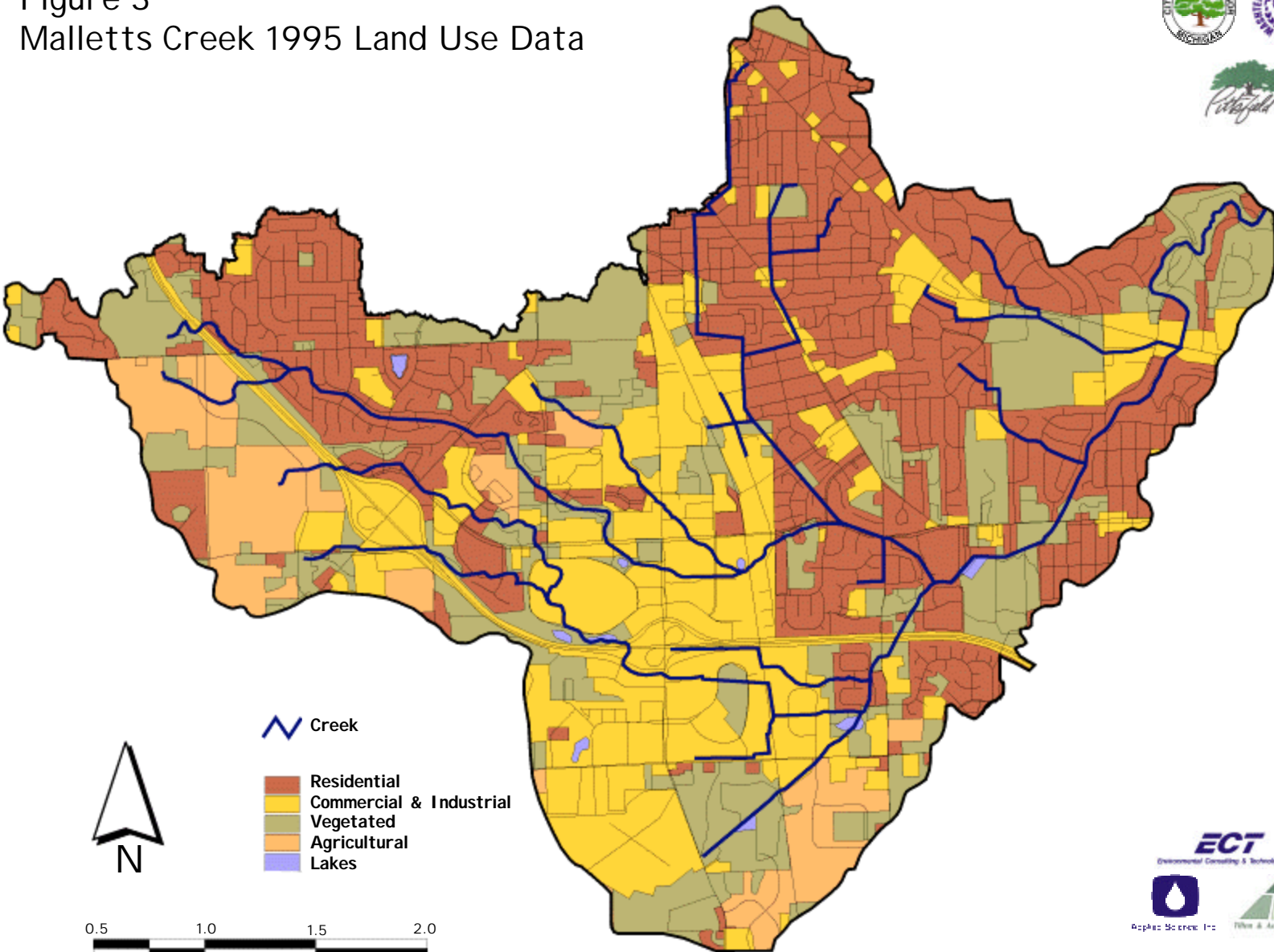








Figure 3
Malletts Creek 1995 Land Use Data



-  Creek
-  Residential
-  Commercial & Industrial
-  Vegetated
-  Agricultural
-  Lakes



In the last 40 years, the Malletts Creek watershed has seen extensive development, including shopping malls, new subdivisions, apartment complexes, homes, parking lots, businesses, stores, churches and industrial buildings. The majority of the watershed is occupied by residential, commercial, and industrial land uses with some pockets of vegetated open space and few remaining areas of agricultural activity.

Hydrology

The hydrology of the creek has been modified by development. When people speak of Malletts Creek they are usually referring to the open channel system depicted as blue on Figure 2. This open waterway is fed by a network of storm drains which have been installed in the developed areas. Most of this drainage system was put in place using design standards that were not sensitive to habitat and other environmental concerns. These drains were designed to rapidly and efficiently carry storm water from developed areas.

Other areas of the watershed have been developed more recently and have been developed with more modern design standards. In these areas detention ponds collect the storm water runoff from roads, rooftops, and parking lots (impervious surfaces), and discharge runoff to the creek at a slower rate, minimizing downstream flooding and protecting the creek environment. Detention ponds are common in some upper portions of the watershed.

Malletts Creek also serves as an important aesthetic resource for citizens as well as a potentially important ecological resource for macroinvertebrates, fish, and wildlife. However, its role as a storm water conduit has impaired the ability of Malletts Creek to serve these other important roles.

Fish Survey

A fish survey was conducted by MDEQ⁽⁶⁾ during summer low flow in August 1997 to assess the fish population during the time of greatest stress for most fish. The MDEQ metrics rate the fish community of Malletts Creek as 'Acceptable' at the Eisenhower Road site and 'Poor' at the Chalmers Road site. The difference in rating between the sites is due different expectation based on the size of the stream as well as a higher percentage of the largemouth bass at the Eisenhower Road site.

Designated Uses

The key water quality concern for the MDEQ is whether the creek meets its designated uses. These designated uses are established by the State of Michigan and Federal water quality programs. The impaired uses of Malletts Creek are aquatic life and warmwater fishery. Table 3 lists the watershed concerns noted by stakeholders, and the associated impaired uses that result.

Table 3
Malletts Creek Watershed Concerns and Impaired Uses

Watershed Concerns	Impaired Designated Uses
Excessive phosphorus	Warm water fishery/aquatic life
Eroding streambanks	Aquatic life
Flashy stream flow	Warm water fishery/aquatic life
Flooding in various areas in watershed	Warm water fishery/aquatic life
Trash and debris in creek	Warm water fishery/aquatic life

Water quality sampling conducted by MDEQ in 1995 identified the Malletts Creek watershed as among the most significant contributors of phosphorus to the river system.

Recreational uses of the Huron River, particularly Ford and Belleville Lakes (located in the Middle Huron River system) have been affected by frequent algae blooms. In 1987, The Michigan Water Resources Commission established a target concentration for phosphorus in Belleville Lake of 30 micrograms per liter (Fg/l). In 1994, MDEQ personnel determined that this would be an appropriate target to eliminate the growth of this nuisance aquatic vegetation.

The water quality goals for Malletts Creek as defined by the MDEQ, the HRWC and the MCA are shown in Table 4.

Table 4
Malletts Creek Water Quality Goals

Impaired Uses	Goal
Aquatic life	Increase amount of aquatic life by reducing phosphorus, sediment and peak flows
Warm water fishery	Improve habitat for fish and wildlife by controlling stream velocities and reducing phosphorus

1995 MDEQ Phosphorus Data

MDEQ sampled 11 wet weather events near the mouth of Malletts Creek at Chalmers Road. Approximately three samples were collected during each wet weather event and analyzed for total Kjeldahl nitrogen (TKN), total phosphorus, orthophosphate and total suspended solids (TSS). In addition to the wet weather samples, periodic grab samples were collected between December 1994 and November 1995; thirteen of the grab samples were considered dry weather samples. This data was used to establish the total phosphorus load from Malletts Creek to the Huron River and the Total Maximum Daily Load (TMDL).

Malletts Creek has scored the lowest in terms of biodiversity in the Huron River system.

Next, the MDEQ identified current sources of phosphorus to Ford and Belleville Lakes and calculated the “allowable” load - the total amount of phosphorus that could enter the Huron River but still meet the target concentration of 30 $\mu\text{g/l}$.⁽⁷⁾ MDEQ divided the TMDL among the many tributaries of the Huron River, including Malletts Creek.

In its current state, Malletts Creek carries a large amount of phosphorus to South Pond and the Huron River. Water quality sampling conducted by MDEQ in 1995 identified the Malletts Creek watershed as among the most significant contributors of phosphorus to the river system. MDEQ also determined that the total phosphorus load in Malletts Creek would need to decrease by 50 percent to meet the target concentration in the Middle Huron River.

Aesthetics and Ecological Habitat

Residents of the Malletts Creek watershed involved in the HRWC's Adopt-A-Stream Program have been characterizing the physical state of the stream as well as the benthic populations since 1992. One monitoring site on the West Branch is just downstream of I-94, the next site is downstream of Scheffler Park on the Main Branch, and the third site is on the Main Branch at Chalmers Road. Populations at each site were sampled twice a year and compared to other sites in the Huron River system. When a stream is healthy, a great diversity of creatures can be found in the stream. The two downstream sites have the lowest scores in diversity and all sites in Malletts Creek scored the lowest in the Huron River system.

Warm summer temperatures limit the biota in many headwater reaches. While some downstream reaches of Malletts Creek are buffered by an undeveloped riparian edge and provide the greatest diversity of habitat structure, the flashy nature of the stream flow and poor water quality from urban runoff degrade the habitat structure and aquatic community of the creek. The fish and macroinvertebrate fauna found in Malletts are typical of a small warmwater stream and the tolerant nature of most of the taxa confirms the biological impairment of Malletts Creek.

As a result of the data collection effort it was determined that the key problems in Malletts Creek are as follows:

1. Excessive velocities and flows in the creek
2. Channel and bank erosion as a result of the high velocities
3. Flooding associated with increased flow, undersized hydraulic structures and improper building siting
4. High phosphorus levels in the creek contributing to the impairment of South Pond, and downstream impoundments
5. Diminished habitat due to lack of bank vegetation, degraded stream beds and increased water temperature
6. Needed structural repairs and improvement to existing pipes, culverts and bridges

RESTORATION ACTIVITIES

The restoration activities can be broadly categorized into three types of BMPs: source controls, treatment controls and other management techniques. Following are the recommended activities to meet the water quality goals:

Goal: Reduce Total Phosphorus in the Creek by 50%

A number of activities are required to achieve the ambitious goal of reducing the phosphorus load from Malletts Creek by 50%. These include:

- Retrofit existing detention basins;
- Add five in-system storage structures to three storm drains (County Farm, Lansdowne area and Burns Park/Georgetown area);
- Promote landowner participation in creek-safe lawn maintenance with a target of 25% participation (the phosphorus reduction resulting from 50% participation that was modeled is believed to be offset by the large amount of sediment capture expected in the in-system storage structures);
- Implement related public education and technical assistance programs;
- Conduct an illicit discharge elimination program;
- Increase frequency of street sweeping in residential and commercial areas;
- Increase frequency of catch basin cleaning;
- Renovate and expand Brown Park Pond; and
- Create a new wetland pond at County Farm Park.

Goal: Improve Habitat for Fisheries

The Malletts Creek watershed is listed as a non-attainment area for habitat. This listing will lead to the establishment of a TMDL under which the MDEQ will mandate an improvement in habitat quality. Excessive water velocities are undermining fisheries and species habitat. The following activities or objectives, if implemented, will fulfill the MDEQ requirements for the Malletts Creek watershed:

- Increase detention in the watershed to reduce peak velocities;
- Remove logjams and sediment islands;
- Enforce soil erosion and sedimentation control ordinances;
- Revise local government ordinances to reduce runoff and improve storm water management;
- Create meandering low flow channels between pools;
- Increase stream bank plantings to stabilize banks and provide food and cover for wildlife; and
- Protect and create riparian wetland areas.

Goal: Structural/Engineering Improvements

In addition to addressing the environmental concerns, the team was charged with addressing the structural concerns of the publicly-owned structures along the watercourse. These included:

- Identifying the restrictive culverts and enclosures which cause local flooding
- Identifying structures, including culverts and headwalls and endwalls, where deterioration was found

- Identifying reaches where structural bank stream stabilization solutions are recommended when vegetative approaches alone are likely to fail

Local flooding can be addressed through structural improvements at five locations as described below.

Eisenhower Office Park Area

It is recommended that floodwalls and/or berms be constructed to floodproof the buildings in the 100-year floodplain. It is unclear whether the designing and constructing the floodwalls/berms should be publicly or privately funded since the buildings were constructed prior to adoption of the FEMA FIS and it is not known whether the building were constructed in accordance with permits from the WCDC. The responsibility for the floodproofing will be determined by future investigations.

Eisenhower Parkway West of State

It is recommended that Plaza Drive and Market Place be regraded to provide flow over the parkway to a downstream section of Malletts at a lower elevation, which will not flood the Concord Center buildings. Plaza Drive and Market Place are private roads, which are assumed to be private roads, but the actual ownership is unclear at this time. For several reasons, it is unclear how the recommended solution will be implemented and funded. Further investigations and coordination meetings with Concord Center, Briarwood Mall the City of Ann Arbor and WCDC are required.

Oakbrook Drive Area

It is recommended that the Streambank at Oakbrook Drive be stabilized to prevent bank erosion during floods that overtop the roadway. Since Oakbrook Drive is a public roadway, the stabilization will be designed and constructed as part of the Restoration Plan and funded by the drainage district.

Lansdowne Pond Area

It is recommended that floodwalls be constructed to flood proof the homes not currently flood proofed in this area. Since the homes are private property, the design and construction of floodwalls would be private initiatives. Floodplain elevations will be provided from the SWMM modeling work and FEMA study.

Cranbrook Tower Area

It is recommended that the Brookhaven pond outlet be modified to lower flooding levels in the Cranbrook Tower area. The existing pond outlet is restrictive and has significantly less capacity than the downstream culverts under Eisenhower Parkway.

It is unclear whether modifying the Brookhaven Pond outlet should be a publicly or privately funded project. The Brookhaven Pond outlet carries the flow for the entire branch of Malletts Creek and is in a public ROW. However, the pond was privately constructed and no permit from the WCDC can be found. If a permit was not issued, responsibility for modifying the Brookhaven pond outlet will be private.

If the flooding problem in the Cranbrook Tower area cannot be solved entirely through modifying the Brookhaven Pond outlet (due to the downstream culvert capacity restriction), then floodproofing of the Cranbrook Tower building is recommended. This floodproofing would be private funded as it is not a result of Malletts Creek operations.

A project restoration schedule was prepared and approved by the TAC. This multi-year strategy will allow for technically, financially and environmentally sound sequencing of restoration activities. Tables 9, 10 and 11 show the recommended prioritized restoration activities sequenced over the next 6 years with their associated costs. Further detail for the project schedule and supporting costing information is included in Appendix O.

Table 9: Restoration Activity Schedule and Estimated Costs

Restoration Activities		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total Estimated Costs
Project #		SCHEDULE						
1	Illicit Discharge Elimination Program							\$212,700
2	Sampling for Bacteria & Phosphorus							\$27,720
2a	Sampling for Benthics							\$9,900
3	USGS Stream Gage - Continue Operation							\$54,000
4	Enforce Existing Ordinances							\$450,000
5	Ordinance & Code Revisions for Stormwater Quality & Management							\$360,000
6	Stream Maintenance (routine)							\$195,000
7	Public Education Program							\$720,000
8	Design In-System Storage Structures for Large Storm Drain Outlets							\$75,000
9	Remedy 10-yr. Storm Flooding Problem - Design Solution for Oakbrook Drive Crossing							\$10,000
10	Investigate 100-yr. Storm Flooding Problems - Determine Responsibilities							\$20,000
8a	Construction of In-System Storage Structures							\$1,198,214
9a	Remedy 10-yr. Storm Flooding Problems - Start Construction							\$42,600
11	Start Detention Pond Study Throughout The Watershed (Survey & Design 40 ponds/year)							\$696,360
12	Design Structural Repairs to Stream -To be done by petition.							\$150,000
11a	Start Detention Ponds Retrofit - Outlet Structures, Wetlands and Sediment Forebay							\$2,218,250
12a	Structural Repairs to Stream -Start Construction							\$4,837,815
13	Residential Street Sweeping - Phase 1 - Area F							\$10,100
14	Brown Park Pond Improvements - Design							\$250,000
15	County Farm Park Wetlands - Design							\$50,000
13a	Residential Street Sweeping - Phase 2 - Area F & C							\$27,000
14a	Brown Park Pond Improvements - Start Construction							\$2,244,163
15a	County Farm Park - Start Construction							\$263,600
13b	Residential Street Sweeping - Phase 3 - All Areas							\$134,800
14b	Brown Park Pond - Monitoring							\$35,000
15b	County Farm Park Wetland Pond - Monitoring							\$35,000
16	Sweep Commercial Streets on a Monthly Basis							\$68,800
17	Stream Bank Stabilization - Design							\$208,000
18	Habitat Improvements - Design							\$22,000
19	Pilot Project - Catch Basin Restriction							\$1,169,329
20	Catch Basin Cleaning - Clean 2x/year							\$944,300
17a	Stream Bank Stabilization - Implement							\$2,211,311
18a	Habitat Improvements - Implement							\$174,000

\$19,124,962

**Table 10: Malletts Creek Restoration Plan
Estimated Costs Summary**

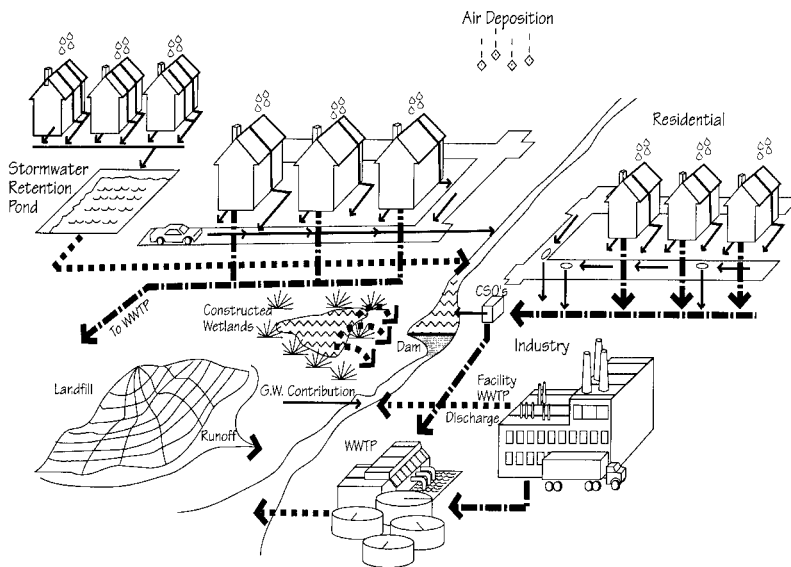
	Capital Costs	Finance Costs	O&M Costs	Public Involvement Costs	Total Estimated Costs
Year 1	\$ 105,000	\$0	\$ 323,760	\$ 53,000	\$ 481,760
Year 2	\$ 1,117,600	\$294,814	\$ 324,900	\$ 66,000	\$ 1,803,314
Year 3	\$ 2,206,500	\$698,522	\$ 337,060	\$ 103,000	\$ 3,345,082
Year 4	\$ 3,597,500	\$1,315,285	\$ 269,800	\$ 178,000	\$ 5,360,585
Year 5	\$ 2,729,580	\$963,651	\$ 965,930	\$ 181,000	\$ 4,840,161
Year 6	\$ 1,807,160	\$613,151	\$ 758,750	\$ 115,000	\$ 3,294,061
Totals	\$ 11,563,340	\$3,885,422	\$ 2,980,200	\$ 696,000	\$ 19,124,962

Note: Finance costs are assumed to be 6.5% over 10 years
Finance costs were calculated on capital projects over \$500,000

**Table 11: Malletts Creek Drainage District
Apportionment %**

Ann Arbor City	74.54
Pittsfield Twp.	18.85
State	5.62
Washtenaw County	0.99

The twenty priority projects identified by the TAC are summarized below. Further detail is provided on each project in the referenced appendix.



Sources of Water Pollution

concern. The second phase requires a similar sampling program within the enclosed drains that exhibit signs of sewage or other pollutants. The final phase requires site visits at privately owned facilities suspected to have illicit connections. Often dye testing is required.

Details of the cost estimate are provided in Appendix O.

Project #2: Sampling Program for Bacteria, Phosphorus and Benthics

In an effort to evaluate the effectiveness of the restoration project as it proceeds, three monitoring programs are recommended. These programs will document the changes in key chemical parameters, the biological characteristics and the discharge from the creek. Monitoring water quality parameters, during wet weather, such as total phosphorus and E. Coli is recommended at six sampling sites throughout the watershed. The sampling schedule is twice a year, every other year at an estimated cost of \$27,720. This cost estimate is based on similar work done on the restoration project in 1999.

Biological monitoring for insects and habitat is recommended at six sites throughout the watershed. The recommended frequency of the sampling is once a year, every other year alternating with the phosphorus and bacteria sampling. The estimated cost of this program is \$9,900. This cost estimate of \$9,900 was derived from the Adopt-A-Stream program sponsored by the HRWC and assumes they will continue to perform this monitoring.

Project #3: USGS Stream Gage

To gather an accurate picture of the hydrologic conditions of the creek, the USGS installed a stream gage at Chalmers Road. Continuing to operate the USGS stream gage at this site will allow stream flow to be monitored during the restoration process and determine if the recommended flow control pro-

Project #1: Illicit Discharge Elimination Program

Illicit discharges occur when sanitary sewers are inadvertently connected to the storm drainage system. This type of connection is common in areas that were constructed before modern standards for plan review and inspection were instituted. Illicit connections are sources of both phosphorus and E-Coli. In Area F, where unusually high loadings of phosphorus were measured in dry weather flow, illicit connections are suspected. Thus an illicit discharge elimination program is recommended.

The illicit discharge elimination program will take place over three years at an estimated cost of \$212,700. The first phase will provide for county and/or city employees to “walk” the drains, sample the low flow discharge at appropriate areas, identify “hot” outlets and prioritize the areas of concern.

grams are effective in reducing peak discharge rates. This method of evaluation is scheduled for all six years at a total cost of \$54,000. This cost estimate is based on the annual cost of the gage as of 1999.

Project #4 Enforce Existing Ordinances

Several of the sources of sediment and phosphorus are currently regulated under existing ordinances. Lack of available staff has prevented adequate enforcement of these regulations. The recommendation is to hire one additional staff person to enforce the existing ordinances concerning construction soil erosion and control, including methods of slope stabilization, sediment-trapping devices, and construction entrance and roadway stabilization. This staff person could be jointly funded by the City of Ann Arbor and Washtenaw County, thereby covering the entire watershed.

This staff person would also be available to enforce ordinances regarding pond maintenance. Proper maintenance of detention/retention ponds is also required under existing ordinances. Because there is no inspection, there has been no enforcement. The estimated annual cost is \$75,000 and is based on the addition of one additional staff person.

Project #5: Ordinance and Code Revisions for Storm Water Quality and Management

In addition to enforcing existing ordinances, revisions are recommended in several local codes and ordinances. The recommended revisions are documented in "Review of Ordinances Affecting Storm Water Quantity and Quality for the Malletts Creek Watershed" included in Appendix L.



Failing culvert

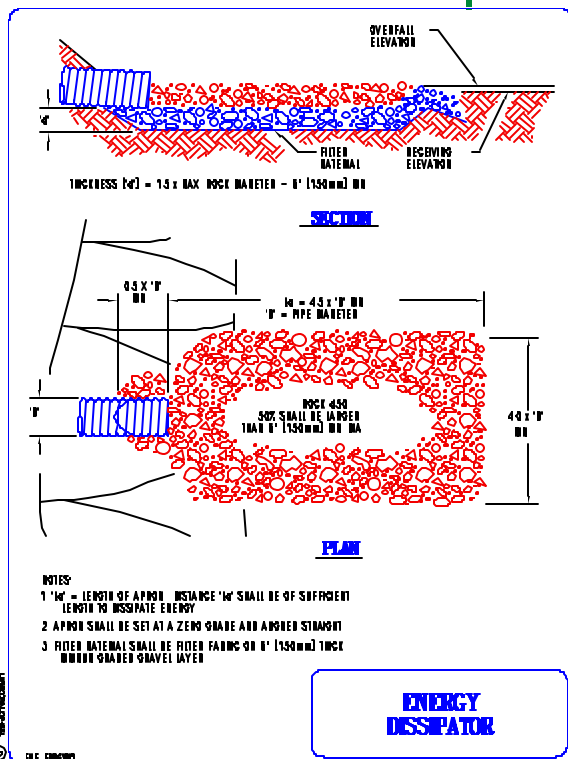
As part of the restoration study, all ordinances that affect storm water quality and quantity were reviewed and recommendations made on aspects that would affect levels of impervious cover, management of storm water flows, sediment and phosphorus. Revisions of existing ordinances and codes would be prorated across the community of origin. The estimated cost is \$360,000 over six years and includes legal fees, public meetings and hearings, and assumes no legal challenges to the ordinance revisions. This cost estimate was taken from the literature and is based on a national average.

Project #6: Stream Maintenance (routine)

Annual maintenance on the open channel of Malletts Creek is required to minimize streambank erosion and maintain a healthy stream. For purposes of estimation, it has been assumed that three log jams and/or tree removals as well as repairs of five minor outlet structures will be accomplished each year. This cost is estimated at \$195,000 over the 6 year period

Project #7: Public Education Program

Several urban watershed studies have reported that residential lawns contribute up to 67% of the phosphorus load. Additional sources of phosphorus, such as autumn leaf pick up practices, also contribute to the phosphorus problem. These major sources of phosphorus



Suggested culvert stabilization with energy dissipation

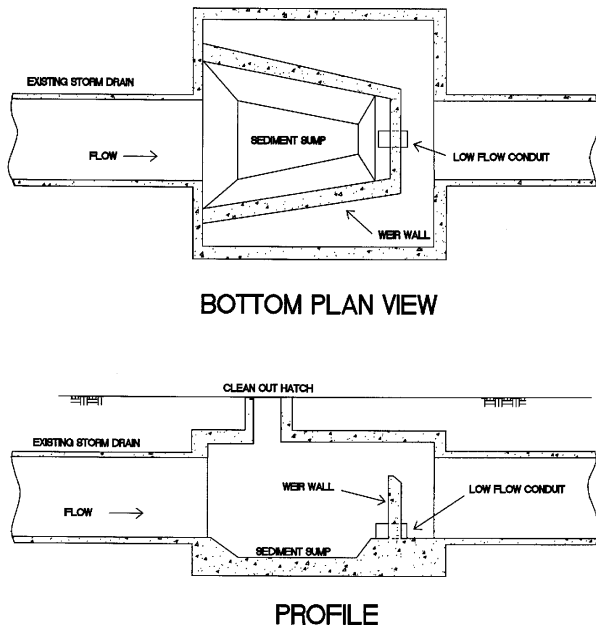


Figure 14: Conceptual Design of In-system Storage Device

can only be reduced by individual homeowners. A public education program aimed at modifying current lawn care practices, promoting low or no phosphorus fertilizer, and proper leaf storage, is recommended to reduce the phosphorus loading to Malletts Creek. It is also recommended that signs be placed at road crossings to increase the public's awareness of the creek. The estimated cost for a public education program is \$720,000 and includes \$67,000 a year for materials and the addition of one staff person (\$53,000/year) for the length of the restoration project. These estimates are based on costs of a similar effort recently performed by the City of Ann Arbor.

Project #8: In-system Storage Structures for Large Storm Drains

Five (5) in-system storage structures are recommended to be constructed. Three (3) along the storm drain leaving the Burns Park area; 1 along the drain entering the Lansdowne Ponds; and 1 along the County Farm Park drain.

In-system storage structures will substantially reduce downstream peak flow and delay the peaks for most storms. The in-system storage structures will reduce peak flow rates for small storms by up to 50%.

The in-system storage structures currently envisioned are technology taken from combined sewer overflow control programs. The enlarged pipe section serves as a sediment trap and is proposed to be constructed in the middle of the street with easy access for routine cleaning. Figure 14 depicts the conceptual design of the recommended structure. The estimated cost is \$1,273,214 and includes design and construction.

The construction cost estimate was taken from similar projects in southeast Michigan, while the maintenance cost was based on the current cost of operating a vactor (high-volume vacuum truck) by the City of Ann Arbor.

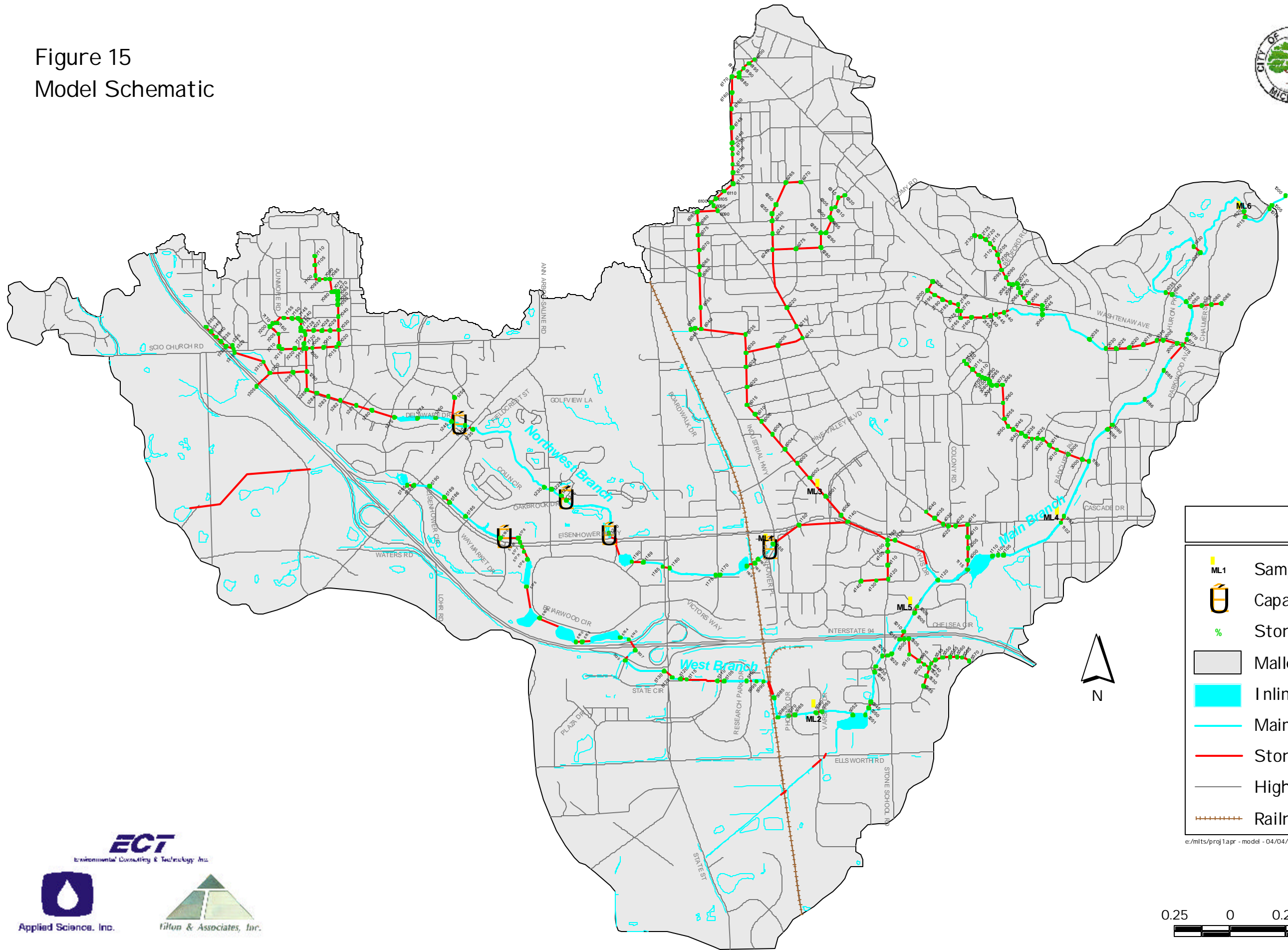
Project #9: Remedy 10-Year Storm Flooding Problems

This project involves the study design and construction of a streambank stabilization project at the Oakbrook Drive crossing of the Northwest Branch of Malletts Creek. These areas are indicated on Figure 15, the model schematic. The cost is estimated to be \$52,600.

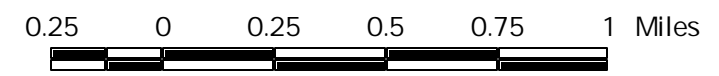
Project #10: Investigate 100-Year Storm Flooding Problems and Determine Responsibilities

This project involves investigating the flooding problems at the Eisenhower Office Park and in the area of Eisenhower Parkway west of State Street. The estimated cost is \$20,000 and includes, further study and analysis, including a survey of grades and building elevations. Research into the permits issued, and compliance with permit conditions will be done. Meetings between affected parties will occur to attempt to develop alternative solutions responsibilities for funding, and an implementation schedule. These areas are indicated on Figure 15, the model schematic.

Figure 15
Model Schematic



LEGEND	
	Sampling Locations
	Capacity Problem Areas
	Stormwater Nodes
	Malletts Creek Watershed
	Inline Ponds
	Main Branches
	Storm Sewers
	Highways and Roads
	Railroad



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Project #11: Retrofit Detention Ponds

It is estimated that there are about 120 detention ponds in the watershed. All of these ponds have a beneficial impact on both flood control and water quality. This beneficial impact could be improved if all of the ponds met modern design standards. To that end, 40 ponds will be surveyed each year for 3 years.

This effort builds upon the detention pond survey performed as part of the restoration project. Seventy ponds were identified of which 31 were surveyed. All twelve of the in-line ponds in Malletts Creek were surveyed. The remaining eighteen ponds were selected because they had the most significant effect on the hydrology/hydraulics of Malletts Creek.

It was assumed that each year 30 of the 40 surveyed ponds will require maintenance and/or modification of the outlet structure. Additionally, some of the ponds will be retrofitted with wetlands and/or sediment forebays. To coordinate this effort, it is assumed that staff time will be required with a level of effort of approximately half-time.

The estimated cost for this phase is \$522,000 over three years.

Starting in year 3, construction of the retrofits will begin. This will include:

- Removing existing outlet structures (100-year ponds) and replacement with low flow openings;
- Retrofit ponds (100-year or first flush) with wetlands; and
- Retrofit ponds (100-year or first flush) with a sediment forebay.

Not every pond will require retrofitting. For purposes of the cost estimate, we have assumed that 90 ponds will have the outlet structures modified, 15 ponds will have wetlands and 30 ponds will have a sediment forebay. The total estimated cost is \$1,477,500 over three years.



Old Stone School Road bridge in need of repair



Close up of Old Stone School Road bridge damage

Project #12: Structural Repairs

Five locations were identified as potentially requiring major structural repairs. None are in danger of immediate failure but each shows signs of on-going degradation and is in need of attention. All of the projects fall under the jurisdiction of the Drain Commissioner and will likely require that the local units of government petition the Drain Commissioner to finance and construct the required work. The estimated cost is \$4,987,815 and includes the design and repairs described in the following paragraphs.

The conduits passing under Old Stone School Road are eroding badly. The eroded sediment, of course, contributes to the sediment load. More importantly the road continues to be undermined. As a result the restoration plan recommends a detailed engineering analysis be performed and the required repairs be completed.

There are two conduits which pass under Eisenhower Road near State and enter into the Briarwood North Pond. Ann Arbor officials report that in the past a series of sink holes have formed, apparently above the lower of the two conduits. These sink holes occurred at regular intervals and in a straight line. This observation suggests that the joints of this pipe were not properly sealed, allowing soil to enter the pipe during wet conditions. The void caused by this process will ultimately lead to a failure. Therefore it is recommended that an

engineering analysis be initiated to identify the severity of this condition, prepare plans and specs for the recommended measures and oversee the construction of the project.

The West Branch of Malletts Creek at Research Park Drive at the east crossing includes a pipe that has been placed apparently to help pass the peak flow. Currently, the entire low flow passes through the conduit leaving the sediment-laden stream channel dry. Discussions with Drain Commissioner staff could not identify the origins or the purpose of the conduit. Thus, the pipe could be removed if it does not adversely impact local drainage and/or flooding. A study is recommended to verify that the conduit can be removed from service without affecting the hydraulic regime. If the project is shown to be feasible, funds have been requested to construct the chosen alternative.

The concrete headwall of the conduit that drains both Area A and Area C shows signs of degradation. Substantial spalling suggests that a study be initiated to assure that the structural integrity has not been compromised. If the headwall and end section are structurally sound, the concrete should be refinished to halt further degradation and extend the life of the structure.

Downstream of Washtenaw Avenue (adjacent to Boston Market), a rock gabion retaining wall is being used to stabilize the west bank. There are no known drawings of this structure. In the past, remedial efforts have been required to mitigate subsidence in the adjacent parking lot and concern remains as to the structural integrity of the gabion retaining wall. It is, therefore, recommended that a geotechnical study be commissioned to evaluate the structural integrity and to precisely monitor the movement of the gabions. If stabilization is required, it should be designed and installed. The current cost estimate does not provide for removal and replacement of the existing structure.

Project #13: Residential Street Sweeping

The first line of defense in reducing pollutants in the creek is to remove them from storm water. Directly connected paved surfaces such as streets and parking lots in residential areas are second only to residential lawns for contribution of phosphorus. Cleaning pavement monthly in residential areas can reduce pollutant discharges to storm water. An increase in street sweeping frequency would be phased in over three years based on evaluation of the first or pilot year. The first year would start with Area F, with subsequent years adding Areas C, D, A and B.

The estimated cost is \$10, 100/year and includes labor, equipment, materials, and disposal. Starting in year four additional staff and a sweeper would be needed; the capital costs are estimated to be \$50,000/year to lease a sweeper, and \$40,000/year for a staff person.

Project #14: Brown Park Pond Improvements

Brown Park provides an opportunity to moderate the downstream impact of flood flows as well as substantially improve its ability to capture phosphorus. All areas tributary to the Brown Park pond will benefit from this improvement.

The redesign of the pond will start in year three for an estimated cost of \$250,000. Construction will begin in year four to be completed in year five.

Enlarging Brown Park pond involves the excavation of about 40,000 cubic yards of soil above elevation 801 feet, the excavation of 25,000 cubic yards of soil below elevation 801 feet, and the creation of 8 acres of wetland area.

Construction costs are estimated at \$1,627,400. After construction of the wetlands is completed, monitoring of the wetland function will start at an estimated cost of \$17,500 a year.

Project #15: County Farm Park Wetland Pond

Construction of an additional wetland pond at County Farm Park will substantially reduce the amount of phosphorus entering Malletts Creek. The creation of a pond in County Farm Park involves the excavation of 7,000 cubic yards of material above elevation 809 feet, the excavation of 3,000 cubic yards of material below elevation 809 feet, as well as the creation of one (1) acre of wetland.

The cost estimate to design the pond is \$50,000.

Construction costs are estimated at \$263,600. After construction of the wetlands is completed, monitoring of the wetland function will start at an estimated cost of \$17,500 a year.

Project #16: Commercial Street and Parking Lot Sweeping

Studies have shown that in some watersheds, commercial areas, streets and parking lots contribute 80%-90% of the phosphorus to surface water. Due to the heavy phosphorus loading caused by sediment washed off streets into storm drains, an enhanced commercial street sweeping and parking lot program is recommended. This program is scheduled to start in year five based upon pilot area evaluation. The cost is estimated at \$34,400 and assumes 20% of commercial areas in Malletts Creek are parking lots.

Project #17: Streambank Stabilization – Design and Implement

The stream survey indicated that stream bank erosion was evident in approximately 5 miles of Malletts Creek (measured on one side of the stream). Soil bioengineering methods are proposed for many stretches of Malletts Creek where soil type, bank slope and flooding frequency have contributed to streambank erosion. It is recommended that streambanks be stabilized on all reaches with flow over 3 ft./sec.

Several reaches of Malletts Creek have severe erosion. These coincide with the reaches that experience the highest velocities during wet weather. In these reaches, the modelling effort predicts velocities in excess of 5 ft./sec. which is the velocity at which high rates of erosion are expected. At these high velocities the drag (or tractive forces) cause the soil particles to erode from the streambank. Soil bioengineering is effective at lower velocities but once the velocities exceed 5 ft./sec. these techniques must be augmented with rip rap, gabions or similar structural methods.

Rip rap is the most commonly used structural material for stabilizing streambanks. Gabions are rectangular, rock-filled wire baskets that are pervious, semi-flexible building blocks or mats. Both applications can be improved with the addition of vegetative material. The advantages include:

- Improving the performance of armor layer by preventing washout of fine particles and by reinforcing the underlying native soil.
- A more natural appearance.
- Providing riparian cover and wildlife habitat.
- Slow water velocities near the bank and trap sediment. (Source: Gray & Sotir) ⁽⁸⁾

The cost for installing soil bioengineering methods varies with the particular technique chosen. The costs provided in Table 12 were provided by the USDA Natural Resources Conservation Service (NRCS) and were compiled by Robbin B. Sotir & Associates. These costs must be expanded to include the cost of earth moving, toe protection and structural components.

Table 12: Unit Costs
Soil Bioengineering Methods (in 1997 dollars)

Method	Installed Unit Cost
Live stakes	\$1.50 - 3.50 per stake
Joint planting	\$2.00 - 9.00 per stake
Live fascine	\$5.00 - 12.00 per lineal foot
Live cribwall	\$14.00 - 25.00 per square foot of front face
Brushlayer - cut	\$8.00 - 15.00 per lineal foot
Brushlayer - fill	\$12.00 - 25.00 per lineal foot
Vegetated geogrid	\$12.00 - 30.00 per lineal foot
Live siltation construction	\$12.00 - 16.00 per lineal foot
Brushmattress	\$10.00 - 20.00 per square yard
Installation includes: harvesting, transportation, storage, and placement	

It is therefore recommended that plans and specifications be prepared for the high velocity reaches. The design engineer will be required to collect additional soils information to be used with the velocities predicted in the modeling effort to select an appropriate mix of stabilization techniques. The estimated cost for the design is \$208,000 and \$2,211,311 to implement stabilization. The implementation of the streambank stabilization efforts is scheduled for the sixth year and is projected to continue beyond the project life.

Project #18: Habitat Improvements – Design and Implement

After structural improvements are made to moderate flow and velocity, the following habitat improvements are suggested:

- Revegetation of channel banks with tree plantings along top of the banks to provide shade to the channel and to shade out some of the heavy brush currently growing on the banks.
- Maintain trees and woody vegetation near the tops of banks protected by gabions or rip rap in order to provide shade
- Plant fruit and nut trees at select locations to provide food and nesting cavities for wood ducks, raccoons and squirrels. These plantings should be located in an area that will not require their removal if future maintenance is required.
- Creation of habitat structures in stream such as a hand constructed low flow channel between pools by rock removal to banks.
- Placement of rock cobble in the stream channel and creation of gravel riffles.
- Scattered boulder cluster placement could be implemented where adequate stream bank protection is in place.

Before these are implemented a detailed design must be done at an estimated cost of \$22,000. The implementation costs are estimated at \$174,000.

Project #19: Catch Basin Restriction Pilot Project

A pilot project is proposed that involves installing catch basin restrictors in the residential areas of the drainage network tributary to the Lansdowne Ponds. This area was chosen since there is less on-street parking in this area than in some other Ann Arbor neighborhoods which will make maintenance easier. Also, the drainage system is newer, and the existing catch basins should include sumps with an outlet pipe which can be more easily retrofit with different types of restrictors.

The restrictors may include: 1) grates with smaller and/or few holes; 2) orifice plates installed on the outlet pipe in the sump; or 3) vortex valves on the outlet pipe.

The pilot project will involve more intensive street sweeping, catch basin cleaning, and leaf pick-up to avoid street flooding complaints. Also, flow monitoring both pre- and post-project is required to determine the effectiveness of the pilot projects in reducing peak flows and velocities. The project estimate (\$1,169,329) includes the cost to:

- Place Catch Basin Restrictors in Area A (tributary to Lansdowne Ponds)
- Clean Catch Basins on a monthly basis
- Remove restrictors at end of pilot program (if desired)

Project #20: Catch Basin Cleaning

The preferred place to capture solids associated with road runoff is through street sweeping. The second line of defense is at the catch basin. Once the catch basin becomes full of sediment, it no longer catches sediment. Solids

that make it past the catch basin are delivered directly to the river (unless a retention basin is placed between the catch basin and the river outlet). To assure that the catch basins continue to capture solids, regularly scheduled maintenance is needed. The literature recommends that catch basins be cleaned twice annually (Schueler, 1997).

A cost estimate was made to compare the cost of having catch basins cleaned using a private contractor (\$1.5 million) and expanding the existing public (Ann Arbor) staff. The public sector was substantially less costly (\$944,300). To cover the entire Malletts Creek drainage area would require adding three new two-person crews and leasing three new vacators. Further detail on the cost estimate is provided in Appendix O.

PUBLIC INVOLVEMENT

The Public Involvement Process

The goal of this component of the project was to establish an educated and involved public and to get feedback on what was possible. The project team first identified a comprehensive list of stakeholders for the watershed that included groups such as elected and appointed officials, environmental groups, public and private schools, business associations, homeowners associations and lawn care companies.

Several mechanisms were used to reach out to and involve these stakeholders. These included a Malletts Creek web page, four community-wide meetings, working with the Malletts Creek Association, focus groups and conducting telephone surveys.

Four Community-wide Meetings

Meeting #1 – Goal: Educate and inform

The goal of this meeting was to inform and educate the public as well as engage them in the planning process. The first meeting introduced the project and identified the major problems of the creek (high phosphorus loading and flooding in certain areas). It was explained that the restoration process must look at the watershed as a whole and not focus on just the creek itself. Any restoration solution must have the commitment and willingness of the stakeholders in the watershed.

Meeting #2 – Goal: Introduce public to BMPs

At this meeting, the public involvement (PI) team emphasized the concept that the Malletts Creek watershed problems would need to be addressed with changes and actions that involved all the people who live in, work in, and visit the watershed. Categories of BMPs were described: management methods, i.e. ordinance review and planning; treatment methods, i.e. detention ponds and storm water wetlands; and source controls, i.e. alternative landscaping and installation of rain barrels. Helpful input from the public was gained and used in designing plan recommendations.

Meeting #3 – Goal: Present draft restoration alternatives

The goal of this meeting was three fold: 1) to educate participants about the results of the phosphorus and flow studies, 2) help participants gain an understanding of which types of BMPs (source control, treatment, or management) could be applied in certain areas and 3) gain input and ideas from the public.

Meeting #4 – Goal: Present final restoration plan

This final public meeting was held to: 1) review the project; 2) summarize findings and restoration goals; 3) show restoration activities, implementation time line and projected costs and; 4) gain input from public

Focus Groups

The main goals of focus groups, interviews or surveys were as follows:

- Educate and create awareness among certain essential groups/stakeholders about the problems in the creek and watershed



Example of an alternative lawn

- Establish a baseline of knowledge with which to help make decisions about recommendations
- Foster a better understanding of preferences, needs, barriers, and motivations
- Assess the potential success of any future recommendations for the restoration plan

Focus Group /Interview Summaries:

- *Elected/Appointed Officials*
These officials were identified in the stakeholder list and invited to all public meetings. The team had introductory meetings with Ann Arbor City Council, Pittsfield Township Board of Directors and the Ann Arbor Planning Commission to explain the project. Special meetings were held with the planning commissions on 6/23/99 and 1/20/00 to discuss potential ordinance revisions.
- *Schools*
Both private and public schools were identified in the stakeholder list and invited to public meetings. In addition, conversations were held with staff from the Ann Arbor public schools science curriculum office and a subsequent meeting was held to introduce the project to the science coordinators.
- *Large Businesses*
Large businesses in the watershed were identified as stakeholders and invited to all public meetings. After a corporate representative attended community meeting #1, a creek clean-up day was held by Dayton Hudson employees. It was found that many of the 100-year detention ponds are owned and managed by private property owners and management companies. A telephone survey was conducted to determine if they would be open to management/structural alternatives regarding their detention ponds. All were amenable to working with the Drain Commissioner in the future on improving the creek by modifying their ponds.
- *Homeowners*
Riparian homeowners were identified as stakeholders and invited to the public meetings. In addition, a homeowner focus group was conducted during which discussion focused on three main topics: lawn care alternatives, roof runoff alternatives, and detention basin design. This sub-set of homeowners suggested aggressive public education and involvement strategies for lawn and garden maintenance.
- *Lawn Care Companies*
Lawn Care providers were identified as stakeholders and invited to public meetings. In addition, a focus group was held with lawn care providers. A discussion was held concerning alternative lawn care options, "creek-friendly" lawn care and education for "do-it-yourselfers". It was interesting to learn that changing the programs and practices of lawn care providers in the watershed is not the key. Only about 15% of the watershed residents use a commercial lawn care service. Additionally, fertilizers that are distributed to retail chains have high phosphorus contents, so a low or no phosphorus alternative is not readily available to the public. Thus, it is the market that supplies lawn and garden fertilizers that should be targeted for change.