STORMWATER REPORT

CRESTWOOD STORMWATER MASTER PLAN

CRESTWOOD, MISSOURI 63126

Prepared for:

The City of Crestwood

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Crestwood, Missouri 63126
314-729-4700

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Prepared by:

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1. Executive Summary

The City of Crestwood approached Horner & Shifrin to perform an update on their stormwater master plan. The purpose of this report is to provide an updated solution, cost estimate and prioritization list for each project area given to Horner & Shifrin by The City of Crestwood. The project areas investigated were based on a Stormwater Improvement Plan (SWIP) report conducted by CDM for The City of Crestwood dated February 2001, located in Appendix A. The project numbering system used in this report coincides with the numbering in the original report. Additional projects added to the Update are added consecutively within each watershed, although some were added and then removed by City staff prior to the Update.

The City of Crestwood covers an area of approximately 2,292 acres which contains four principal watershed basins: the main branches of Gravois Creek, Kirkwood Creek, Mulberry Creek, and Sappington Creek. The Gravois Creek watershed is situated along the eastern side of the City and exhibits a general southeasterly flow pattern, with approximately 816 acres of this watershed contained within the City limits. In the northwestern portion of Crestwood, the Kirkwood Creek watershed also flows in a southeasterly direction and encompasses roughly 530 acres of the municipal area. The southern region of the City falls within the Mulberry Creek watershed, which drains in a northeasterly direction capturing approximately 914 acres within Crestwood. Finally, the southeastern corner of the City contains a portion of the Sappington Creek watershed, which also flows in a northeasterly direction and includes approximately 31 acres within the City's jurisdiction. These reaches ultimately combine into Gravois Creek as it flows southeast out of The City of Crestwood.

The initial phase of the study consisted of field investigations to evaluate site-specific flooding and channel erosion issues, to conduct a detailed analysis of the physical condition and stability of the City’s natural drainage channels, and to inspect and observe the state of any improvements conducted since 2001. Flooding and erosion problem areas were originally identified through a City-led questionnaire survey conducted in February 2001. A total of 4,876 surveys were distributed to property owners within the municipal boundary, with 1,296 responses received. Completed projects and new problem areas have been incorporated into this report.

The channel stability analysis focused on evaluating existing cross-sectional geometry, bank conditions, and evidence of active erosion or sediment deposition. The objective was to identify reaches where stabilization measures could be effectively implemented. These stabilization techniques involve the use of bioengineering methods, which combine vegetation with structural components such as geotextiles, rock toe protection, and soil lifts to protect against erosion while preserving the natural appearance and function of the stream system.

Existing, completed and new problem areas have been assessed for a total of 30 prioritized drainage projects. A comparative analysis of feasible options was performed for each issue, resulting in 30 conceptual projects detailed in this report. The assessment criteria encompassed estimated construction cost, constructability, anticipated benefits, level of public acceptance, and potential environmental impacts. Construction cost estimates were developed for each recommended alternative using unit cost data derived from recent stormwater infrastructure projects in the St. Louis region. The Metropolitan Sewer District's prioritization methodology was applied to rank the proposed projects. This methodology considers the severity of the identified issues, the projected benefits to the community, and the estimated construction costs. The table below presents the prioritized list of all 30 improvement projects. The total estimated construction cost for the proposed improvements is approximately $6,930,800. Alternates for GC-3 and MC-6 have been included for tracking purposes and are not displayed in the total. All cost estimates shown reflect 2025 estimates and should be adjusted for inflation when projects are scheduled.

Ranking	Rating	Project Number	Project Name	Cost Estimate
1	35.25	GC-16	1032-1039 Coffey Court	$8,000
2	30.543	MC-19	9409 Sappington Greens Lane	$9,200
3	30	MC-21	8856 Glen Rose Drive	$9,600
4	24.649	MC-24	9501-9503 Crain Court	$11,400
5	22.623	MC-22	9875 Richter Lane	$6,100
6	19.726	MC-18	8718-8722 Villa Crest Drive	$14,600
7	16.145	MC-23	Eudora Court/Arban Drive	$76,000
8	10.082	GC-3	9107 Grant Park Drive	$48,600
9	9.683	GC-4	9000-9012 Cordoba Lane	$75,100
10	9.657	MC-5	9600 Block Yorkshire Estates Drive	$671,200
11	9.273	MC-13	8866-8878 Rudson Lane	$51,200
12	8.413	MC-11	Existing Channel – Lowill Lane to Crest Oak Lane	$307,800
13	7.908	GC-5	8951-9027 Pardee Road	$788,500
14	7.24	KC-1	9636-9724 Greenview Drive	$111,700
15	7.039	GC-2	7600 Block Capilia Drive	$220,200
16	6.934	MC-10	9000 Block Maple Grove/Sky Crest	$600,300
17	6.779	MC-7	8900 Block Lindenhurst Drive	$217,900
18	6.003	MC-12	8900 Block Rudson Lane	$624,800
19	5.927	MC-16	8841 Cornish Drive	$63,400
20	5.871	MC-14	10069-10075 Barberton Drive	$59,100
21	4.464	GC-7	Existing Channel – Blackthorn Drive to Grant Road	$1,149,700
22	4.016	KC-2	1000-1028 Banyon Drive	$257,000
23	3.581	GC-10	1020-1022 Diversey Drive	$583,000
24	3	MC-6	9781-9783 Twin Vista Drive	$56,400
25	2.31	MC-17	8701-8715 Gayle Avenue	$90,900
*	1.355	MC-6.2	9781-9783 Twin Vista Drive	$155,000
26	0.914	GC-1	9000 Block Whitehaven Drive	$446,400
*	0.868	GC-3.2	9107 Grant Park Drive	$482,600
27	0.297	GC-6	Whitecliff Park/Pardee Lane	$300,500
~~28~~	~~0~~	~~MC-15~~	~~8901 Manda Lane~~	~~$0~~
*	-0.076	MC-6.3	9781-9783 Twin Vista Drive	$1,853,400
29	-2.794	GC-8	700 Block Fieldcrest Drive	$69,000
30	-10	MC-1	9440-9506 Lodge Pole Lane	$3,200

Table 1-1 – Priority Rating of Recommended Projects

The cost estimates and proposed solutions presented in this report are based on an initial, high-level assessment of the identified issues and assumed scope of each solution. These estimates are intended for use in project programming and should not be interpreted as definitive. Actual project costs and design parameters may deviate substantially from these preliminary figures. A comprehensive engineering analysis, including detailed survey, hydrologic and hydraulic modeling, material selection, detailed analysis of existing structures, and construction methodology will be conducted during the design phase. Upon completion of the final design, an updated engineer's estimate will be developed.

2. Introduction

a. Purpose

The City of Crestwood approached Horner & Shifrin to perform an update on their stormwater master plan. The purpose of this report is to provide an updated solution, cost estimate and prioritization list for each project area given to Horner & Shifrin by The City of Crestwood. The project areas investigated were based on a Stormwater Improvement Study (SWIP) report provided by The City of Crestwood dated February 2001, located in Appendix A. Some descriptions, project areas or solutions may remain from the previous report.

b. Scope of Work

This report presents an assessment of the City's known system needs and presents a prioritized list of feasible solutions to resolve these issues. The scope of this study included the following:

- Reviewed existing reports, complaints and previous solutions.
- Performed field inspections to document flooding, erosion, standing water, and other current conditions to identify underlying hydrologic and hydraulic factors.
- Evaluated and developed a recommended solution for each of 30 identified projects.
- Incorporated the Metropolitan Sewer District's project prioritization framework to support each recommended capital improvement project. This matrix is based on factors such as issue severity, cost-effectiveness and community impact, placing particular emphasis on low-cost solutions that benefit multiple property owners.
- Present the most feasible solution based on construction feasibility, lifecycle cost, performance, and environmental considerations.
- Generated detailed construction cost estimates for each proposal, utilizing available bids from recent stormwater infrastructure projects within the St. Louis region.
- Integrated bioengineering methodologies where applicable to enhance streambank stabilization efforts, emphasizing sustainable and environmentally sensitive design practices.
- Compiled a comprehensive report summarizing the technical findings, analytical methodologies, and proposed stormwater improvement strategies derived from the study.

3. Description of Watersheds

a. Watershed Description

The City of Crestwood is situated entirely within the Gravois Creek watershed, which encompasses a total drainage area of approximately 14,558 acres in southern St. Louis County, Missouri. The watershed is hydrologically interconnected with five primary tributaries: Kirkwood Creek, Mehlville Creek, Mulberry Creek, Sappington Creek, and St. George Creek. The low-lying regions are primarily served by approximately 112,464 linear feet of unimproved open-channel drainage systems. In contrast, the upland areas are predominantly serviced by an estimated 129,888 linear feet of buried storm sewer systems with diameters exceeding 36 inches. Crestwood occupies approximately 2,292 acres, representing 16% of the total watershed area of Gravois Creek.

b. Subwatershed Description

The City of Crestwood is situated within four distinct subwatersheds of the Gravois Creek watershed system: the upper main stem of Gravois Creek, Kirkwood Creek and Mulberry Creek, each discussed below. For the purpose of hydrologic classification, tributary channels are defined as secondary drainage pathways that convey flow into the main channel.

i. Gravois Creek

The upper main branch of the Gravois Creek watershed originates near the City of Kirkwood, Missouri, at an elevation of approximately 634 feet above Mean Sea Level (MSL). The watershed exhibits a predominant southeasterly drainage pattern along a primary channel extending approximately 21,648 linear feet. The total contributing drainage area for this segment of the watershed encompasses approximately 2,885 acres.

The upper main branch of the Gravois Creek watershed encompasses an area of approximately 816 acres of The City of Crestwood, representing 36% of the city’s total land area. This section of the watershed includes 10,240 linear feet of primary (mainstem) channel and an additional 8,529 linear feet of open tributary channels.

ii. Kirkwood Creek

The headwaters of the Kirkwood Creek watershed are situated approximately 900 feet east of Lindbergh Boulevard in the City of Kirkwood, at an elevation of 610 feet above MSL. The watershed exhibits a predominantly southeasterly drainage pattern along a primary channel extending approximately 12,144 linear feet. The total contributing drainage area for this segment of the watershed encompasses approximately 1,885 acres.

The Kirkwood Creek watershed encompasses an estimated 530 acres of The City of Crestwood, representing approximately 23% of the city's total land area. This segment of the watershed contains approximately 6,420 linear feet of main open channel and an additional 3,985 linear feet of open tributary channel.

iii. Mulberry Creek

The Mulberry Creek watershed originates near Eddie and Park Road at an approximate elevation of 620 feet above MSL. The watershed exhibits a predominantly northeasterly drainage pattern along a primary channel extending 8,976 linear feet. The total contributing drainage area for this segment of the watershed encompasses approximately 1,241 acres.

The Mulberry Creek watershed encompasses an area of approximately 914 acres of The City of Crestwood, representing roughly 40% of the city's total land area. The hydrologic infrastructure within Crestwood includes approximately 9,342 linear feet of the main open channel and an additional 5,686 linear feet of tributary open channels.

iv. Sappington Creek

The headwaters of the Sappington Creek watershed originate east of the intersection of Sappington Road and Gravois Road, at an elevation of 550 feet above MSL. The watershed exhibits a predominant northeasterly drainage pattern along a primary channel extending 9,504 linear feet. The upper main branch of the Sappington Creek watershed encompasses a contributing drainage area of approximately 1,447 acres.

Within the jurisdictional boundaries of the City of Crestwood, the Sappington Creek watershed encompasses an area of 31 acres of The City of Crestwood, representing approximately 1 percent of the city's total land area. Notably, there are no open channel segments of Sappington Creek located within the city limits in this portion of the watershed. No projects were identified in the old or new report per the City of Crestwood.

	Drainage Area (acres)	Percentage of Subwatershed Area	Percentage of Total Watershed Area
Gravois Creek			
Residential	716	87.7%	35.6%
Commercial	63	7.7%	
Industrial	37	4.6%	
Mulberry Creek			
Residential	804	88.0%	39.9%
Commercial	106	11.6%	
Industrial	4	0.4%	
Kirkwood Creek			
Residential	381	71.8%	23.2%
Commercial	73	13.7%	
Industrial	77	14.5%	
Sappington Creek			
Residential	31	100%	1.3%
Commercial	0	0.0	
Industrial	0	0.0	

Table 3-1: Land Use Characteristics

4. Data Collection and Study Methodology

a. Data Collection and Review

Information provided by The City of Crestwood was used alongside field observations by Horner & Shifrin to create this report. The Metropolitan St. Louis Sewer District (MSD) identification numbers, which include 8-character grid and structure identification numbers, are used frequently throughout this report to refer to existing inlets, manholes, and outfalls. These identification numbers are shown on the accompanying exhibits with potential solutions to assist in locating the improvements. The following information was used to conduct the study:

i. City Records

The City of Crestwood provided Horner & Shifrin with the previous Stormwater Improvement Plan. The records provided by the City included the following:

- Previous report completed in 2001
- Projects completed since 2001
- New issues reported since 2001
- 36 stormwater problem areas and locations
- MSD facilities maps and contour maps
- FEMA flood insurance studies and FIRM panels

ii. Field Investigations

Horner & Shifrin conducted field visits to investigate the state of the reported issues. These field inspections were used to verify the scope and priority of each issue. Reports of inundated structures or standing water were verified in-field when conditions allowed. Photos of erosion observations and failing channel structures are available in later sections. Structural analysis of existing infrastructure was not included in this scope; however, visual analysis was noted and should be reviewed further during any potential project design. The City of Crestwood notified Horner & Shifrin that some of the 29 projects were completed and additional areas were added. Below is a list of projects that have been added or completed since the original 2001 report:

Completed	
Number	**Project**
GC-9	631 Fieldcrest Drive
KC-3	Spellman Park
KC-4	546 and 538 Aspen Drive
MC-2	9319 Lawndale Drive
MC-3	9518-9534 Pine Spray Court
MC-4	9528 Craigwood Terrace
MC-8	Crestwood Park Entrance
MC-9	8940 Craighurst Terrace
Added	
GC-16	1032-1039 Coffey Court
MC-16*	8841 Cornish Drive

MC-17	8701-8715 Gayle Avenue
MC-18	8718-8722 Villa Crest Drive
MC-19	9409 Sappington Greens Lane
MC-21	8856 Glen Rose Drive
MC-22	9875 Richter Lane
MC-23	Eudora Court/Arban Drive
MC-24**	9501-9503 Crain Court
*On February 2025, the Public Works Director requested to add this project due to the severity of the damage on the project area and wanted it to be numbered MC-16. **This project was previously numbered as MC-16, but due to the added project on February 2025 from the Public Works Director this project was renumbered.	

Table 4-1: List of Completed and Added Projects

iii. Geomorphic Assessment

Field investigations of open channels were performed on April 17, 18 and May 9 of 2025. Channels were inspected for erosion, sedimentation and failing structures, such as retaining walls and gabion walls. Section 6 discusses the improvements recommended for each project following these site assessments.

iv. Existing Mapping and GIS Data

City reports and publicly available Geographic Information System (GIS) data was compiled to support this study. Available GIS data, including MSD records for structures, has been utilized to note deficiencies and create conceptual solutions for each project.

v. Previous Studies

Horner & Shifrin reviewed the Stormwater Improvement Study completed by CDM in February 2001 prior to the development of this study. The previous study provided background information and is referenced throughout this report where still applicable.

vi. Stormwater Questionnaire Data

In 2001, The City of Crestwood conducted a questionnaire inviting residents to report problem areas with flooding, erosion, maintenance, or nuisance concerns. See the Stormwater Improvement Study performed by CDM for a detailed explanation of the questionnaire data.

b. Study Methodology

i. General Design Standards

Unless otherwise stated, all standards for design shall conform with Section 4.0 of the MSD Rules and Regulations and Engineering Design Requirements for Sanitary Sewage and Stormwater Drainage Facilities, February 2018. Storm sewer within MSD regulation areas are designed using the 15-year, 20-minute design storm, but the 100-year overflow paths require additional consideration. All improvements shall be implemented in accordance with applicable city design standards and specifications to ensure long-term functionality and integration with the existing drainage infrastructure.

ii. Hydrology

The MSD design manual specifies the Rational Method be used to evaluate capacity for the 15-year, 20-minute design storm. MSD 2-foot contours were used to determine drainage areas to a specific point for each project location. The impervious surfaces layers on MSD's GIS website were used with runoff coefficients from the MSD Rules and Regulations to calculate the runoff of each drainage area.

iii. Hydraulics

1. Inlet Control

Inlet control calculations were developed according to the third edition of the Urban Drainage Design Manual-Hydraulic Engineering Circular #22.

iv. Potential Restorative Methods

The Stormwater Master Plan completed by CDM and this update provides many different option for restorative measures. Those that may not be obvious are defined below. In the solutions and recommendations provided for each project area, several options may be combined, and if the recommended solution was identified in the original Stormwater Master Plan, and still applicable, it is noted within each recommendation description.

1. Channel Cleaning and Maintenance

In considering project monitoring and maintenance, the probability of project success increases if maintenance is performed and the opposite is also true: if measures are not properly maintained, solutions will not provide lasting results. Numerous circumstances, from budgetary to natural events such as flooding, can prevent maintenance from occurring. Project planners must evaluate how susceptible a project design is to risk of failure if maintenance does not occur, is reduced in scope, or delayed. Projects that rely on structural features may be at less risk than projects dependent on natural or biological components (vegetation maintenance). With projects such as these that will be property owner or HOA owned, maintenance education should be a top priority. Project solutions should also consider how the improvements will function if not properly maintained.

2. Retaining Wall

The retaining wall restorative method consists of structural and cosmetic repairs designed to stabilize and extend the service life of an existing retaining wall showing signs of distress such as cracking, tilting, or settlement. The process begins with a thorough assessment of the wall's condition, including documentation of structural deficiencies, drainage issues, and signs of movement. If necessary, soil behind the wall is partially excavated to relieve lateral pressure and allow for safer access during repairs. Structural reinforcement may be implemented using methods such as helical tiebacks, soil nails, deadman anchors, or geogrid systems to stabilize the wall and prevent further movement. Drainage improvements are a key component and typically include the installation or repair of weep holes, placement of perforated drainage pipes behind the wall, and replacement of native backfill with free-draining aggregate to minimize hydrostatic pressure. Visible cracks and surface damage are repaired using appropriate materials, such as epoxy injections for concrete or grout for masonry, and deteriorated mortar joints may be repointed. In cases where the wall is leaning, partial disassembly, realignment, and re-leveling may be required, sometimes aided by hydraulic jacks. As a final step, the wall may be coated with waterproofing sealants or finished with protective and aesthetic treatments to enhance its durability and visual appearance.

3. *Soil Bioengineering*
   Streambank soil bioengineering is defined as the use of living and non-living plant materials, in combination with natural and synthetic support materials, for slope stabilization, erosion reduction, and vegetative establishment. This method can be used to either restabilize already eroded slopes or be installed as a preventative measure to curb future erosion.

4. *Vegetated Rock Walls*
   A vegetated rock wall is in the category of mixed construction. Structural, mechanical and vegetative elements work together to prevent surface erosion and shallow mass movement by stabilizing and protecting the toe of steep slopes. These type of treatments can reduce the need to grade the banks. These walls differ from conventional retaining structures because they are placed against relatively undisturbed earth and are not designed to resist large earth pressures. They are most applicable in high energy streams with narrow riparian corridors. These types of solutions may not be applicable where soil slides are possible.

5. *Vegetated Geogrids*
   Vegetated geogrids are a restorative method used for stabilizing steep slopes, streambanks, and retaining structures by combining structural reinforcement with vegetation. This technique integrates layers of high-strength geogrid or geosynthetic reinforcement with lifts of compacted soil and live vegetation, such as native grasses, shrubs, or live cuttings. The geogrids provide immediate mechanical stability to the slope or bank, while the vegetation establishes over time to offer long-term erosion control, hydraulic resistance, and ecological benefits. During installation, soil is placed and compacted between each layer of geogrid, and vegetation is either planted or embedded to ensure root growth into the reinforced matrix. Over time, the roots interlock with the soil and geogrid, increasing shear resistance and helping the slope withstand surface runoff and flow forces. This method is particularly effective for environmentally sensitive areas where traditional hard armoring (like concrete or riprap) is either undesirable or prohibited.

6. *Wire Mesh Gabions*
   Woven wire mesh is a double-twisted, hexagonal mesh consisting of two wires twisted together in two 180-degree turns. Welded wire mesh has a uniform square or rectangular pattern and a resistance weld at each intersection. Within these two types there are two styles of gabions: gabion baskets and gabion mattresses.

Baskets are 12 inches or more in height, while mattresses typically range from five to 12 inches in height.

Gabion baskets can be particularly effective for toe stabilization on problem slopes. They provide the size and weight to stay in place, with the further advantage of being tied together as a unit. Baskets can be installed in multiple rows to increase stability and provide a foundation for other measures above them. Gabion mattresses are best suited for revetment type installations, channel linings, and waterways. They may also be used for basket foundations and scour aprons.

7. *Bio-Gabions*

Bio-gabions are a sustainable streambank and slope stabilization method that combines traditional gabion baskets (wire mesh cages filled with rock) with live vegetation to enhance ecological function and structural integrity. This technique involves installing gabion baskets along eroded or unstable banks, then integrating live cuttings of native woody plants—such as willow or dogwood—into and around the gabions. The live stakes root and grow through the rock fill and surrounding soil, reinforcing the structure over time.

This restorative method provides immediate stabilization through the weight and interlocking nature of the rock-filled gabions, while the vegetation offers long-term resilience by anchoring the soil and dissipating hydraulic energy. As plants mature, they also improve habitat value, water quality, and aesthetic appeal. Bio-gabions are particularly effective in areas subject to high flow velocities, where softer stabilization techniques alone may not be sufficient.

5. Project Rating System

a. Purpose

Each project was scored using MSD's prioritization form, available in Appendix B. Issues are evaluated for flooding and erosion severity and recurrence.

b. Evaluation Categories

The following categories are used in ranking the identified problem:

Flooding – Flooding recurrence is evaluated based on Chronic (yearly), Frequent (every 10 years) and Infrequent (every 100 years) intervals. Points are then assigned based on the type of structure being flooded or the severity of roadway flooding.

Erosion – Erosion is evaluated based on the ratio of stabilized and compromised channel for each section being evaluated. Points are then assigned based on whether structures, roadways or other infrastructure is impacted, particularly if continued erosion may lead to catastrophic failure of a structure.

Benefits to Properties – The number of benefited properties and type of restorative method receive points per structure or linear foot as appropriate.

c. Priority Rating Form

Project prioritization is conducted using evaluation worksheets adapted from the Metropolitan St. Louis Sewer District's standardized project prioritization framework. These worksheets are divided into two primary components: problem assessment and proposed solutions. The problem section is categorized by specific issues related to flooding and erosion, with further delineation based on impacts to infrastructure such as roadways, structures, and private properties (e.g., yards), as well as the frequency and magnitude of the storm events contributing to the issue. Each identified problem is assigned a weighted score based on severity.

The solutions section documents the proposed mitigation strategies, including the type and estimated quantity of restorative measures, and assesses whether the intervention contributes to a broader, regional solution. A preliminary cost estimate is generated for each project; this value (normalized per $1,000) is divided by the total weighted score derived from both the problem and solution categories to calculate a cost-benefit ratio. Projects are then ranked based on this ratio, with higher values indicating greater prioritization.

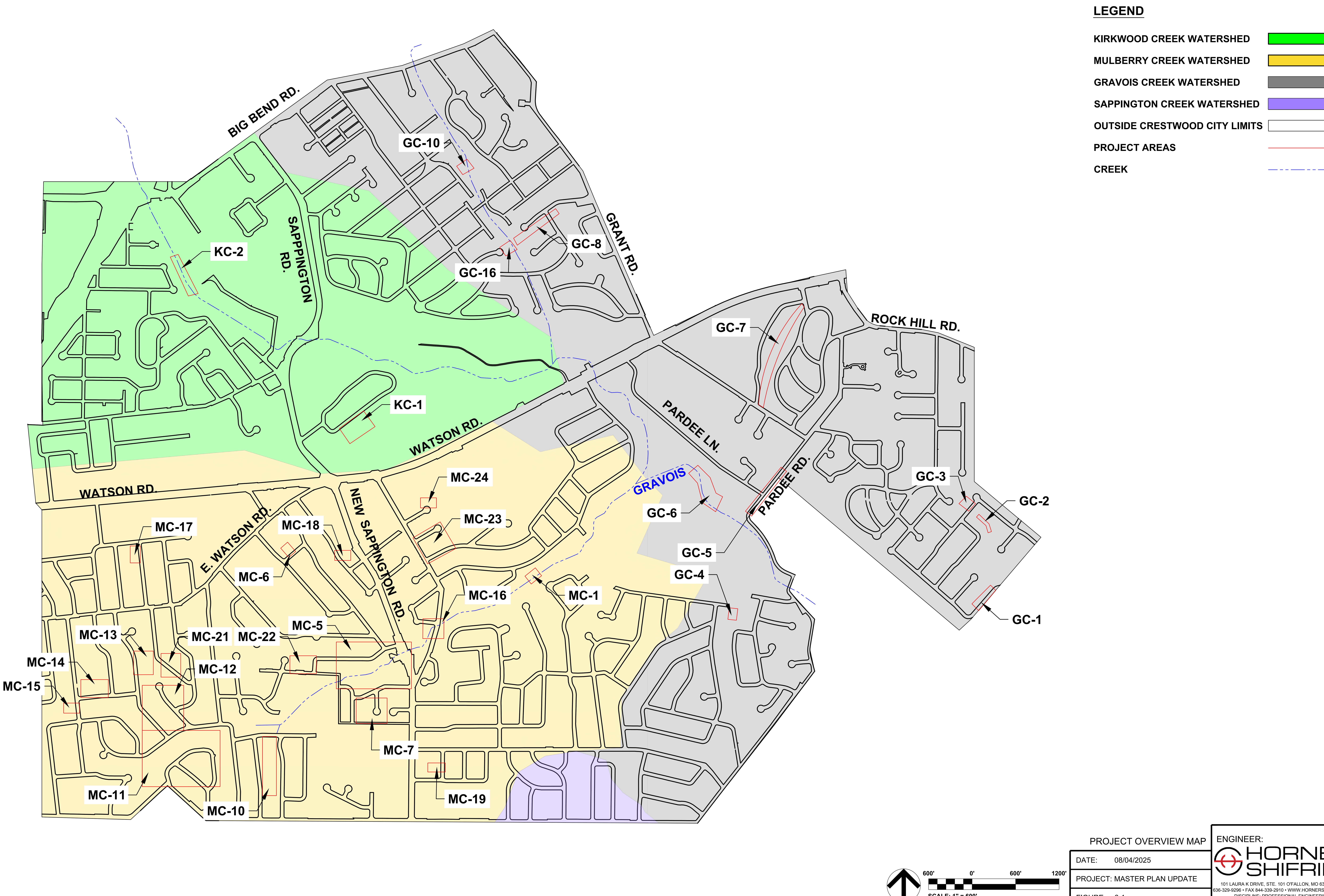
Quantities for proposed restorative methods are considered preliminary due to the reconnaissance-level nature of the assessment. While field measurements were performed in some instances, most quantity estimations were derived from photographic documentation. Erosion issues were recorded qualitatively during site visits, without the detailed granularity required for final design.

Where proposed construction is expected to impact private property, it is assumed that easement acquisition will be required, including both temporary construction easements and permanent utility or drainage easements. However, for the purposes of this preliminary analysis, only permanent easements were considered; no monetary value was assigned to any type of easement.

A priority rating form, as shown in Appendix B, was developed and used to prioritize each recommended project. The first step in completing the form is to identify the applicable evaluation categories as discussed above.

d. Cost Estimating

The cost estimates provided as part of the project prioritization are to be used only for long-term planning. Additional data would be necessary to develop a detailed estimate for construction bidding purposes. During final design, which is not within the scope of this analysis, the appropriate geotechnical investigations, topographic survey and full engineering design must be conducted to verify and adjust these initial recommendations and estimated costs. Geotechnical investigations may be required above and beyond what are identified in these costs based on property owner concerns. Engineering fees were set 12%, which may be conservative to include surveying and engineering in some instances. In areas where work in a floodway is proposed, additional analysis for no-rise certification may be required; however, because the intent of each project is to provide a restorative within creeks, it is assumed that simplified floodplain (no modeling required) will be acceptable to both MSD and the City. If floodplain modeling is required for any project area, the engineering fees may be substantially larger.



PROJECT OVERVIEW MAP

DATE: 08/04/2025

PROJECT: MASTER PLAN UPDATE

FIGURE: 6-1

ENGINEER:

HORNER SHIFRIN

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DISCIPLINE: PROFESSIONAL ENGINEERING

6. Stormwater Improvement Projects

As part of this study, a total of 30 high-priority stormwater problem locations were identified and assessed. Each issue has been provided a project scope and recommended solution. The total estimated probable cost for implementing all 30 projects is approximately $6,954,400. Figure 6-1 on the previous page provides a spatial representation of the proposed improvement project locations.

For each identified problem area, the report includes a detailed summary of the stormwater issue, recommended solution, proposed project layout, preliminary cost estimate, assigned priority ranking, and representative photographs.

a. Gravois Creek Watershed

The alternative for GC-3 has been included in the table for tracking purposes but is not displayed in the Gravois Creek project total. The Gravois Creek watershed contains 10 project areas totaling $3,689,000, summarized in the table below:

Project Number	Location	Cost
GC-1	9000 Block Whitehaven Drive	$446,400
GC-2	7600 Block Capilia Drive	$220,200
GC-3	9107 Grant Park Drive	$48,600
GC-3.2	9107 Grant Park Drive (alt. 2)	$482,600
GC-4	9000-9012 Cordoba Lane	$75,100
GC-5	8951-9027 Pardee Road	$788,500
GC-6	Whitecliff Park/Pardee Lane	$300,500
GC-7	Blackthorn Drive to Grant Road	$1,149,700
GC-8	700 Block Fieldcrest Drive	$69,000
GC-10	1020-1022 Diversey Drive	$583,000
GC-16	1032-1039 Coffey Court	$8,000

Table 6.a-1: Gravois Creek Summary of Cost for Project Areas

i. GC-1 9000 Block Whitehaven Drive

Residents situated between addresses 9047 and 9071 Whitehaven Drive have reported structural flooding along the northwest overbank area, upstream of the existing eight-foot by four-foot Reinforced Concrete Box (RCB) culvert, designated as structure 26K1-006D, beneath Whitehaven Drive. Hydraulic analysis indicates that the current culvert is inadequate to convey flows from the 15-year design storm event, resulting in upstream surcharging and localized flooding.

To mitigate the flooding risk, the proposed improvement includes increasing the existing system's conveyance capacity by installing a parallel four-foot by four-foot box culvert totaling approximately 300 linear feet. The structural integrity and functionality of the existing culvert appears to be sound, allowing for the cost-effective approach of supplementing rather than replacing the current structure. The original proposal is still the recommended course of action. The estimated probable project cost is approximately $446,400.

HORNER & SHIFRIN

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - GC-1				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

GC-1

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	4' x 4' RCB	356	LF	$ 400.00	$ 142,400.00
2	WING WALLS	2	EA	$ 20,000.00	$ 40,000.00
3	RIPRAP	200	SY	$ 75.00	$ 15,000.00
4	STREET PAVEMENT - CONCRETE REM. AND REP.	305	SY	$ 120.00	$ 36,600.00
5	SEEDING	330	SY	$ 2.50	$ 825.00
6	EROSION CONTROL	1	LS	$ 2,500.00	$ 2,500.00
	SUBTOTAL:	≈			$ 237,400.00
	MOBILIZATION (8%)				$ 18,992
	UTILITY RELOCATION (20%)				$ 47,480
	DESIGN ENGINEERING (12%)				$ 28,488
	GEOTECHNICAL INVESTIGATION (8%)				$ 18,992
	CONSTRUCTION ADMINISTRATION (10%)				$ 23,740
	CONTINGENCY (30%)				$ 71,220
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 446,400.00**

Table 6.a.i-1: GC-1 Preliminary Cost Estimate

PROJECT NAME: GC-1 Date: 8/1/2025

Table 6.a.i-2: GC-1 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
			Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	2	25	0	300
		Basement (1 lot per structure) Address:	200	0	100	2	15	0	200
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: GC-1 Date: 8/1/2025

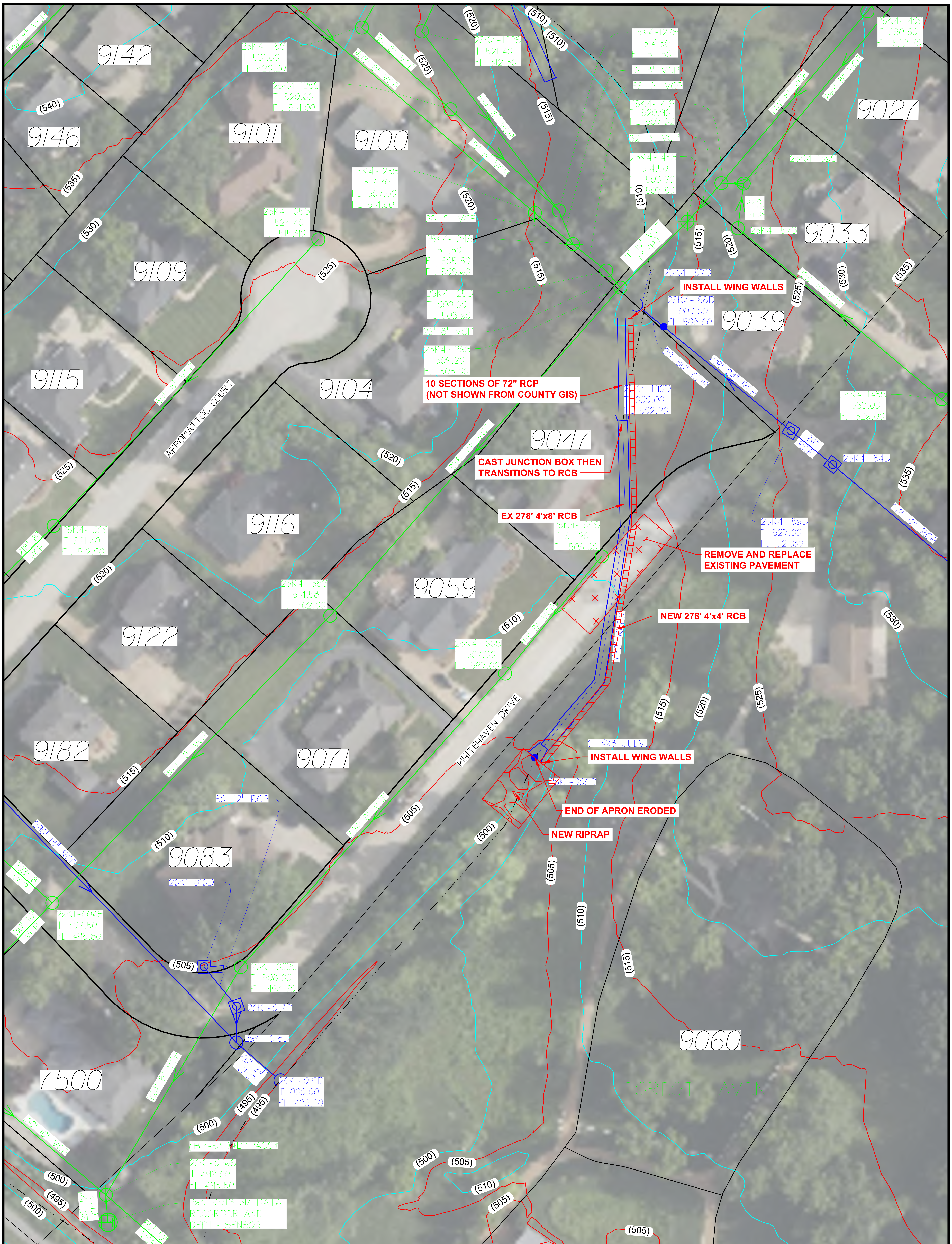
Table 6.a.i-3: GC-1 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)	1	EACH	2		2
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)	300	PER 10 LF	3		90
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
TOTAL PROBLEM POINTS						500
TOTAL SOLUTION POINTS						92
GRAND TOTAL POINTS						408

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	446.4
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**0.914**



50' 0' 50' 100'

SCALE: 1" = 50'

9000 BLK. WHITEHAVEN DR.

DATE: 08/04/2025

PROJECT: GC-1

FIGURE: 6.a.i-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
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Figure 6.a.i-2 9000 Block Whitehaven Drive

ii. GC-2 7600 Block Capilia Drive

The channel located downstream of Grant Park Drive, between the properties at 7630 and 7638 Capilia Drive, is exhibiting signs of active erosion along the north bank. Additionally, the existing stormwater outlet pipe at this location is subject to localized erosion and will require remedial maintenance to ensure long-term functionality. Previous stabilization efforts have been implemented on the downstream segment of the channel, including the construction of a gabion wall and placement of riprap along the streambanks, which have contributed to mitigating further erosion in that area. By contrast, the upstream segment remains untreated and is currently experiencing noticeable bank and bed erosion. A preliminary site review indicates that the adjacent residential backyards provide sufficient space to accommodate the proposed engineered improvements necessary for establishing a stable, naturalized channel system.

The proposed scope of work entails the removal of an existing fence and accumulated debris along a 250-foot section of the stream channel to enhance hydraulic conveyance capacity. Following debris clearance, biotechnical erosion control measures will be implemented to improve long-term bank stability. These measures will include the installation of Turf Reinforcement Mats (TRMs) in conjunction with structural elements—such as biodegradable logs or appropriately sized stone—installed at the toe of the slope to provide foundational support and resist erosive forces. Upon stabilization of the streambanks, revegetation will be conducted using native riparian and woodland plant species to restore ecological function and improve habitat quality. Additionally, native trees will be strategically planted along the corridor to further reinforce bank stability and enhance the overall integrity of the riparian buffer zone. Alternative 1 from the original proposal is the recommended course of action. The estimated probable project cost is approximately $220,200.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - GC-2				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

GC-2

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 5,000.00	$ 5,000.00
2	CLEARING	1	LS	$ 20,000.00	$ 20,000.00
3	EXCAVATION - GRADING	20	CY	$ 28.00	$ 560.00
4	GABION WALL	69	FSF	$ 50.00	$ 3,450.00
5	SEEDING	500	SY	$ 2.50	$ 1,250.00
6	REFORESTATION	0.75	ACRE	$ 3,000.00	$ 2,250.00
7	TRM	500	SY	$ 15.00	$ 7,500.00
8	MAJOR STREAM MAINTENANCE	250	LF	$ 300.00	$ 75,000.00
9	EROSION CONTROL	1	LS	$ 2,000.00	$ 2,000.00
	SUBTOTAL:	≈			$ 117,100.00
	MOBILIZATION (8%)				$ 9,368
	UTILITY RELOCATION (20%)				$ 23,420
	DESIGN ENGINEERING (12%)				$ 14,052
	GEOTECHNICAL INVESTIGATION (8%)				$ 9,368
	CONSTRUCTION ADMINISTRATION (10%)				$ 11,710
	CONTINGENCY (30%)				$ 35,130
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 220,200.00**

Table 6.a.ii-1: GC-2 Preliminary Cost Estimate

PROJECT NAME: GC-2 Date: 8/1/2025

Table 6.a.ii-2: GC-2 Priority Rating Sheet

Section	Subsection	PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding: Points per Category	Chronic (1-Yr) Flooding: No. Lots Affected	Frequent (10-Yr) Flooding: Points per Category	Frequent (10-Yr) Flooding: No. Lots Affected	Infrequent (100-Yr) Flooding: Points per Category	Infrequent (100-Yr) Flooding: No. Lots Affected	Total Points
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	8	50	0	1600
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: GC-2 Date: 8/1/2025

Table 6.a.ii-3: GC-2 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY							
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10		0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount			
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2			0
	Outlet Pipe Extension		PER 10 LF	1			0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3			0
	Gabion Wall		PER 10 LF	2			0
	Channel Enclosure		PER 10 LF	3			0
	Rip Rap Revetment		PER 10 LF	1			0
	Streambank Biostabilization	250	PER 10 LF	2			50
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)		
	Points for Easements						0
					TOTAL PROBLEM POINTS		1600
					TOTAL SOLUTION POINTS		50
					GRAND TOTAL POINTS		1550

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	220.2
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**7.039**

50' 0' 50' 100'

SCALE: 1" = 50'

7600 BLK. CAPILIA DR.

DATE: 08/04/2025

PROJECT: GC-2

FIGURE: 6.a.ii-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
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Figure 6.a.ii-2 7600 Block Capilia Drive

iii. GC-3 9107 Grant Park Drive

The resident at 9107 Grant Park Drive has reported recurring flooding in the rear yard area where the existing open drainage channel transitions into an enclosed stormwater conveyance system. The source of the flooding has been identified as insufficient hydraulic capacity at the junction where the open channel enters the 54-inch Reinforced Concrete Pipe (RCP), identified as structure 25K4-052D. This location lacks the necessary headwater depth and is not equipped with an overflow channel to accommodate excess flow during peak storm events, resulting in surcharge conditions and localized flooding that adversely affects adjacent structures.

Alternative 1

The proposed solution is to protect the building from flooding by removing the basement windows and closing the building entrance next to the creek. This will help prevent water from entering the building and meet the city's flood safety requirements. The estimated probable project cost is approximately $48,600.

Alternative 2

The alternative solution is to upsize approximately 270 linear feet of existing 54-inch RCP to a five-foot by five-foot RCBC. Without additional information for stormwater calculations, this solution is not recommended unless capacity issues have been observed within the existing system beneath Grant Park Drive. Survey and analysis of the existing structure and stormwater facilities must be conducted to determine the headwater depth in comparison to the lowest finish floor elevation. Additionally, analysis of downstream facilities is needed prior to proceeding with Alternative 2. This option would need to be constructed in conjunction with project GC-1 improving the capacity beneath Whitehaven Drive. The estimated probable project cost for the improvements is approximately $482,600. This estimates only the work necessary for upsizing the existing storm sewer beneath Grant Park Drive and does not include any off-site or downstream improvements detailed in GC-1 or which may be identified during further analysis. As such, Alternative 2 has been ranked using the prioritization form but not included in the project summary table.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - GC-3				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

GC-3

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	FLOODPROOFING	1	LS	$ 30,000.00	$ 30,000.00
	SUBTOTAL:	≈			$ 30,000.00
	MOBILIZATION (8%)				$ 3,000
	UTILITY RELOCATION (0%)				$ -
	DESIGN ENGINEERING (12%)				$ 3,600
	GEOTECHNICAL INVESTIGATION (0%)				$ -
	CONSTRUCTION ADMINISTRATION (10%)				$ 3,000
	CONTINGENCY (30%)				$ 9,000
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 48,600.00**

Table 6.a.iii-1: GC-3 Preliminary Cost Estimate

PROJECT NAME: GC-3 Date: 8/1/2025

Table 6.a.iii-2: GC-3 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
		Note:Problem points are awarded only for those problems solved by the proposed solution	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	1	150	0	25	0	300
		Basement (1 lot per structure) Address:	200	1	100	0	15	0	200
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend		lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: GC-3 Date: 8/1/2025

Table 6.a.iii-3: GC-3 Priority Rating Solutions Sheet

	SOLUTION BENEFIT CATEGORY					
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	1		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Floodproofing	1	EACH	10		10
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
					TOTAL PROBLEM POINTS	500
					TOTAL SOLUTION POINTS	10
					GRAND TOTAL POINTS	490

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	48.6
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**10.082**

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - GC-3 - Alternative 2				DATE:	10/3/2025
CRESTWOOD, MISSOURI				EST. BY:	KMM
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR
		GC-3			
ITEM NUMBER	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**TOTAL**
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 24,000.00	$ 24,000.00
2	EXCAVATION AND GRADING	950	CY	$ 12.00	$ 11,400.00
3	5'x5' RCBC	270	LF	$ 565.00	$ 152,550.00
4	8'x8' CURB INLET	2	EA	$ 12,000.00	$ 24,000.00
5	HEADWALL, WINGWALLS, AND APRON	2	EA	$ 18,000.00	$ 36,000.00
6	STABILIZATION	1	LS	$ 6,000.00	$ 6,000.00
	SUBTOTAL:	≈			$ 254,000.00
	MOBILIZATION (8%)				$ 25,400
	UTILITY RELOCATION (20%)				$ 50,800
	DESIGN ENGINEERING (12%)				$ 30,480
	GEOTECHNICAL INVESTIGATION (8%)				$ 20,320
	CONSTRUCTION ADMINISTRATION (10%)				$ 25,400
	CONTINGENCY (30%)				$ 76,200
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 482,600.00**

Table 6.a.iii-1: GC-3 Alternative 2 Preliminary Cost Estimate

PROJECT NAME: GC-3 - ALTERNATIVE 2 Date: 10/3/2025

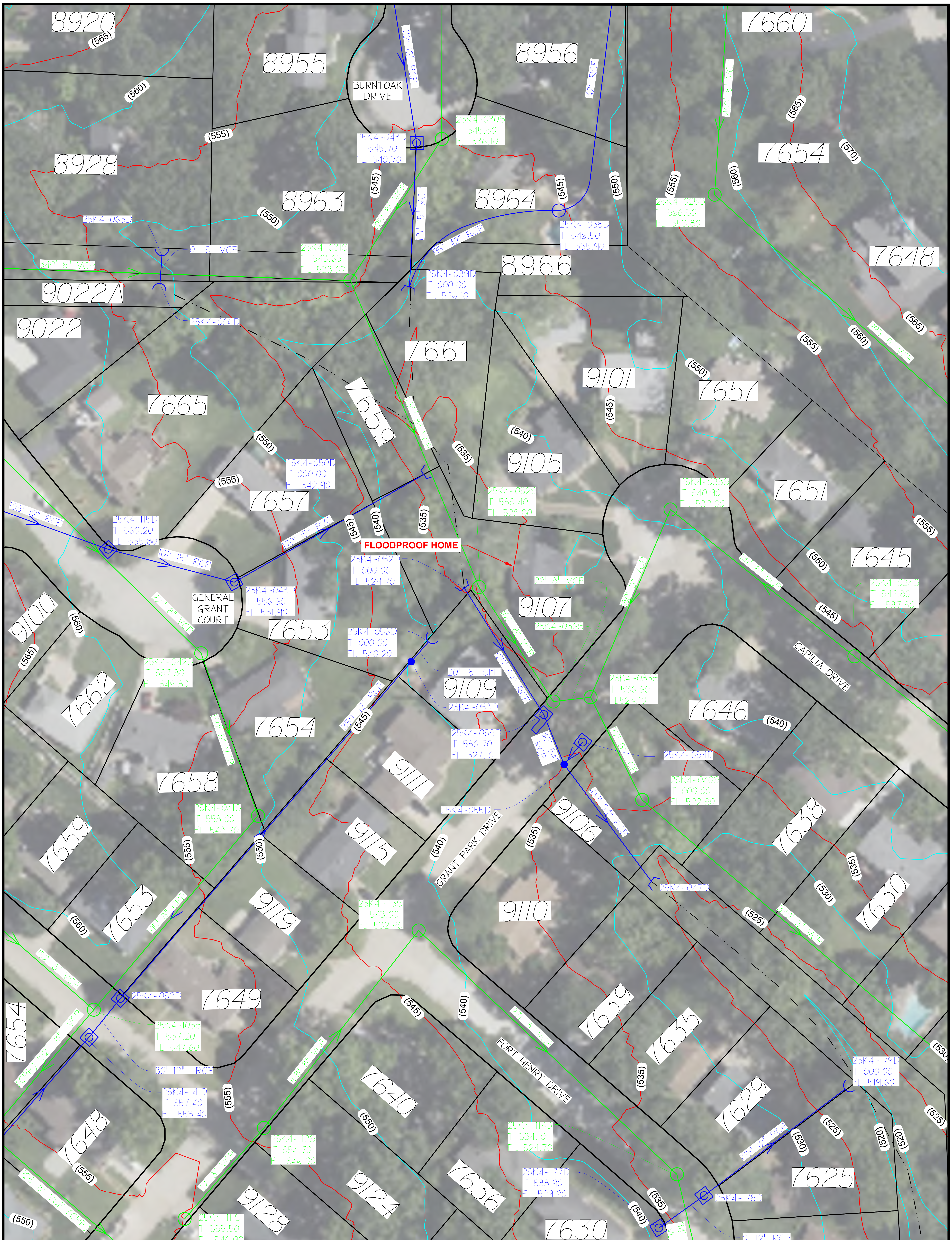
Table 6.a.iii-3: GC-3 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	1		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)	270	PER 10 LF	3		81
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Floodproofing		EACH	10		0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
TOTAL PROBLEM POINTS						500
TOTAL SOLUTION POINTS						81
GRAND TOTAL POINTS						419

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	482.6
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**0.868**



50' 0' 50' 100'

SCALE: 1" = 50'

9107 GRANT PARK DR.

DATE: 08/04/2025

PROJECT: GC-3

FIGURE: 6.a.iii-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
DISCIPLINE: PROFESSIONAL ENGINEERING

Figure 6.a.iii-2 9107 Grant Park Drive

iv. GC-4 9000-9012 Cordoba Lane

Erosion has washed out the area adjacent to the outlet headwall directly behind 9012 Cordoba. The outlet headwall provides structural support for two outfall pipes, labeled 26L2-164D and 26L2-165D. Additional bank erosion was observed just downstream of structural wall systems behind 9006 Cordoba. Erosion was also found at the outlet pipe of the structural wall system along with some debris along the stream banks. The original problem with the yard drainage eroding the west creek bank and yards behind homes located from 9006 to 9024 Cordoba Lane seems to have been resolved from the site visit done by Horner & Shifrin.

The proposed solution involves performing creek maintenance and adding streambank bio-stabilization. Long-term erosion protection should be installed in the form of bio-gabions. The proposed improvement section extends along the west bank 130 feet downstream from the outlet headwall. The bio-gabion extension would tie into the existing wall at this location, which was found to be in good condition. Depending on the grade, a second tier of gabions could be necessary on top of the first. However, in most instances, the slopes from the gabion basket to the top of the slope should be graded at 2 percent and stabilized with vegetation. A detailed construction survey will be required to determine the extents where additional gabions are needed. A mixture of native woodland, riparian, and fescue species should be planted to promote stabilization and durability of the channel section. The slopes above the baskets should be graded back and stabilized with TRMs and Rolled Erosion Control Products (RECP) as necessary. Residents should be informed not to place yard waste or compost piles along the banks of the creek as it compromises the integrity of the channel. Alternative 1 from the original proposal is the recommended course of action. The estimated probable project cost is approximately $75,100.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - GC-4				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

GC-4

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 3,500.00	$ 3,500.00
2	CLEARING	1	LS	$ 1,500.00	$ 1,500.00
3	FENCING	70	LF	$ 50.00	$ 3,500.00
4	EXCAVATION - GRADING	20	CY	$ 28.00	$ 560.00
5	SEEDING	130	SY	$ 2.50	$ 325.00
6	TRM	350	SY	$ 20.00	$ 7,000.00
7	MAJOR STREAM MAINTENANCE	75	LF	$ 300.00	$ 22,500.00
8	EROSION CONTROL	1	LS	$ 1,000.00	$ 1,000.00
	SUBTOTAL:	≈			$ 39,900.00
	MOBILIZATION (8%)				$ 3,192
	UTILITY RELOCATION (20%)				$ 7,980
	DESIGN ENGINEERING (12%)				$ 4,788
	GEOTECHNICAL INVESTIGATION (8%)				$ 3,192
	CONSTRUCTION ADMINISTRATION (10%)				$ 3,990
	CONTINGENCY (30%)				$ 11,970
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 75,100.00**

Table 6.a.iv-1: GC-4 Preliminary Cost Estimate

PROJECTS NAME: GC-4 Date: 8/1/2025

Table 6.a.iv-2: GC-4 Priority Rating Sheet

Section	PROBLEM SOLVED CATEGORY	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
	Note:Problem points are awarded only for those problems solved by the proposed solution	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM / 1.1 FLOODING	1.1.1 Structure Flooding							
	Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
	Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
	Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
	Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
	Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
	Yard Flooding (1 per lot) Address:	150	0	100	0	0	0	0
	1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
	Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
	Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
	Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
	Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
	Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
	Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
	Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
	Public Utility Infrastructure (pipes, culverts, manholes, etc.)	83	Per 10 ft. of Pipe or Specific Structure					830
	1.2.2 No. of lots (from 1.2.1) on outside of bend		lots	10 points per lot				0
	1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Arterial Road:	75	0	50	0	12	0	0
	Collector Road:	35	0	25	0	6	0	0
	Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECTS NAME: GC-4 Date: 8/1/2025

Table 6.a.iv-3: GC-4 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)	40	EACH	2		80
	Outlet Pipe Extension	228	PER 10 LF	1		22.8
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements				0	0
					TOTAL PROBLEM POINTS	830
					TOTAL SOLUTION POINTS	102.8
					GRAND TOTAL POINTS	727.2

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	75.1
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**9.683**

50' 0' 50' 100'

SCALE: 1" = 50'

9000-9012 CORDOBA LN.

DATE: 08/04/2025

PROJECT: GC-4

FIGURE: 6.a.iv-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
DISCIPLINE: PROFESSIONAL ENGINEERING

Figure 6.a.iv-2 9000-9012 Cordoba Lane

v. GC-5 8951-9027 Pardee Road

The Pardee Road roadside drainage system does not have the capacity to handle surface runoff from the road, leading to flooding on the south side between 8951 Pardee Road and Gravois Creek. Several sections of the road are experiencing undercutting. The existing roadside ditch suffers from erosion and lacks the necessary capacity to effectively manage stormwater runoff. Additionally, utility infrastructure, such as power poles located along the road, complicates efforts to widen the roadway and install curb and gutter systems. As a result, the cost estimate includes provisions for utility relocation to accommodate the removal and relocation of these power poles. Construction requires closing one lane and traffic control is required during construction.

The proposed improvements consist of the installation of 1,016 feet of type S-curb and 1,016 feet of 24-inch Reinforced Concrete Pipe (RCP). To ensure proper drainage, three curb inlets will be integrated to facilitate the effective removal of stormwater from the roadway surface. Additionally, restoration efforts will involve the use of sod and Rolled Erosion Control Products (RECP) to immediately stabilize any slopes with observed undercutting along the road, ensuring long-term protection against erosion. The estimated probable project cost is approximately $788,500.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - GC-5				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR
		GC-5			
ITEM NUMBER	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**TOTAL**
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 10,000.00	$ 10,000.00
2	CLEARING	1	LS	$ 15,000.00	$ 15,000.00
3	24" RCP	1016	LF	$ 140.00	$ 142,240.00
4	CURB INLET	3	EA	$ 3,150.00	$ 9,450.00
5	CONNECTION TO EXISTING STRUCTURE	2	EA	$ 2,400.00	$ 4,800.00
6	MANHOLE	1	EA	$ 3,000.00	$ 3,000.00
7	EXCAVATION - GRADING	350	CY	$ 28.00	$ 9,800.00
8	SEEDING	1200	SY	$ 2.50	$ 3,000.00
9	CURB AND GUTTER	1016	LF	$ 40.00	$ 40,640.00
10	ASPHALT PAVEMENT	800	SY	$ 100.00	$ 80,000.00
11	COMPACTION	350	CY	$ 15.00	$ 5,250.00
12	TRAFFIC CONTROL	1	LS	$ 15,000.00	$ 15,000.00
13	EROSION CONTROL	1	LS	$ 60,000.00	$ 60,000.00
	SUBTOTAL:	≈			$ 398,200.00
	MOBILIZATION (8%)				$ 31,856
	UTILITY RELOCATION (30%)				$ 119,460
	DESIGN ENGINEERING (12%)				$ 47,784
	GEOTECHNICAL INVESTIGATION (8%)				$ 31,856
	CONSTRUCTION ADMINISTRATION (10%)				$ 39,820
	CONTINGENCY (30%)				$ 119,460
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 788,500.00**

Table 6.a.v-1: GC-5 Preliminary Cost Estimate

PROJECT NAME: GC-5 Date: 8/1/2025

Table 6.a.v-2: GC-5 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
			Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	8	1	0	40
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	650	Per 10 ft. of Pipe or Specific Structure					6500
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: GC-5 Date: 8/1/2025

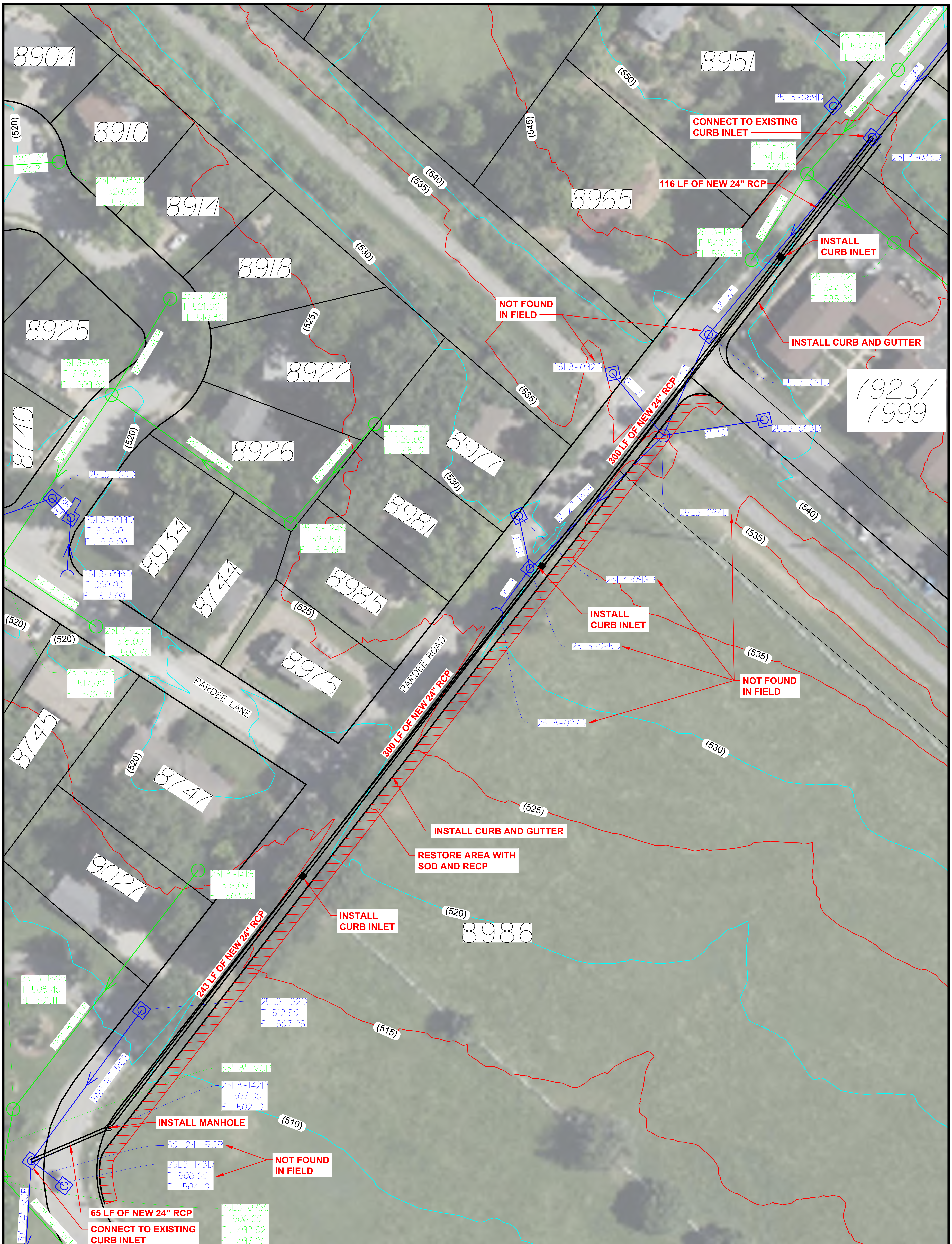
Table 6.a.v-3: GC-5 Priority Rating Solutions Sheet

	SOLUTION BENEFIT CATEGORY					
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure	1016	PER 10 LF	3		304.8
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
	TOTAL PROBLEM POINTS					6540
	TOTAL SOLUTION POINTS					304.8
	GRAND TOTAL POINTS					6235.2

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	788.5
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**7.908**



50' 0' 50' 100'

SCALE: 1" = 50'

8951-9027 PARDEE RD.

DATE:	08/04/2025
PROJECT:	GC-5
FIGURE:	6.a.v-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
DISCIPLINE: PROFESSIONAL ENGINEERING

Figure 6.a.v-2 8951-9027 Pardee Road

vi. GC-6 Whitecliff Park/Pardee Lane

Two primary issues have been identified along Gravois Creek within Whitecliff Park, between the confluence with Mulberry Creek and the Crestwood city limits. This segment of the creek remains in a natural channel configuration. The first issue is progressive fluvial erosion, which is actively destabilizing the streambanks. The second issue involves overbank flooding, which impacts both the southeastern parking lot near the Park Service Road Bridge and the rear yards of residential properties located at 8711–8737 Pardee Lane. During a 15-year recurrence interval storm event, a substantial portion of the park is inundated, with floodwaters reportedly reaching elevations of approximately five feet above the bridge deck.

Field investigations documented widespread severe bank erosion throughout this reach, characterized by vertical and over-steepened banks. Notably, a sanitary sewer line located at the upstream extent of the study area has become exposed and is at risk of structural failure due to near-complete undercutting. Channel morphology indicates active degradation, including vertical incision (downcutting) and subsequent lateral expansion. Due to the substantial bank height and channel width, implementation of a geomorphically stable alignment would necessitate disturbance of a large footprint within the riparian corridor.

Previously, the Metropolitan St. Louis Sewer District (MSD) installed riprap armoring to stabilize a localized section of bank upstream of the Park Service Road Bridge. However, downstream of this location, the same bank continues to exhibit erosive failure. Additionally, the gabion retaining structures on the opposing bank, located just upstream of the bridge, are showing signs of structural failure and deterioration.

The proposed mitigation strategy addresses both erosion and flood-related concerns and consists of a two-part integrated solution, which will be developed to restore hydraulic function and stabilize infrastructure while minimizing environmental disturbance. The original proposal remains the recommended course of action:

Component 1 – Replace the existing bridge. The flooding of the Park Service Road Bridge, which basically acts as a maintenance crossing, is primarily caused by two factors. First, the current bridge skew is 25 degrees, but 40 feet upstream the stream is making a turn from a path that is actually parallel to the orientation of the bridge. Because of momentum and the current skew, higher flows do not make the turn in the contraction zone on the upstream face of the existing bridge. The result is high water flowing into the parking area. The proposed alignment for any replacement structure should have a skew closer to 90 degrees. The second contributing problem is the small flow opening and low elevation of the bridge deck. The recommended solution includes removing the bridge and constructing 80 feet of low flow crossing in the form of a bendway weir with a low flow culvert. Bendway weirs are upstream angled low elevation sills. The weir acts to redirect water flowing over the weir at an angle perpendicular to the channel. Weirs angled upstream direct water away from the outer bank toward the inner part of the bend. This crossing would still provide vehicular access for park maintenance; however, the new alignment would require changes to the vertical alignment of the existing road on the north end of the bridge. A detailed construction survey and bridge proposal would be needed to estimate this component of the project.

Component 2 – Flood bench. Grading changes are recommended for the areas upstream of the service road bridge. A flood bench area of about 9,925 square feet should be excavated on the northeast side of the stream to allow for more efficient conveyance of flows during large flood events. If this flood bench is created, the stream may ultimately realign itself through the flood bench area eliminating the erosion concerns on the opposite bank. Even if realignment does not occur, the erosive forces on the opposite bank will be reduced during large flood events due to the larger channel cross-section. Some introductions of the native riparian species should be performed in the flood bench area to promote the establishment of desirable plant species and preclude the establishment of undesirable vegetation. However, in general, the flood bench area should be allowed to develop naturally. The estimated probable project cost for this component is approximately $300,500.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - GC-6				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

GC-6

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	15" RCP - LOW WATER CROSSING	80	LF	$ 130.00	$ 10,400.00
2	CONCRETE - LOW WATER CROSSING	400	CY	$ 150.00	$ 60,000.00
3	FLOOD BENCH (EXCAVATION)	1100	CY	$ 28.00	$ 30,800.00
4	REFORESTATION	1.25	ACRE	$ 3,000.00	$ 3,750.00
5	REMOVAL OF EXISTING BRIDGE	1	LS	$ 50,000.00	$ 50,000.00
6	RESEEDING - FLOOD BENCH	1124	SY	$ 2.50	$ 2,810.00
7	EROSION CONTROL	1	LS	$ 2,000.00	$ 2,000.00
	SUBTOTAL:	≈			$ 159,800.00
	MOBILIZATION (8%)				$ 12,784
	UTILITY RELOCATION (20%)				$ 31,960
	DESIGN ENGINEERING (12%)				$ 19,176
	GEOTECHNICAL INVESTIGATION (8%)				$ 12,784
	CONSTRUCTION ADMINISTRATION (10%)				$ 15,980
	CONTINGENCY (30%)				$ 47,940
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 300,500.00**

Table 6.a.vi-1: GC-6 Preliminary Cost Estimate

PROJECTS NAME: GC-6 Date: 8/1/2025

Table 6.a.vi-2: GC-6 Priority Rating Sheet

	PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
		Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM / 1.1 FLOODING	1.1.1 Structure Flooding							
	Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
	Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
	Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
	Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
	Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
	Yard Flooding (1 per lot) Address:	150	0	100	0	0	0	0
	1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
	Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	1	100	0	15	0	200
	Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
	Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
	Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.0 STREAM / 1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
	Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
	Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
	Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
	Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
	1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
	1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Arterial Road:	75	0	50	0	12	0	0
	Collector Road:	35	0	25	0	6	0	0
	Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECTS NAME: GC-6 Date: 8/1/2025

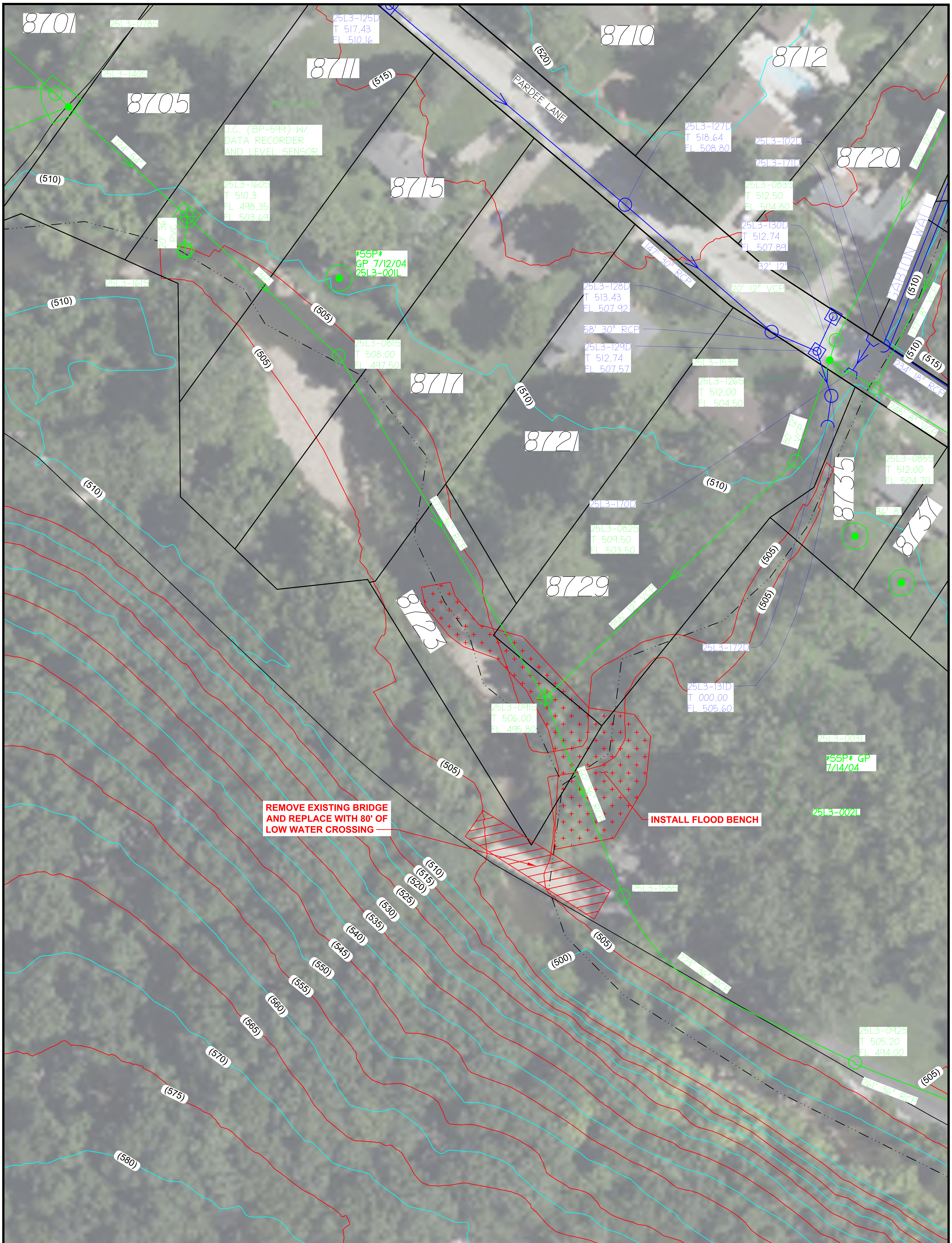
Table 6.a.vi-3: GC-6 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)	239	PER 10 LF	3		71.7
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure	80	PER 10 LF	3		24
	Rip Rap Revetment		PER 10 LF	1		0
	Low Water Crossing	1	EACH	10		10
	Flood Bench	1	EACH	5		5
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements				0	0
					TOTAL PROBLEM POINTS	200
					TOTAL SOLUTION POINTS	110.7
					GRAND TOTAL POINTS	89.3

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	300.5
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**0.297**



50' 0' 50' 100'

SCALE: 1" = 50'

WHITECLIFF PARK/PARDEE LN.

DATE: 08/04/2025

PROJECT: GC-6

FIGURE: 6.a.vi-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
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Figure 6.a.vi-2 Whitecliff Park/Pardee Lane




vii. GC-7 Existing Channel-Blackthorn Drive to Grant Road

The natural channel located between Grant Road and Blackthorn Drive, adjacent to the block parallel to Heather Drive, is experiencing erosion. The upstream section of the channel has undergone modifications, including the installation of riprap along the side slopes. Two outlet pipes, labeled 25L2-352D and 25L2-353D, are present in the existing channel, both of which remain partially filled with standing water. Erosion has been observed around these outlet pipes. Moving downstream, the west side of the channel features gabions that appear to be bulging, while the east side contains a retaining wall that remains in fair condition, except for localized undermining at the wall's end. The channel bottom near the retaining wall and gabion wall previously featured gabions, but high-water velocities have caused erosion of these structures.

At the point where the retaining wall is undermined, there is a drop of approximately two feet in the channel, with standing water present. Further downstream, additional erosion is evident on the side slopes of the channel, where some areas are stabilized with grouted riprap, while others are supported by gabion walls. Multiple outlet pipes discharging into the creek have been observed, with erosion around these pipes indicating a need for maintenance.

In the vicinity of 8 Heather Drive, a wall located in the backyard is in close proximity to the house. This 10-foot-high wall is in poor condition, with an exposed sanitary sewer main running through it and significant cracking and separation along its length. Sections of the wall will require inspection and replacement due to its deteriorated state. Immediately following this wall, the gabion structure adjacent to the house's driveway appears to be leaning. Further downstream, near the box culvert, another sanitary main line crosses the creek, with portions exposed and in need of maintenance. At this crossing, the channel features a one-foot drop. The box culvert itself has been inspected, and exposed rebar was found on the top surface.

The proposed improvement consists of installing bioengineered bank stabilization on both sides of the streambank along approximately 1,635 feet of channel.

Channel velocities do not indicate a need for highly durable armoring solutions, assuming the implementation of a uniform channel cross section. Sections of this area have been previously armored with concrete indicating past concerns for grade stability. These sections require the implementation of stone grade control weirs at regular intervals to limit future down cutting. Stone weirs should be constructed so that the entire width of the channel cross-section is protected, preventing the flows from circumventing the structure.

The proposed stream bank treatments include bio-gabions to reduce velocities compared to those of a concrete-lined channel. The channel would be graded to a depth to convey the 15-year storm while preserving existing trees adjacent to the channel. Existing walls will be replaced with bio-gabions, and the existing degree of meandering of the channel will be preserved, which will help reduce velocities. Additional plantings of trees will complete the re-vegetation of the stream corridor, adjacent to the streambank, to supplement the native riparian and woodland species.

The stabilization of the streambank toe will be dependent on the varying physical characteristics of the channel bottom. The property at 18 Heather Drive marks the division for two types of stabilization that will be needed at the toe of the banks on both sides of the stream. Upstream of 18 Heather Drive, 1,800 feet (including both banks) of coir log should be installed. Downstream of this residence, 1,460 feet (including both banks) of gabion to stabilize the toe for the lower reach should be constructed. In locations where bedrock is exposed on the channel bottom, the use of 18-inch-high gabions is recommended as toe stabilization. These gabions will protect the naturally occurring weak zones where thin layers of soil cannot be sufficiently stabilized with vegetation. Additionally, the use of wire reinforced TRM is recommended in zones where localized velocities are expected to exceed 5 fps. Alternative 1 from the original report is the recommended course of action. The estimated probable project cost is $1,149,700.

HORNER SHIFRIN

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - GC-7				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

GC-7

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 10,000.00	$ 10,000.00
2	CLEARING	1	LS	$ 5,000.00	$ 5,000.00
3	GABION WALL	7650	FSF	$ 50.00	$ 382,500.00
4	WALL REPAIR	1	LS	$ 20,000.00	$ 20,000.00
5	GROUTED RIP RAP	20	SY	$ 110.00	$ 2,200.00
6	EXCAVATION - GRADING	3260	CY	$ 28.00	$ 91,280.00
7	SEEDING	1810	SY	$ 2.50	$ 4,525.00
8	GABION TOE	800	LF	$ 40.00	$ 32,000.00
9	REFORESTATION	3.32	ACRE	$ 3,000.00	$ 9,960.00
10	TRM	1600	SY	$ 15.00	$ 24,000.00
11	EROSION CONTROL	1	LS	$ 30,000.00	$ 30,000.00
	SUBTOTAL:	≈			$ 611,500.00
	MOBILIZATION (8%)				$ 48,920
	UTILITY RELOCATION (20%)				$ 122,300
	DESIGN ENGINEERING (12%)				$ 73,380
	GEOTECHNICAL INVESTIGATION (8%)				$ 48,920
	CONSTRUCTION ADMINISTRATION (10%)				$ 61,150
	CONTINGENCY (30%)				$ 183,450
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 1,149,700.00**

Table 6.a.vii-1: GC-7 Preliminary Cost Estimate

PROJECT NAME: GC-7 Date: 8/1/2025

Table 6.a.vii-2: GC-7 Priority Rating Sheet

PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM							
1.1 FLOODING							
1.1.1 Structure Flooding							
Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
Yard Flooding/Poor Drainage (1 per lot) Address:	10	0	5	0	0	0	0
1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
Traffic obstruction (>6" of water) on residential street. Address:	150	0	100	0	1	0	0
1.2 EROSION							
1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Habitable structures, residential (1 lot per structure) Address:	300	0	200	28	50	0	5600
Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Arterial Road:	75	0	50	0	12	0	0
Collector Road:	35	0	25	0	6	0	0
Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: GC-7 Date: 8/1/2025

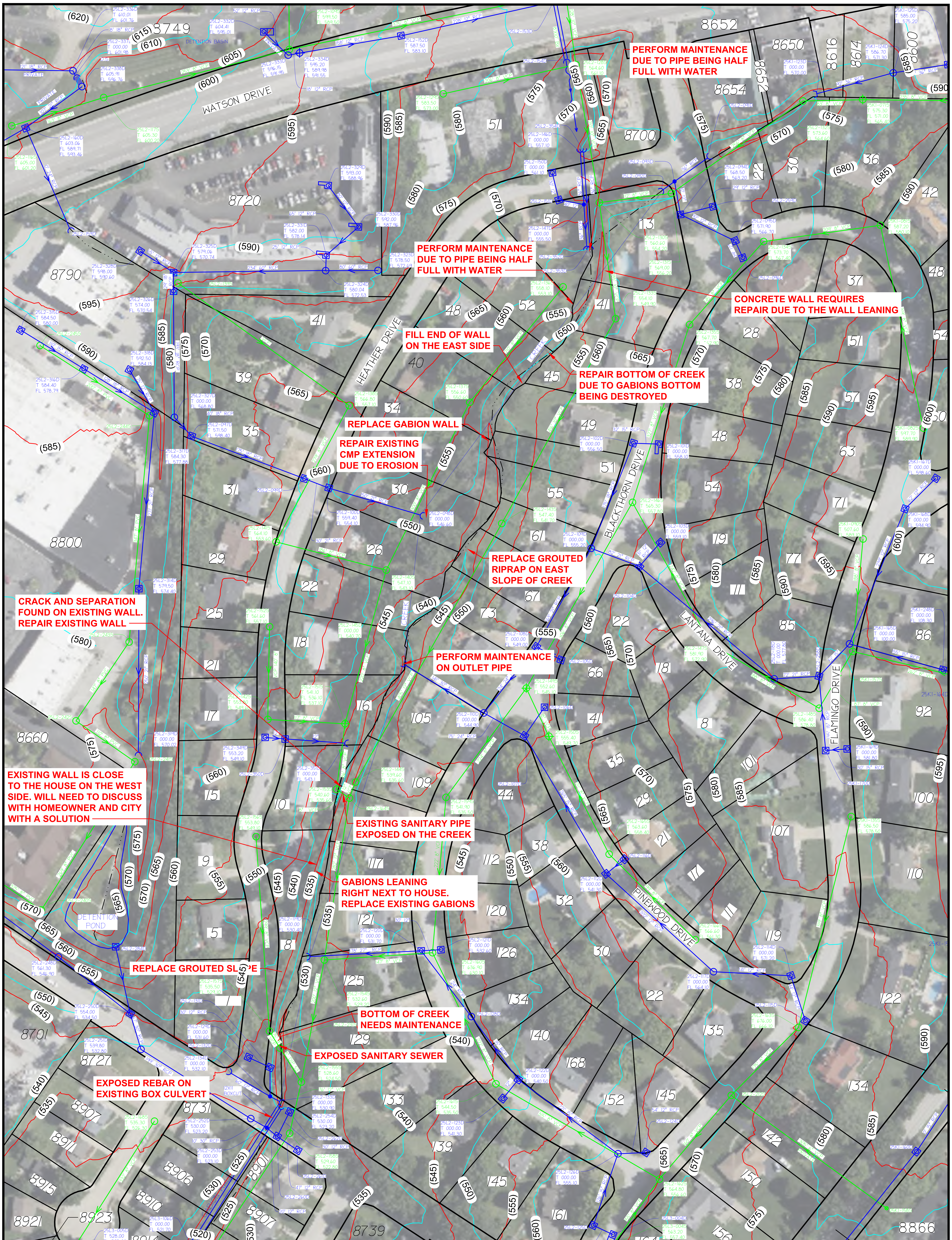
Table 6.a.vii-3: GC-7 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY							
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10		0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount			
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2			0
	Outlet Pipe Extension		PER 10 LF	1			0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3			0
	Gabion Wall	1440	PER 10 LF	2			288
	Channel Enclosure		PER 10 LF	3			0
	Rip Rap Revetment		PER 10 LF	1			0
	Streambank Biostabilization	900	PER 10 LF	2			180
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)		
	Points for Easements						0
						TOTAL PROBLEM POINTS	5600
						TOTAL SOLUTION POINTS	468
						GRAND TOTAL POINTS	5132

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	1149.7
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**4.464**



100' 0' 100' 200'

SCALE: 1" = 100'

EXISTING CHANNEL-
BLACKTHORN DR. TO GRANT RD.

DATE: 08/04/2025

PROJECT: GC-7

FIGURE: 6.a.vii-1

ENGINEER:
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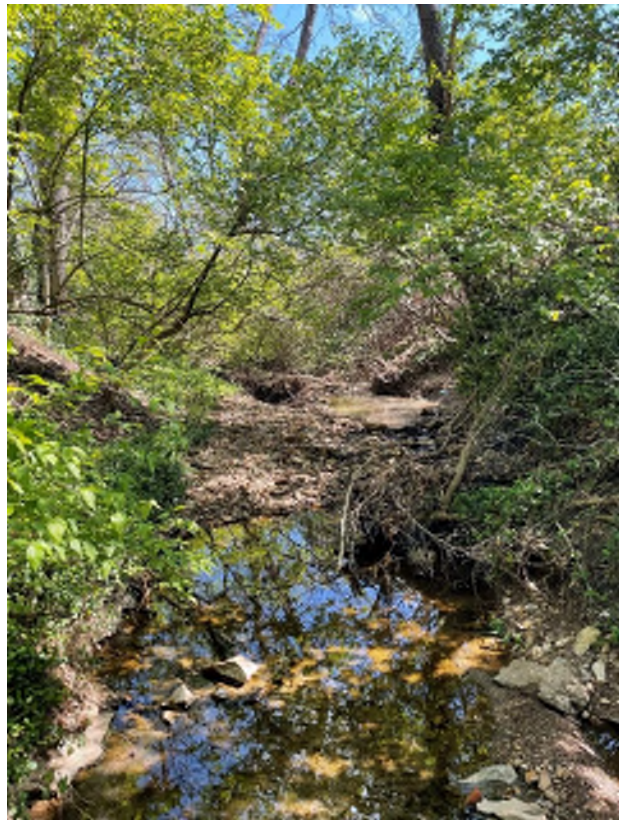
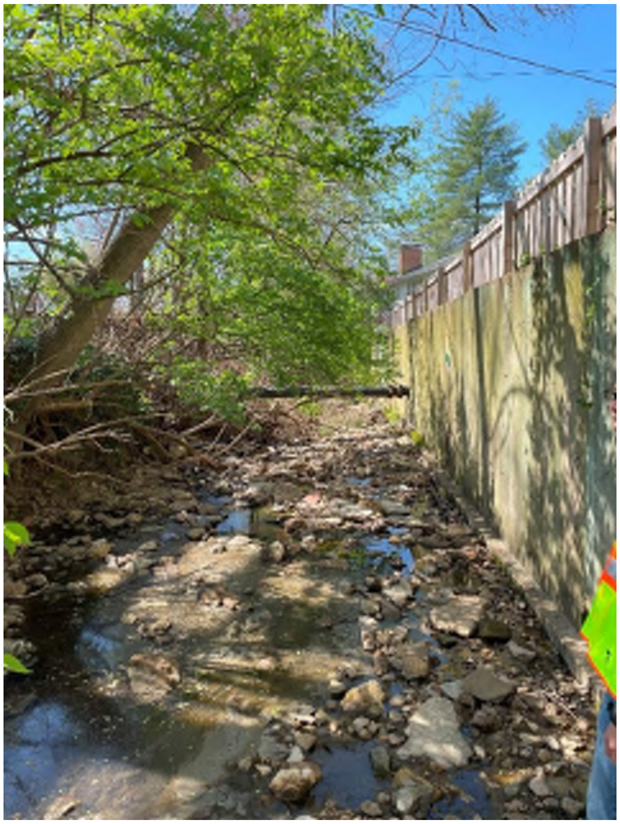
Figure 6.a.vii-2 Existing Channel Blackthorn Drive to Grant Road






viii. GC-8 700 Block Fieldcrest Drive

Based on the site visit conducted by Horner & Shifrin, it appears that the existing box culvert on Fournier Drive was recently constructed, as older reports indicate the original design called for a twin 48-inch RCP configuration. The installed box culvert consists of a double box design with dimensions of six feet by four feet. The outlet pipe of the box culvert requires maintenance, specifically the addition of riprap to address erosion control concerns. Downstream of the box culvert, the channel is generally in acceptable condition. It is likely that the culvert upsizing has mitigated previous erosion issues within the channel. While some cleaning and minor maintenance of the channel will be necessary, no significant problems were observed with the current state of the channel. The estimated probable project cost is $69,000.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - GC-8				DATE:	8/4/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

GC-8

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	CLEARING	1	LS	$ 5,000.00	$ 5,000.00
2	TRM	1070	SY	$ 15.00	$ 16,050.00
3	RIPRAP	76	SY	$ 75.00	$ 5,700.00
4	SEEDING	50	SY	$ 2.50	$ 125.00
5	REFORESTATION	1.6	ACRE	$ 3,000.00	$ 4,800.00
6	EROSION CONTROL	1	LS	$ 5,000.00	$ 5,000.00
	SUBTOTAL:	≈			$ 36,700.00
	MOBILIZATION (8%)				$ 2,936
	UTILITY RELOCATION (20%)				$ 7,340
	DESIGN ENGINEERING (12%)				$ 4,404
	GEOTECHNICAL INVESTIGATION (8%)				$ 2,936
	CONSTRUCTION ADMINISTRATION (10%)				$ 3,670
	CONTINGENCY (30%)				$ 11,010
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 69,000.00**

Table 6.a.viii-1: GC-8 Preliminary Cost Estimate

PROJECT NAME: GC-8 Date: 8/4/2025

Table 6.a.viii-2: GC-8 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
			Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: GC-8 Date: 8/4/2025

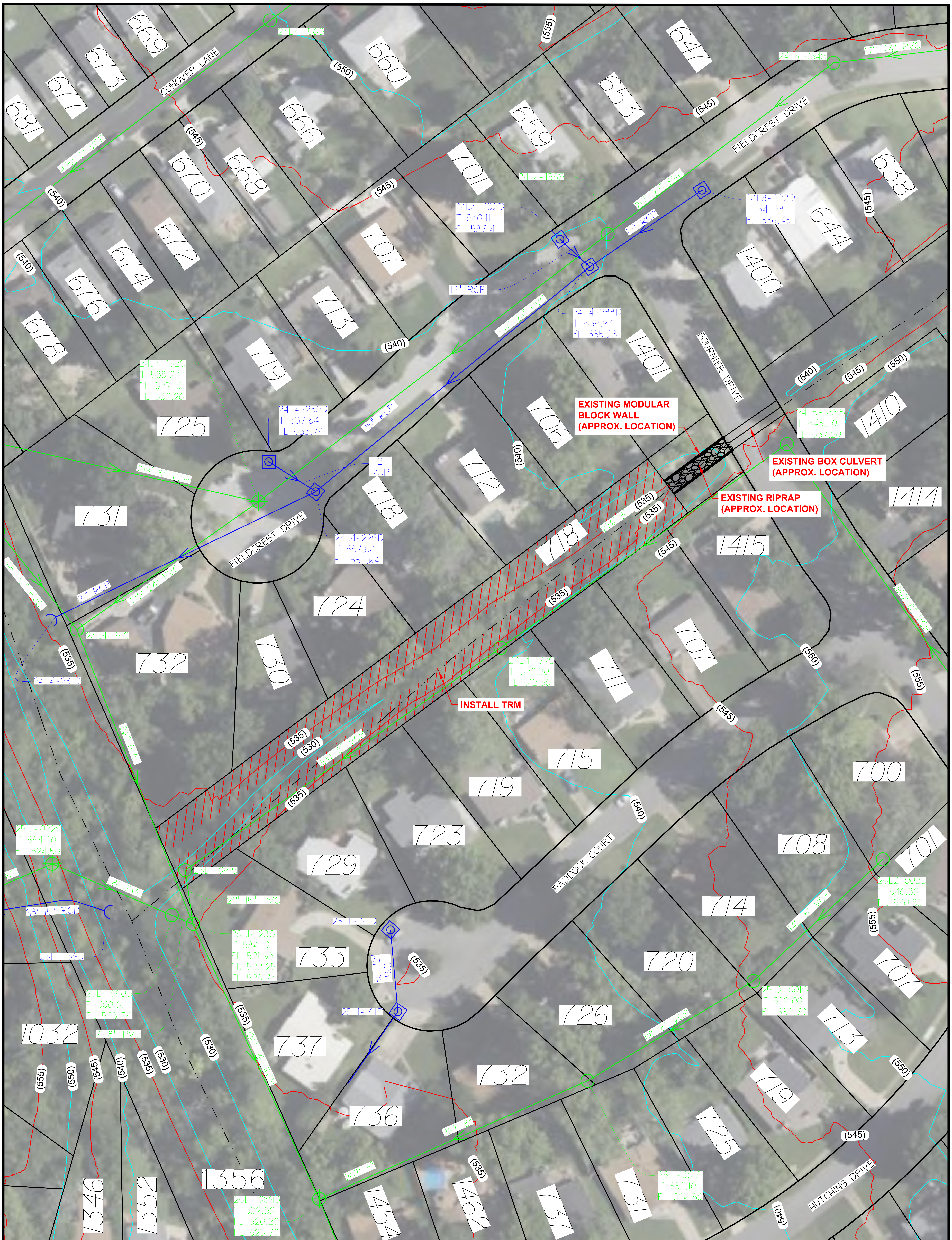
Table 6.a.viii-3: GC-8 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY							
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10		0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount			
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)	1	EACH	2			2
	Outlet Pipe Extension		PER 10 LF	1			0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3			0
	Gabion Wall		PER 10 LF	2			0
	Channel Enclosure		PER 10 LF	3			0
	Rip Rap Revetment		PER 10 LF	1			0
	Streambank Biostabilization	954	PER 10 LF	2			190.8
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)		
	Points for Easements						0
						TOTAL PROBLEM POINTS	0
						TOTAL SOLUTION POINTS	192.8
						GRAND TOTAL POINTS	-192.8

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	69
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**-2.794**



50' 0' 50' 100'

SCALE: 1" = 50'

700 BLK. FIELDCREST DR.

DATE: 08/04/2025

PROJECT: GC-8

FIGURE: 6.a.viii-1

ENGINEER:

HORNER SHIFRIN

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DISCIPLINE: PROFESSIONAL ENGINEERING

Figure 6.a.viii-2 700 Block Fieldcrest Drive




ix. GC-10 1020-1022 Diversey Drive

A site investigation was conducted to assess the condition of the gabion walls along approximately 520 linear feet of creek channel. The gabion structures in this area were originally installed to provide bank stabilization and erosion control. Upon inspection, it was noted that the lower tier of gabion baskets is experiencing widespread corrosion. The steel wire mesh used in the construction of these baskets has deteriorated significantly, leading to the failure of the basket foundations. Additionally, multiple sections of the wall are visibly leaning, indicating potential undermining of the structural base and loss of lateral support. A critical failure has occurred in a 40-foot segment within this reach, where the entire gabion wall has collapsed. The failure is attributed primarily to increased hydraulic loading and erosion at the base of the wall, likely caused by high creek flows during storm events.

The failure of the gabion wall system can be attributed to a combination of long-term corrosion of the basket wire, inadequate foundation protection, and increased hydraulic forces. The lack of protective coatings on the wire baskets has accelerated deterioration, especially in an environment with high moisture and flow variability. The current structural integrity of the remaining gabion walls is compromised, and without intervention, additional segments are at risk of collapse. Hydraulic analysis is warranted to determine whether upstream development or changes in watershed hydrology have contributed to increased flow velocities or volumes. Such changes may exacerbate erosion at the toe of the bank, leading to undermining and structural instability.

The recommended approach to the full replacement of the existing gabion walls involves the implementation of streambank bio stabilization techniques. This method entails the removal of the deteriorated gabion baskets and the installation of bio-gabions, designed to provide both structural support and ecological benefits. To ensure long-term stabilization at the toe of the channel, it is recommended that traditional stone-filled gabions be used as a buried foundation. These would serve as the base of the bio gabion wall system and be constructed in conjunction with a wire Turf Reinforced Mat (TRM). This approach is known to be highly effective when installed on a solid base. The buried gabion toe should ideally be placed at or below the streambed grade, acting as an anchor and reinforcing the streambank toe. However, the feasibility of burying the toe may be limited by site conditions, particularly because the existing gabion wall rests directly on exposed bedrock. In such cases, only the uppermost portion of the toe may be visible during low-flow conditions.

The streambank area above the bio gabion wall would be further stabilized using a combination of a Wire Turf Reinforced Matrix (WTRM) and TRM. The WTRM would be applied to the lower section of the bank above the bio gabions, while the TRM would be used on the upper portions of the slope. This dual system will provide both mechanical stability and support for vegetation establishment on the slope.

Revegetation efforts will include the planting of woody vegetation and native tree species to re-establish a stable riparian corridor. These plantings should include non-spiral root container stock, greenhouse plugs, and root-pruned Root Production Method

(RPM) trees. All vegetation should be planted at an appropriate time and spacing based on site conditions and species' requirements. Where feasible, the use of engineered soil and soil amendments may be employed to enhance plant survival and growth. Alternative 1 from the original report is the recommended course of action. The estimated probable project cost is approximately $583,000.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - GC-10				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

GC-10

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	CLEARING	1	LS	$ 10,000.00	$ 10,000.00
2	REMOVAL OF IMPROVEMENTS	1	LS	$ 25,000.00	$ 25,000.00
3	18" HIGH GABION TOE	1040	LF	$ 50.00	$ 52,000.00
4	BIO-GABION	3120	FSF	$ 45.00	$ 140,400.00
5	EXCAVATION - GRADING	1560	CY	$ 28.00	$ 43,680.00
6	SEEDING	5000	SY	$ 2.50	$ 12,500.00
7	TRM	400	SY	$ 15.00	$ 6,000.00
8	WIRE TURF REINFORCEMENT MAT	400	SY	$ 35.00	$ 14,000.00
9	REFORESTATION	0.5	AC	$ 3,000.00	$ 1,500.00
10	EROSION CONTROL	1	LS	$ 5,000.00	$ 5,000.00
	SUBTOTAL:	≈			$ 310,100.00
	MOBILIZATION (8%)				$ 24,808
	UTILITY RELOCATION (20%)				$ 62,020
	DESIGN ENGINEERING (12%)				$ 37,212
	GEOTECHNICAL INVESTIGATION (8%)				$ 24,808
	CONSTRUCTION ADMINISTRATION (10%)				$ 31,010
	CONTINGENCY (30%)				$ 93,030
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 583,000.00**

PROJECT NAME: GC-10 Date: 8/1/2025

Table 6.a.ix-2: GC-10 Priority Rating Sheet

	PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
		Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM / 1.1 FLOODING	1.1.1 Structure Flooding							
	Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
	Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
	Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
	Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
	Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
	Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
	1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
	Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
	Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
	Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
	Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.0 STREAM / 1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Habitable structures, residential (1 lot per structure) Address:	300	8	200	0	50	0	2400
	Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
	Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
	Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
	Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
	1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
	1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Arterial Road:	75	0	50	0	12	0	0
	Collector Road:	35	0	25	0	6	0	0
	Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: GC-10 Date: 8/1/2025

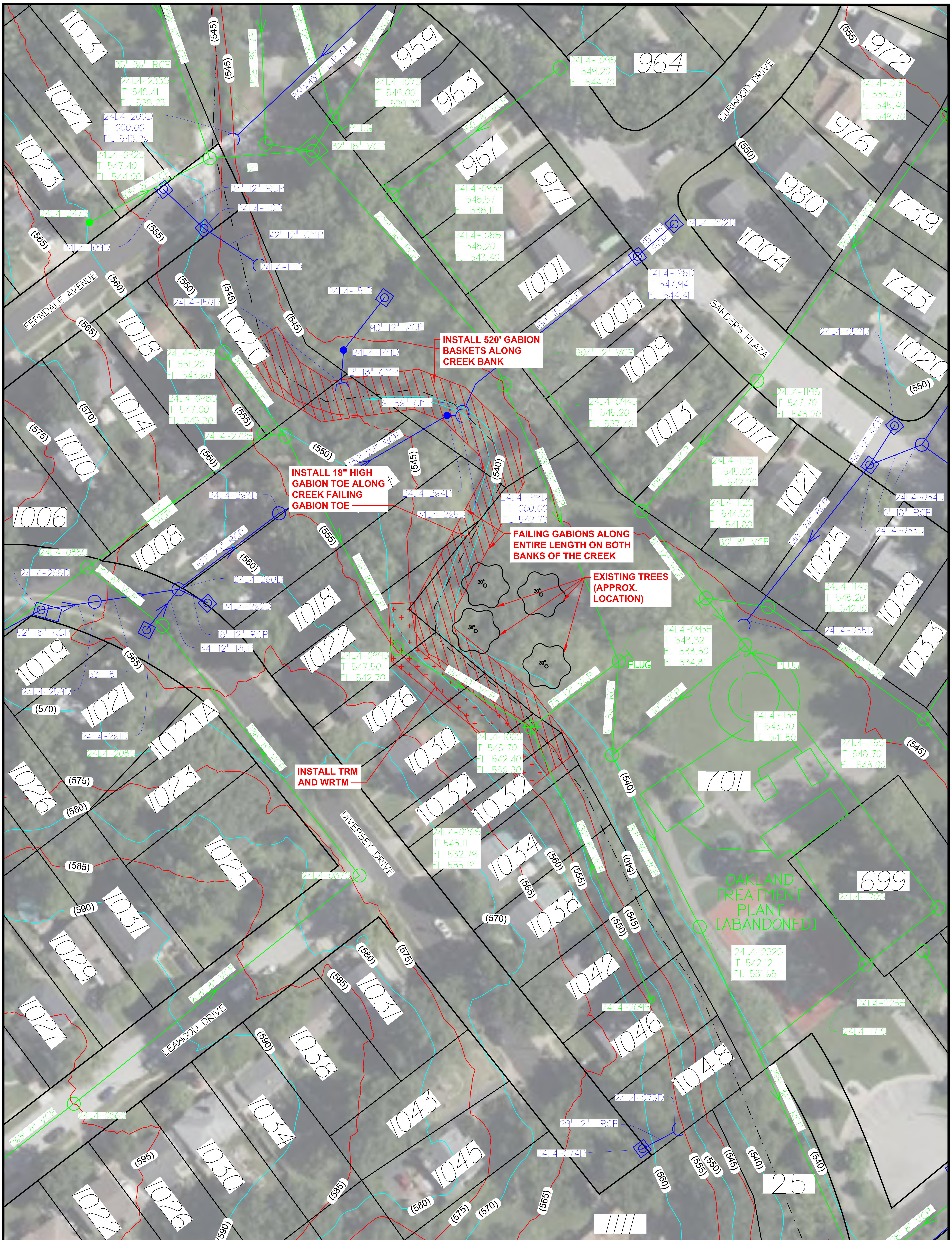
Table 6.a.ix-3: GC-10 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall	520	PER 10 LF	2		104
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Gabion Toe	1040	PER 10 LF	2		208
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
TOTAL PROBLEM POINTS						2400
TOTAL SOLUTION POINTS						312
GRAND TOTAL POINTS						2088

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	583
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**3.581**



50' 0' 50' 100'

SCALE: 1" = 50'

1020-1022 DIVERSEY DR.

DATE: 08/04/2025

PROJECT: GC-10

FIGURE: 6.a.ix-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
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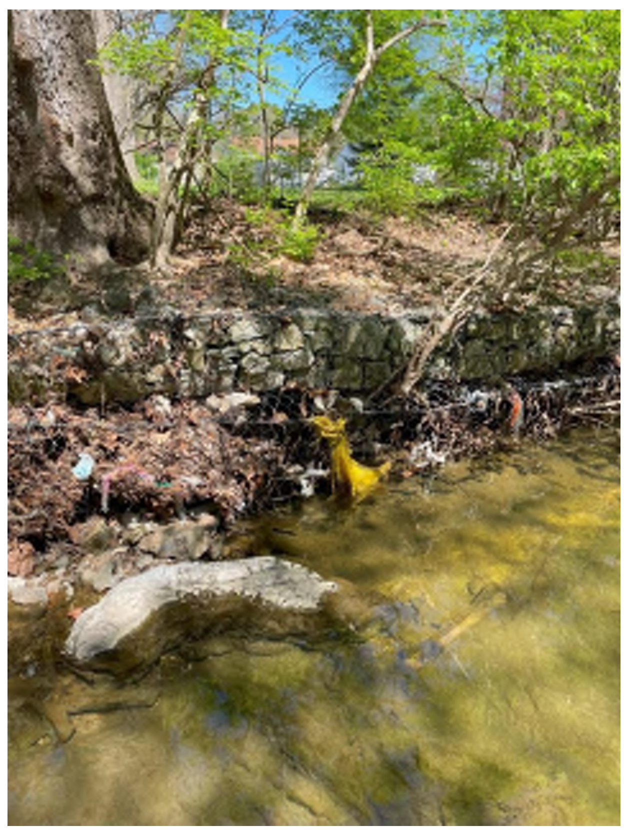
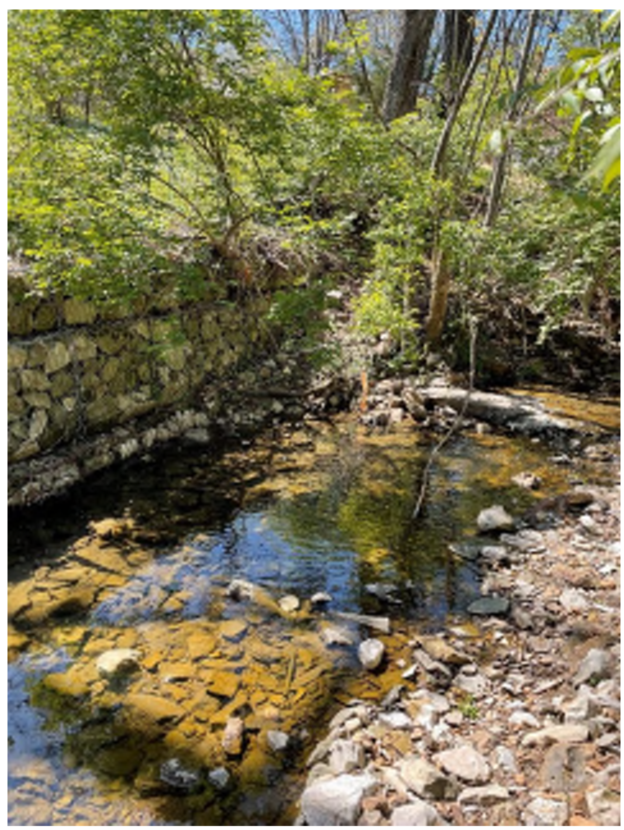
Figure 6.a.ix-2 1020-1022 Diversey Drive





x. GC-16 1032-1039 Coffey Court

A field visit was performed on the properties of 1037 and 1039 Coffey Court that showed drainage issues on the side yards. The side yard issue involves poor drainage that is directing the stormwater towards the basement of the house located at 1032 Coffey Court. An area inlet is located in between the lots of 1032 and 1039 Coffey Court. The area inlet is functioning properly, but the surrounding area will need to be maintained. Upstream of the area inlet is where the drainage issue occurs. A low point is located just upstream of the area inlet and the low point drains towards the house basement. The swale is not graded properly to direct stormwater away from the house. Another concern was found in the rear yard of lot 1039 Coffey Court. The grade on the rear yard is very steep and should be monitored just to make sure the slope does not fail. From the field visit, the slope seems to be in good condition, but it would be beneficial for the city and the homeowner to monitor the slope.

The proposed solution to the issue is to drain the existing swale towards the existing area inlet labeled 25L1-155D. The homeowner would also need to fill the slope that is draining towards the house to prevent ponding near the house. The estimated probable project cost is approximately $8,000.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - GC-16		DATE:	8/1/2025
CRESTWOOD, MISSOURI		EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000		CHK. BY:	SMR

GC-16

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	CLEARING	1	LS	$ 1,000.00	$ 1,000.00
2	EXCAVATION - GRADING	93	CY	$ 28.00	$ 2,604.00
3	SEEDING	350	SY	$ 2.50	$ 875.00
4	EROSION CONTROL	1	LS	$ 500.00	$ 500.00
	SUBTOTAL:	≈			$ 5,000.00
	MOBILIZATION (8%)				$ 400
	UTILITY RELOCATION (0%)				$ -
	DESIGN ENGINEERING (12%)				$ 600
	GEOTECHNICAL INVESTIGATION (0%)				$ -
	CONSTRUCTION ADMINISTRATION (10%)				$ 500
	CONTINGENCY (30%)				$ 1,500
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 8,000.00**

PROJECT NAME: GC-16 Date: 8/1/2025

Table 6.a.x-2: GC-16 Priority Rating Sheet

Section	PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
		Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM / 1.1 FLOODING	1.1.1 Structure Flooding							
	Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
	Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
	Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
	Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
	Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
	Yard Flooding/Poor Drainage (1 per lot) Address:	150	2	100	0	0	0	300
	1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
	Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
	Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
	Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
	Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.0 STREAM / 1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
	Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
	Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
	Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
	Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
	1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
	1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Arterial Road:	75	0	50	0	12	0	0
	Collector Road:	35	0	25	0	6	0	0
	Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: GC-16 Date: 8/1/2025

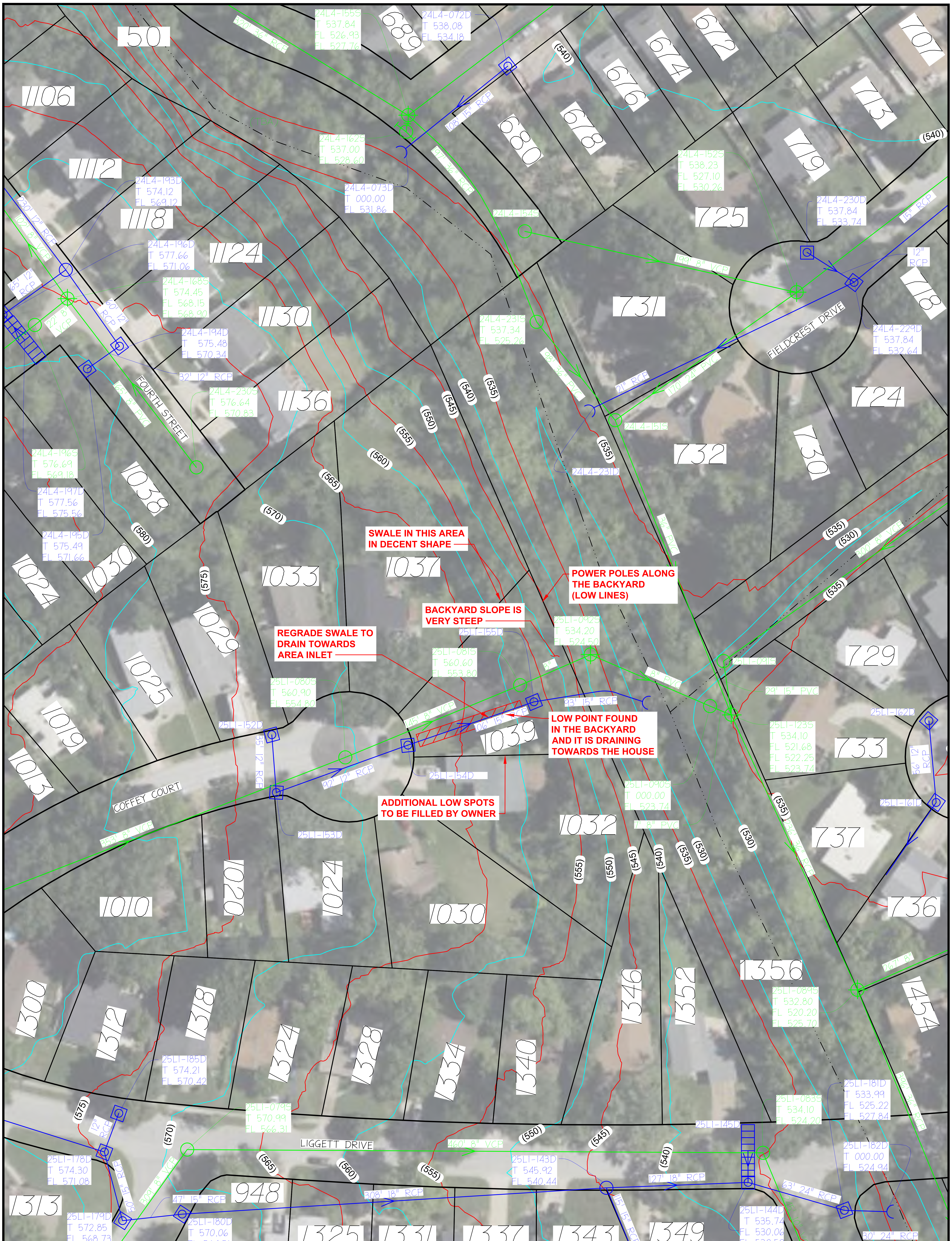
Table 6.a.x-3: GC-16 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Swale	90	PER 10 LF	2		18
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
TOTAL PROBLEM POINTS						300
TOTAL SOLUTION POINTS						18
GRAND TOTAL POINTS						282

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	8
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**35.25**



50' 0' 50' 100'

SCALE: 1" = 50'

1032-1039 COFFEY CT.

DATE: 08/04/2025

PROJECT: GC-16

FIGURE: 6.a.x-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
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Figure 6.a.x-2 1032-1039 Coffey Court

b. Kirkwood Creek Watershed

The Kirkwood Creek watershed contains two projects totaling $368,700, summarized in the table below:

Project Number	Location	Cost
KC-1	9636-9724 Greenview Drive	$111,700
KC-2	1000-1028 Banyon Drive	$257,000

Table 6.b-1: Kirkwood Creek Summary of Cost for Project Areas

i. KC-1 9636-9724 Greenview Drive

Erosion has been identified in the backyards of residential properties located between 9636 and 9724 Greenview Drive. The erosion is primarily attributed to concentrated surface runoff originating from impervious surfaces upstream, including parking lots and Sappington Road. This runoff is conveyed down a steep slope, ultimately discharging into a nearby creek. The resulting high-velocity flow has led to the formation of gullies within the affected backyards. These gullies originate downstream of the 12-inch Reinforced Concrete Pipe (RCP) outfall located at 9720 Greenview Drive. Lots 9708 and 9712 Greenview Drive have fences around their backyards that prevent being able to make any improvements to resolve the issue. Discussions need to take place with the homeowners about being able to do work in their backyards to be able to resolve the issue. In the backyards of lots 9636 and 9640 Greenview Drive, there is a wooded area that has standing water. From the information obtained from the city and county GIS, there is a 30" RCP and manhole in the area. The manhole was not able to be located due to tree blockage. However, the outlet pipe was located, and it was full of water, due to the swale not being defined and maintained downstream.

The proposed scope of work involves the replacement of the existing 24-inch Corrugated Metal Pipe (CMP) located behind 9704 Greenview Drive with a 24-inch RCP. This RCP system will be extended approximately 300 linear feet to the rear of 9720 Greenview Drive to mitigate ongoing gully erosion observed in the backyards along this alignment. A new area inlet is to be constructed in the rear yard between 9720 and 9724 Greenview Drive to intercept surface runoff. Additionally, the existing 12-inch RCP (designated as structure 25L1-106D), which currently discharges on the 9720 Greenview property, shall be extended 50 linear feet and connected to the proposed 24-inch RCP alignment to enhance conveyance efficiency.

The new area inlet shall be a four-sided precast concrete structure, with each side measuring no less than 36 inches, designed to capture excess surface water. A vegetated berm shall be installed approximately 10 feet downstream of the inlet to aid in runoff collection and reduce bypass flow. Furthermore, the area inlet located between 9700 and 9704 Greenview Drive (identified as 25L1-290D) shall be equipped with a catch berm to ensure effective containment of upstream flows and prevent bypassing during peak runoff events.

Maintenance activities are required in the rear yards of 9640 and 9636 Greenview Drive to remove obstructions and restore proper drainage. Additionally, downstream maintenance will be necessary to re-establish the hydraulic function of the existing swale, which has become inefficient and is currently contributing to water accumulation and flow backup toward the outlet structure.

If implementation of a piped drainage system is determined to be unfeasible due to lack of property owner approval, an alternative approach would involve the installation of a biotechnical stabilization system. This system would utilize a soil-filled Rolled Erosion Control Product (RECP) in conjunction with a Turf Reinforced Mat (TRM) and turf-type sod. Due to the shade in this area, it is recommended that the sod also be over-seeded with a shade-tolerant fescue species—such as Dawson's Slender, Chewings, or Creeping Red fescue—to ensure successful establishment in lower-light environments. Alternative 1 from the previous report is the recommended course of action. The estimated probable project cost is approximately $111,700.

HORNER SHIFRIN

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - KC-1				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR
KC-1					
ITEM NUMBER	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**TOTAL**
1	CLEARING	1	LS	$ 5,000.00	$ 5,000.00
2	24" RCP	300	LF	$ 140.00	$ 42,000.00
3	AREA INLET	2	EA	$ 3,200.00	$ 6,400.00
4	MANHOLE	1	EA	$ 3,000.00	$ 3,000.00
5	EXCAVATION - GRADING	20	CY	$ 28.00	$ 560.00
6	SEEDING	350	SY	$ 2.50	$ 875.00
7	EROSION CONTROL	1	LS	$ 1,500.00	$ 1,500.00
	SUBTOTAL:	≈			$ 59,400.00
	MOBILIZATION (8%)				$ 4,752
	UTILITY RELOCATION (20%)				$ 11,880
	DESIGN ENGINEERING (12%)				$ 7,128
	GEOTECHNICAL INVESTIGATION (8%)				$ 4,752
	CONSTRUCTION ADMINISTRATION (10%)				$ 5,940
	CONTINGENCY (30%)				$ 17,820
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 111,700.00**

Table 6.b.i-1: KC-1 Preliminary Cost Estimate

PROJECT NAME: KC-1 Date: 8/1/2025

Table 6.b.i-2: KC-1 Priority Rating Sheet

PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding: Points per Category	Chronic (1-Yr) Flooding: No. Lots Affected	Frequent (10-Yr) Flooding: Points per Category	Frequent (10-Yr) Flooding: No. Lots Affected	Infrequent (100-Yr) Flooding: Points per Category	Infrequent (100-Yr) Flooding: No. Lots Affected	Total Points
1.0 STREAM							
1.1 FLOODING							
1.1.1 Structure Flooding							
Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
Yard Flooding/Poor Drainage (1 per lot) Address:	150	6	100	0	0	0	900
1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.2 EROSION							
1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Habitable structures, residential (1 lot per structure) Address:	300	0	150	0	50	0	0
Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Arterial Road:	75	0	50	0	12	0	0
Collector Road:	35	0	25	0	6	0	0
Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: KC-1 Date: 8/1/2025

Table 6.b.i-3: KC-1 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.: 10		0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)	1	EACH	2		2
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure	281	PER 10 LF	3		84.3
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Maintenance	1	EACH	5		5
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
TOTAL PROBLEM POINTS						900
TOTAL SOLUTION POINTS						91.3
GRAND TOTAL POINTS						808.7

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS = 111.7

(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS = **7.24**

50' 0' 50' 100'

SCALE: 1" = 50'

9636-9724 GREENVIEW DR.

DATE:	08/04/2025
PROJECT:	KC-1
FIGURE:	6.b.i-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
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Figure 6.b.i-2 9636-9724 Greenview Drive


NO
TRESPASSING

ii. KC-2 1000-1028 Banyon Drive

Erosion along the banks of Kirkwood Creek is threatening fences and utilities along the rear yards between 1000 and 1028 Banyon Drive.

To enhance channel stability and prevent erosion, the installation of a buried rock gabion toe is recommended. Stone-filled gabions, when placed on a properly prepared and compacted subgrade, provide a durable and resilient solution for toe stabilization, particularly when integrated with a Wire Turf Reinforcement Mat (WTRM). The gabion structure should be embedded at or slightly below the streambed elevation to function as structural reinforcement for the streambank toe.

The bank slope above the gabion should be regraded and transitioned smoothly from the top of the gabion to the bank crest, with WTRMs installed over these regraded slopes to provide long-term erosion protection. Alternative 1 from the original report is the recommended course of action. The estimated probable project cost is approximately $257,000.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - KC-2				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

KC-2

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	CLEARING	1	LS	$ 5,000.00	$ 5,000.00
2	BIO-GABION	2010	FSF	$ 45.00	$ 90,450.00
3	EXCAVATION - GRADING	760	CY	$ 28.00	$ 21,280.00
4	REFORESTATION	2	ACRE	$ 3,000.00	$ 6,000.00
5	SEEDING	290	SY	$ 2.50	$ 725.00
6	WTRM	290	SY	$ 35.00	$ 10,150.00
7	EROSION CONTROL	1	LS	$ 3,000.00	$ 3,000.00
	SUBTOTAL:	≈			$ 136,700.00
	MOBILIZATION (8%)				$ 10,936
	UTILITY RELOCATION (20%)				$ 27,340
	DESIGN ENGINEERING (12%)				$ 16,404
	GEOTECHNICAL INVESTIGATION (8%)				$ 10,936
	CONSTRUCTION ADMINISTRATION (10%)				$ 13,670
	CONTINGENCY (30%)				$ 41,010
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 257,000.00**

PROJECT NAME: KC-2 Date: 8/1/2025

Table 6.b.ii-2: KC-2 Priority Rating Sheet

PROBLEM SOLVED CATEGORY		Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
Note:Problem points are awarded only for those problems solved by the proposed solution		Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM / 1.1 FLOODING	1.1.1 Structure Flooding							
	Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
	Basement (1 lot per structure) Address:	200	0	100	7	15	0	700
	Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
	Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
	Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
	Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	4	0	0	400
	1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
	Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
	Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
	Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
	Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Habitable structures, residential (1 lot per structure) Address:	300	0	150	0	50	0	0
	Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	2	25	0	200
	Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	150	0	50	0	0
	Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
	Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
	1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
	1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Arterial Road:	75	0	50	0	12	0	0
	Collector Road:	35	0	25	0	6	0	0
	Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: KC-2 Date: 8/1/2025

Table 6.b.ii-3: KC-2 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY							
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10		0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount			
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2			0
	Outlet Pipe Extension		PER 10 LF	1			0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3			0
	Gabion Wall	1340	PER 10 LF	2			268
	Channel Enclosure		PER 10 LF	3			0
	Rip Rap Revetment		PER 10 LF	1			0
	Streambank Biostabilization		PER 10 LF	2			0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)		
	Points for Easements						0
						TOTAL PROBLEM POINTS	1300
						TOTAL SOLUTION POINTS	268
						GRAND TOTAL POINTS	1032

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	257
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**4.016**

50' 0' 50' 100'

SCALE: 1" = 50'

1000-1028 BANYON DR.

DATE: 08/04/2025

PROJECT: KC-2

FIGURE: 6.b.ii-1

ENGINEER:

HORNER SHIFRIN

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Figure 6.b.ii-2 1000-1028 Banyon Drive

c. Mulberry Creek Watershed

Alternates for MC-6 have been included in the table below for tracking purposes and are not displayed in the Mulberry Creek project total. The Mulberry Creek watershed contains 18 projects totaling $2,873,100, summarized in the table below:

Project Number	Location	Cost
MC-1	9440-9506 Lodge Pole Lane	$3,200
MC-5	9600 Block Yorkshire Estates Drive	$671,200
MC-6	9781-9783 Twin Vista Drive	$56,400
MC-6.2	9781-9783 Twin Vista Drive (alt. 2)	$155,000
MC-6.3	9781-9783 Twin Vista Drive (alt. 3)	$1,853,400
MC-7	8900 Block Lindenhurst Drive	$217,900
MC-10	9000 Block Maple Grove/Sky Crest	$600,300
MC-11	Existing Channel-Lowill Lane to Crest Oak Lane	$307,800
MC-12	8900 Block Rudson Lane	$624,800
MC-13	8866-8878 Rudson Lane	$51,200
MC-14	10069-10075 Baberton Drive	$59,100
MC-15	8901 Manda Lane	$0
MC-16	Mulberry Creek Crossing	$63,400
MC-17	8701-8715 Gayle Avenue	$90,900
MC-18	8718-8722 Villa Crest Drive	$14,600
MC-19	9409 Sappington Greens Lane	$9,200
MC-21	8856 Glen Rose Drive	$9,600
MC-22	9875 Richter Lane	$6,100
MC-23	Eudora Court/Arban Drive1	$76,000
MC-24	9501-9503 Crain Court	$11,400

Table 6.c-1: Mulberry Creek Summary of Cost for Project Areas

i. MC-1 9440-9506 Lodge Pole Lane

The structural armoring along the north bank of the channel, between 9440 and 9506 Lodge Pole Lane, is eroding to the point where armor material is being displaced. Visual inspection indicates toe scour and undermining of the grouted riprap, particularly along the lower portion of the side slope. This progressive loss of support is reducing the effectiveness of the slope stabilization system and poses a potential threat to the structural integrity of residential fencing located near the top of bank. Continued erosion may result in further land loss and compromised private property assets.

The areas where the grouted riprap is beginning to deteriorate should be replaced and grouted to match the existing channel bank. Alternative 2 from the original report is the recommended course of action. The estimated probable project cost of is approximately $3,200.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-1				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-1

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	EXCAVATION - GROUTED RIP RAP	10	CY	$ 15.00	$ 150.00
2	GROUTED RIP RAP	20	SY	$ 28.00	$ 560.00
3	REMOVAL - GROUTED RIP RAP	10	CY	$ 20.00	$ 200.00
4	SEEDING	80	SY	$ 2.50	$ 200.00
5	EROSION CONTROL	1	LS	$ 500.00	$ 500.00
	SUBTOTAL:	≈			$ 1,700.00
	MOBILIZATION (8%)				$ 136
	UTILITY RELOCATION (20%)				$ 340
	DESIGN ENGINEERING (12%)				$ 204
	GEOTECHNICAL INVESTIGATION (8%)				$ 136
	CONSTRUCTION ADMINISTRATION (10%)				$ 170
	CONTINGENCY (30%)				$ 510
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 3,200.00**

PROJECT NAME: MC-1 Date: 8/1/2025

Table 6.c.i-2: MC-1 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
		Note:Problem points are awarded only for those problems solved by the proposed solution	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-1 Date: 8/1/2025

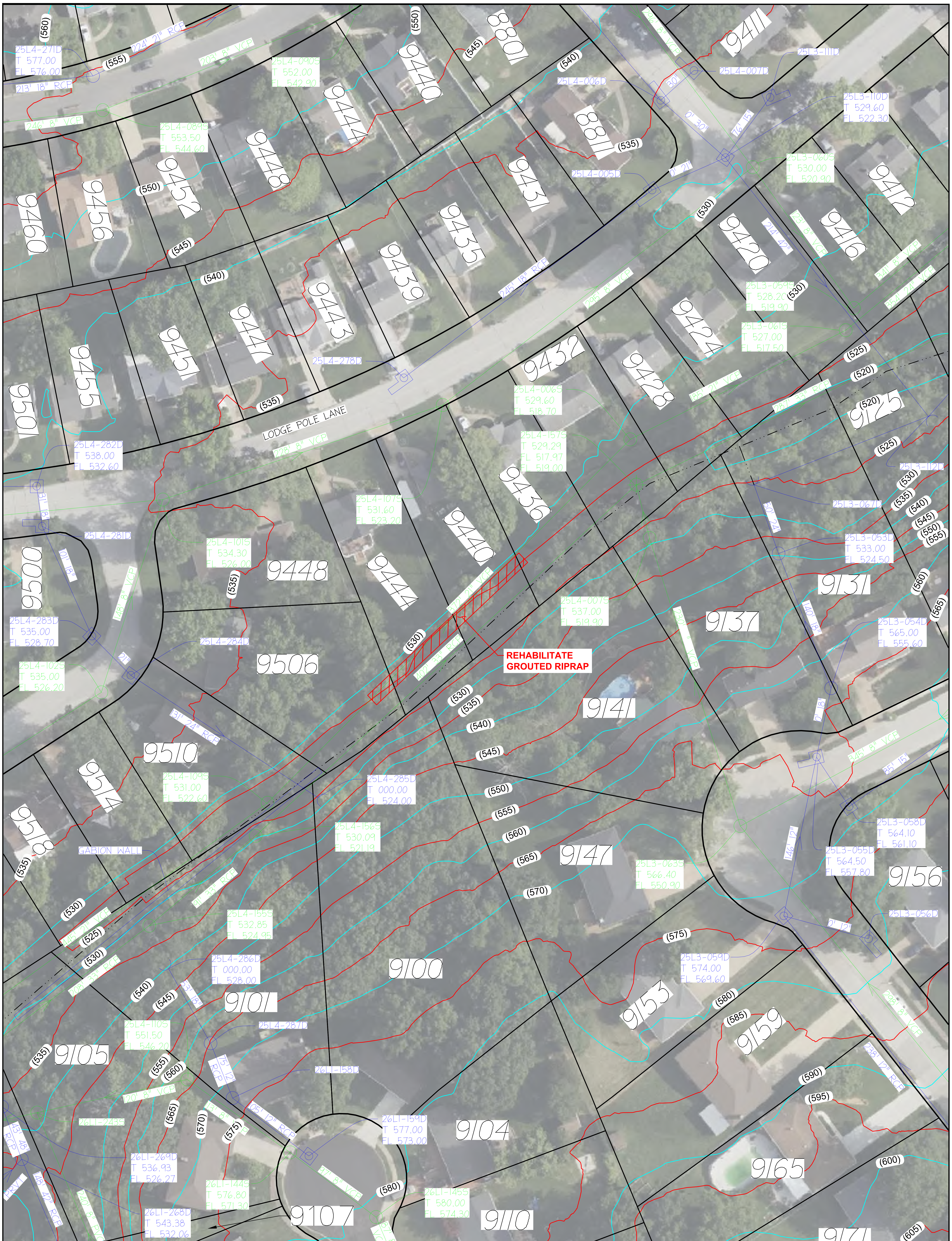
Table 6.c.i-3: MC-1 Priority Rating Solutions Sheet

	SOLUTION BENEFIT CATEGORY					
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization	160	PER 10 LF	2		32
	Maintenance		PER 10 LF	5		0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
	TOTAL PROBLEM POINTS					0
	TOTAL SOLUTION POINTS					32
	GRAND TOTAL POINTS					-32

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	3.2
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**-10**



50' 0' 50' 100'

SCALE: 1" = 50'

9440-9506 LODGE POLE LN.

DATE: 08/04/2025

PROJECT: MC-1

FIGURE: 6.c.i-1

ENGINEER:

HORNER SHIFRIN

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Figure 6.c.i-2 9440-9506 Lodge Pole Lane

ii. MC-5 9600 Block Yorkshire Estates Drive

An inspection was conducted beginning at 9648 Yorkshire Estates Drive, where gabion walls were identified along the south side of the creek. The base of these structures is exhibiting significant corrosion, resulting in the failure of the gabion basket foundations. Additionally, several sections of the gabions are bulging, which appear to be attributable to the presence of nearby trees. In at least one location, tree roots have penetrated the gabion structure, further compromising its integrity.

Progressing downstream within the channel, an outlet pipe labeled 26L1-213D was located. The gabions in this vicinity are in generally good condition and will require only routine maintenance. However, another outlet pipe, labeled 26L1-053D, was found to be in poor condition. A substantial sinkhole, approximately eight feet in depth, was observed at this location. This sinkhole is contributing to increased erosion in the area. The Corrugated Metal Pipe (CMP) connected to the Reinforced Concrete Pipe (RCP) has deteriorated due to erosion and will need to be replaced in conjunction with the sinkhole repair to mitigate future reoccurrence.

Further along the south side of the creek, additional gabion walls were noted to exhibit similar deficiencies as those upstream, primarily involving failure of the lower layers. In contrast, gabion walls along the north side of the creek were observed to be in stable condition.

On the north side, a third outlet pipe, identified as 26L1-016D, was found with grouted riprap installed around the outlet. The riprap is experiencing undermining and will require replacement to ensure long-term stability and prevent potential failure.

At 9628 Yorkshire Estates Drive, a block retaining wall located in the backyard is in poor condition and must be removed. The existing wall has been extended by the property owners using additional blocks, which are also failing. An adjacent gabion wall on the same property is leaning and will require replacement. A tree positioned directly atop this wall is exacerbating the structural instability.

Further downstream, additional gabion structures were found in substandard conditions, with numerous sections missing or exhibiting failure of the bottom layer.

Inspections of properties located at 9616 and 9620 Yorkshire Estates Drive revealed that the residences are situated at a lower elevation relative to the top of the box culvert labeled 26L1-037D. A hydraulic analysis will be necessary to determine whether the existing culvert has adequate capacity to convey the 100-year storm event. A potential mitigation measure includes the installation of a 220-foot-long, four-foot-high floodwall to protect the residential structures from inundation. Additionally, where a concrete swale connects at a bend in the system, signs of undermining were observed, and corrective maintenance will be required at that location.

The proposed scope of work includes the construction of approximately 220 linear feet of floodwall, with a height of four feet, to provide overbank flood protection for the properties located at 9616 and 9620 Yorkshire Estates Drive. This proposed height accounts for the overtopping elevation of New Sappington Road.

Hydraulic capacity at the overtopping location is primarily governed by the existing culvert structure identified as 26L1-040D, which consists of a double six-foot by 11.5-foot Reinforced Concrete Box (RCB) culvert system situated beneath New Sappington Road. Per the Metropolitan St. Louis Sewer District's (MSD) Gravois Creek Watershed Study, and verified using aerial topographic elevation data, this culvert provides sufficient conveyance for the 15-year storm event.

Approximately 870 linear feet of stream bank and existing gabions should be removed and re-graded using geogrid reinforcement and rolled erosion control products (RECP). The toe of the slope within this reach generally consists of exposed bedrock, which contributes to inherent slope stability; however, in segments where bedrock is absent, continued erosive degradation has been observed. These locations will require regrading to stable slope geometries and reinforcement through the establishment of vegetative cover.

Streambank stabilization in vegetated zones shall be accomplished using Turf Reinforcement Mat (TRM) and Wire Turf Reinforcement Mat (WTRM) systems to enhance root support and surface protection where velocities are high. In areas adjacent to the low water line where vegetation cannot be reliably established, structural toe protection will be necessary to prevent undercutting and sloughing. Organic fiber logs or riprap may be appropriate for these locations. All revegetation efforts will utilize native riparian and woodland species to ensure compatibility with the existing ecosystem and to support long-term bank stability.

The existing eroded CMP outlet structures along the creek are to be replaced with new RCP sections, with each replacement sized according to the corresponding existing CMP dimensions. In conjunction with the pipe replacement, all associated erosion at each outlet location must be remediated to ensure structural stability and long-term functionality of the new RCP installations.

The estimated probable project cost is approximately $671,200.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-5				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-5

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 10,000.00	$ 10,000.00
2	FLOODWALL	30	CY	$ 700.00	$ 21,000.00
3	EXCAVATION - EXISTING STRUCTURAL WALL SYSTEM	260	CY	$ 12.00	$ 3,120.00
4	EXCAVATION - GRADING	400	CY	$ 12.00	$ 4,800.00
5	GROUTED RIP RAP	10	SY	$ 110.00	$ 1,100.00
6	GABION WALL	250	FSF	$ 50.00	$ 12,500.00
7	CONCRETE SWALE REPAIR	1	LS	$ 1,000.00	$ 1,000.00
8	54" RCP	40	LF	$ 225.00	$ 9,000.00
9	PUNCH THROUGH WALL	1	EA	$ 8,000.00	$ 8,000.00
10	GEOGRID REINFORCED FILL SLOPE RECP	8800	FSF	$ 30.00	$ 264,000.00
11	MATERIAL TO BE HAULED OFF SITE	260	CY	$ 15.00	$ 3,900.00
12	REFORESTATION	1.3	ACRE	$ 3,000.00	$ 3,900.00
13	SEEDING	630	SY	$ 2.50	$ 1,575.00
14	TRM	870	SY	$ 15.00	$ 13,050.00
	SUBTOTAL:	≈			$ 357,000.00
	MOBILIZATION (8%)				$ 28,560
	UTILITY RELOCATION (20%)				$ 71,400
	DESIGN ENGINEERING (12%)				$ 42,840
	GEOTECHNICAL INVESTIGATION (8%)				$ 28,560
	CONSTRUCTION ADMINISTRATION (10%)				$ 35,700
	CONTINGENCY (30%)				$ 107,100
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 671,200.00**

Table 6.c.ii-1: MC-5 Preliminary Cost Estimate

PROJECT NAME: MC-5 Date: 8/1/2025

Table 6.c.ii-2: MC-5 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
			Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	15	25	0	2250
		Basement (1 lot per structure) Address:	200	0	100	15	15	0	1500
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	15	50	0	3000
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-5 Date: 8/1/2025

Table 6.c.ii-3: MC-5 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)	1	EACH	2		2
	Outlet Pipe Extension	40	PER 10 LF	1		4
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization	880	PER 10 LF	2		176
	Berm		PER 10 LF	1		0
	Flood Wall	220	PER 10 LF	3		66
	Maintenance	4	EACH	5		20
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
TOTAL PROBLEM POINTS						6750
TOTAL SOLUTION POINTS						268
GRAND TOTAL POINTS						6482

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	671.2
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**9.657**

100' 0' 100' 200'

SCALE: 1" = 100'

9600 BLK. YORKSHIRE ESTATES DR.

DATE:	08/04/2025
PROJECT:	MC-5
FIGURE:	6.c.ii-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
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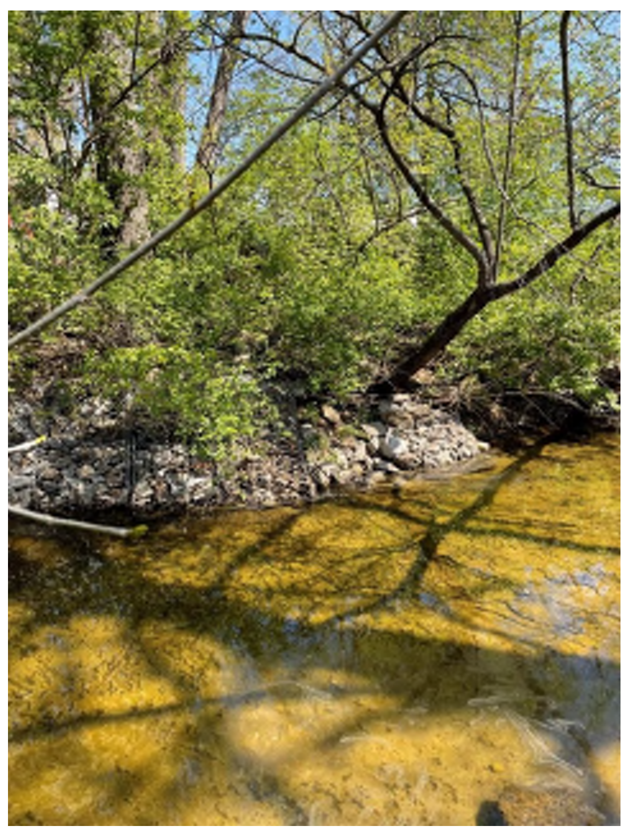
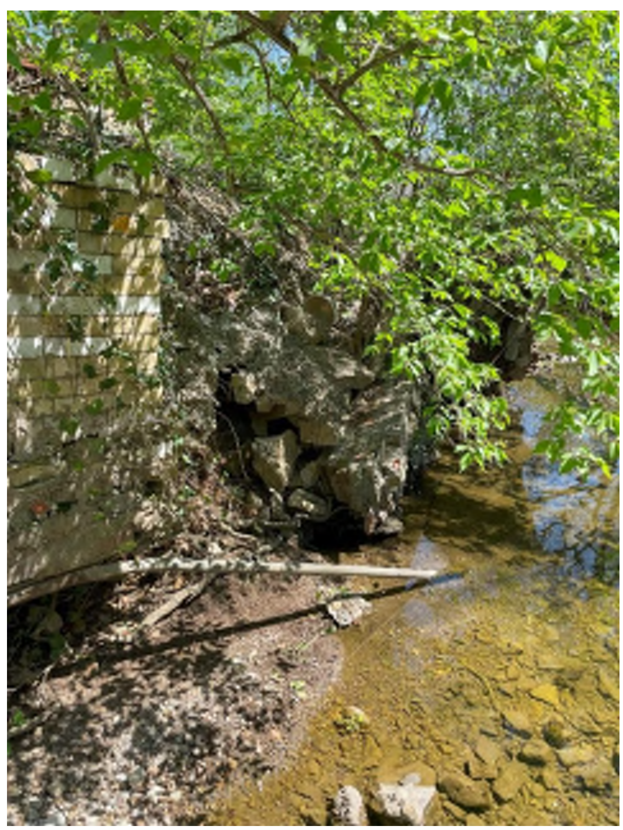
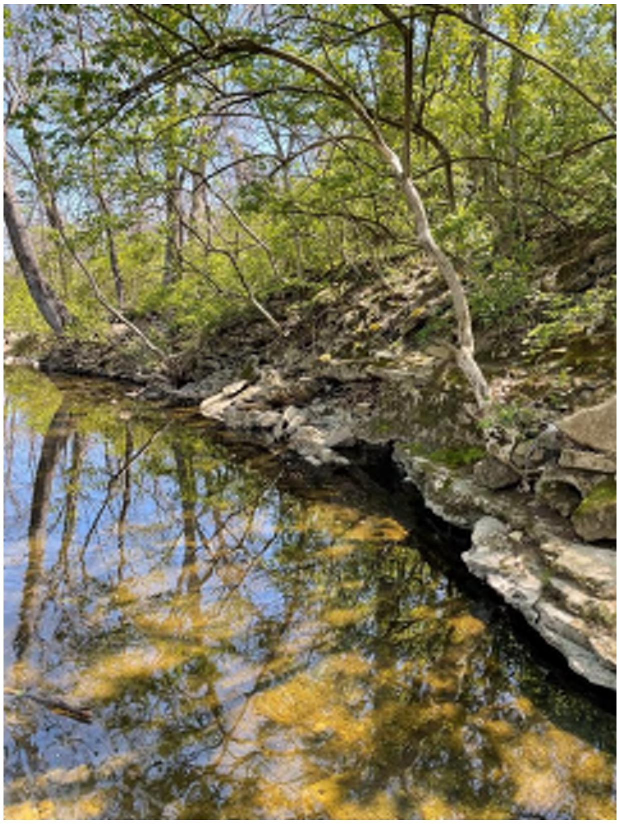
Figure 6.c.ii-2 9600 Block Yorkshire Estates Drive







iii. MC-6 9781-9783 Twin Vista Drive

Structural flooding is observed between 9781 and 9783 Twin Vista Drive as a result of hydraulic surcharge from area inlets 25L4-060D and 25L4-061D. The absence of an overflow conveyance system prevents the excess runoff from being redirected downstream without encountering structures. Furthermore, the existing 42-inch storm sewer line located between the two properties lacks adequate capacity, worsening the localized flooding conditions during storm events.

Alternative 1

The most cost-effective solution to the issue involves implementing comprehensive floodproofing measures for the adjacent garage and residence. This includes sealing or eliminating all low-elevation openings that could permit water intrusion and reinforcing or modifying the building foundations to enhance their resistance to hydrostatic and hydrodynamic flood forces. The concrete to the rear of the structure should also be removed and replaced to provide positive drainage away from the structure. This solution prioritizes floodproofing the affected structure to prevent water intrusion while the area inlet's capacity is exceeded. The existing 42" line, line 25L4-060D, still lacks the capacity to drain the 100-year storm due to the reduced slope through this section. The estimated probable project cost is approximately $56,400.

Alternative 2

Alternative 2 involves detaining the stormwater currently draining to inlet 25L4-060D. The recommended project would be to construct a detention pond and reconstruct inlet 25L4-061D to serve as the outlet structure for the proposed pond to reduce the peak to the capacity of the existing 12" RCP. This reduction would serve to improve the functionality of the existing area inlet, but line 25L4-060D still lacks the capacity to drain the off-site 100-year flow from the north due to its reduced slope. Additionally, a drainage easement for the detention pond and its access would need to be purchased from the owner of 9780 East Watson Road. The estimated probable cost for providing detention north of 9783 Twin Vista Drive is $155,000. Alternative 2 has been ranked using the prioritization form but is not displayed on the project summary table due to receiving a lower score.

Alternative 3

Alternative 3 consists of upsizing the existing 42" RCP downstream of inlet 25L4-060D. Approximately 1,306 linear feet of existing 42" would need to be removed and replaced with 5'x5' RCBC or 8'x3' RCBC depending on the available cover. Survey and additional analysis are needed to confirm the extent of downstream improvements and verify the capacity of downstream structures. The estimated probable cost for upsizing the existing 42" RCP to 5'x5' RCBC is $1,853,400. The surrounding lines have a greater slope; therefore, further analysis may provide an option where a limited number of sections can be reconstructed to share the grade. It is unknown whether utility conflicts or other factors led to the reduced slope of line 25L4-060D. Based on these factors, Alternative 3 has been ranked using the prioritization form but is not displayed on the project summary table due to receiving a lower score.

HORNER SHIFRIN

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-6				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-6

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	FLOOD PROOFING	1	EA	$ 50,000.00	$ 50,000.00
	SUBTOTAL:	≈			$ 50,000.00
	MOBILIZATION (8%)				$ 4,000
	UTILITY RELOCATION (0%)				$ -
	DESIGN ENGINEERING (12%)				$ 6,000
	GEOTECHNICAL INVESTIGATION (0%)				$ -
	CONSTRUCTION ADMINISTRATION (10%)				$ 5,000
	CONTINGENCY (30%)				$ 15,000
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 80,000.00**

PROJECT NAME: MC-6 Date: 8/1/2025

Table 6.c.iii-2: MC-6 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
		Note:Problem points are awarded only for those problems solved by the proposed solution	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	1	25	0	150
		Basement (1 lot per structure) Address:	200	0	100	1	15	0	100
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-6 | Date: 8/1/2025

Table 6.c.iii-3: MC-6 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	1		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Berm		PER 10 LF	1		0
	Floodproofing	1	EACH	10		10
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
					TOTAL PROBLEM POINTS	250
					TOTAL SOLUTION POINTS	10
					GRAND TOTAL POINTS	240

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	80
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**3**

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-6 - Alternative 2 DATE: 10/6/2025
CRESTWOOD, MISSOURI EST. BY: KMM
HORNER & SHIFRIN PROJECT # 250103000 CHK. BY: SMR

MC-6

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMPROVEMENTS	1	EA	$ 18,000.00	$ 18,000.00
2	DRAINAGE EASEMENT PURCHASE	14325	SF	$ 1.50	$ 21,487.50
3	EXCAVATION AND GRADING	1200	CY	$ 12.00	$ 14,400.00
4	OUTLET STRUCTURE, REBUILD EXISTING INLET	1	EA	$ 8,500.00	$ 8,500.00
5	STABILIZATION	1	LS	$ 20,000.00	$ 20,000.00
	SUBTOTAL:	≈			$ 82,400.00
	MOBILIZATION (8%)				$ 6,592
	UTILITY RELOCATION (20%)				$ 16,480
	DESIGN ENGINEERING (12%)				$ 9,888
	GEOTECHNICAL INVESTIGATION (8%)				$ 6,592
	CONSTRUCTION ADMINISTRATION (10%)				$ 8,240
	CONTINGENCY (30%)				$ 24,720
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 155,000.00**

PROJECT NAME: MC-6 - ALTERNATIVE 2 Date: 10/6/2025

Table 6.c.iii-3: MC-6 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	1		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Berm	400	PER 10 LF	1		40
	Floodproofing		EACH	10		0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
					TOTAL PROBLEM POINTS	250
					TOTAL SOLUTION POINTS	40
					GRAND TOTAL POINTS	210

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	155
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**1.355**

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-6 - Alternative 3		DATE:	10/6/2025
CRESTWOOD, MISSOURI		EST. BY:	KMM
HORNER & SHIFRIN PROJECT # 250103000		CHK. BY:	SMR

MC-6

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMPROVEMENTS	1	EA	$ 65,000.00	$ 65,000.00
2	EXCAVATION AND GRADING	3069	CY	$ 12.00	$ 36,828.00
3	5'x5' RCBC	1306	LF	$ 565.00	$ 737,890.00
4	8'x8' CURB INLET, AREA INLET, MANHOLE	9	EA	$ 12,000.00	$ 108,000.00
5	HEADWALL, WINGWALLS, AND APRON	1	EA	$ 18,000.00	$ 18,000.00
6	STABILIZATION	1	LS	$ 20,000.00	$ 20,000.00
	SUBTOTAL:	≈			$ 985,800.00
	MOBILIZATION (8%)				$ 78,864
	UTILITY RELOCATION (20%)				$ 197,160
	DESIGN ENGINEERING (12%)				$ 118,296
	GEOTECHNICAL INVESTIGATION (8%)				$ 78,864
	CONSTRUCTION ADMINISTRATION (10%)				$ 98,580
	CONTINGENCY (30%)				$ 295,740
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 1,853,400.00**

PROJECT NAME: MC-6 - ALTERNATIVE 3 | Date: 10/6/2025

Table 6.c.iii-3: MC-6 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)	1	EACH	1		1
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)	1300	PER 10 LF	3		390
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Berm		PER 10 LF	1		0
	Floodproofing		EACH	10		0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
TOTAL PROBLEM POINTS						250
TOTAL SOLUTION POINTS						391
GRAND TOTAL POINTS						-141

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	1853.4
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**-0.076**

50' 0' 50' 100'

SCALE: 1" = 50'

9781-9783 TWIN VISTA DR.

DATE:	08/04/2025
PROJECT:	MC-6
FIGURE:	6.c.iii-1

ENGINEER:
HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
DISCIPLINE: PROFESSIONAL ENGINEERING

Figure 6.c.iii-2 9781-9783 Twin Vista Drive

iv. MC-7 8900 Block Lindenhurst Drive

A site inspection of the properties located between 8966 and 8978 Lindenhurst Drive revealed multiple drainage and erosion control deficiencies. Rear yard flooding and slope instability are evident, likely due to inadequate stormwater conveyance and lack of proper grading. At 9656 Lindenhurst Drive, the property owner has implemented provisional mitigation measures, including the placement of sandbags along the east basement window well and the excavation of a narrow, non-engineered drainage channel to redirect surface runoff. At 8968 Belmar Court, a structurally insufficient retaining wall appears to be contributing to progressive erosion and potential slope failure. Furthermore, standing water was observed on the sidewalk in front of 8968 Lindenhurst Drive, suggesting poor surface drainage and the need for evaluation of curb/gutter function and pavement grading in that location. These conditions warrant further hydrologic assessment and may require engineered solutions to prevent continued infrastructure degradation and property damage.

The property at 8978 Belmar Court is experiencing localized flooding attributed to a recent building addition on the school property directly to the south. While a culvert discharges runoff toward an existing drainage ditch along Richter Lane, the ditch lacks clear definition and is heavily vegetated, impeding effective stormwater conveyance. To mitigate overflow onto the adjacent roadway and into area inlet 26L1-070D, it is recommended that the swale be cleared and regraded to reestablish proper flow paths. Given the increased runoff from the new development, the existing inlet (26L1-070D) is insufficient to manage a 15-year design storm and may require hydraulic upgrades or additional infrastructure to meet capacity needs. See below for the recommended solution to each issue.

Component 1 – This solution proposes the installation of a subsurface drainage system within the rear yards of the affected properties, with discharge connected to the existing municipal stormwater infrastructure at curb inlet 26L1-007D on Lindenhurst Drive. The scope includes the installation of a new curb inlet at 8968 Belmar Court to address chronic surface ponding and sidewalk inundation. Additionally, an area inlet will be installed in between the properties at 8969 and 9656 Lindenhurst Drive and 8968 and 8970 Lindenhurst Drive to intercept overland flow and mitigate localized yard flooding and erosion. Approximately 329 linear feet of 12-inch diameter RCP will be installed to provide hydraulic connectivity between the new inlets and the existing storm sewer network.

This drainage improvement is intended to alleviate recurring drainage and erosion concerns by facilitating the positive conveyance of stormwater runoff from rear yards to the public storm system.

Component 2 – A system of existing drainage structures, including area inlets designated as 26L1-070D and 26L1-071D, along with an unlabeled CMP end section, is situated south of the property located at 8978 Lindenhurst Drive. These structures currently discharge to junction box 26L1-068D. It is recommended that site grading be revised in the vicinity of the inlets to optimize surface runoff capture and mitigate excessive bypass flow. Additionally, regrading and redefining the existing swale within the adjacent wooded area is advised to improve stormwater conveyance and reduce the potential for drainage impacts to properties along Lindenhurst Drive and Belmar Court.

Component 3 – Two 100-foot lengths of four-foot-high block retaining walls terraced behind 8963 Belmar Court. Geotechnical investigation is needed prior to foundation design and wall drainage needs, to be provided with final design.

Component 4 – Provide backyard drainage swales behind the residences of Belmar Court to divert the stormwater to existing inlet structures. The estimated probable cost for all four components is approximately $217,900.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-7				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-7

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	15" RCP	272	LF	$ 115.00	$ 31,280.00
2	24" RCP	104	LF	$ 140.00	$ 14,560.00
2	MODULAR BLOCK WALL	400	SF	$ 48.00	$ 19,200.00
3	CONNECTION TO EXISTING STRUCTURE	1	EA	$ 2,400.00	$ 2,400.00
4	CURB INLET	1	EA	$ 3,150.00	$ 3,150.00
5	AREA INLET	2	EA	$ 3,200.00	$ 6,400.00
6	CONCRETE DRIVEWAY	6	SY	$ 93.00	$ 558.00
7	S CURB AND GUTTER	60	LF	$ 50.00	$ 3,000.00
8	CONCRETE SIDEWALK	4	SY	$ 63.00	$ 252.00
9	ASPHALT PAVEMENT	15	SY	$ 100.00	$ 1,500.00
10	EXCAVATION - GRADING	980	CY	$ 28.00	$ 27,440.00
11	SEEDING	225	SY	$ 2.50	$ 562.50
12	CLEARING	1	LS	$ 2,500.00	$ 2,500.00
14	EROSION CONTROL	1	LS	$ 2,000.00	$ 2,000.00
15	TRAFFIC CONTROL	1	LS	$ 1,000.00	$ 1,000.00
	SUBTOTAL:	≈			$ 115,900.00
	MOBILIZATION (8%)				$ 9,272
	UTILITY RELOCATION (20%)				$ 23,180
	DESIGN ENGINEERING (12%)				$ 13,908
	GEOTECHNICAL INVESTIGATION (8%)				$ 9,272
	CONSTRUCTION ADMINISTRATION (10%)				$ 11,590
	CONTINGENCY (30%)				$ 34,770
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 217,900.00**

Table 6.c.iv-1: MC-7 Preliminary Cost Estimate

PROJECT NAME: MC-7 Date: 8/1/2025

Table 6.c.iv-2: MC-7 Priority Rating Sheet

PROBLEM SOLVED CATEGORY	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
Note:Problem points are awarded only for those problems solved by the proposed solution	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM – 1.1 FLOODING							
1.1.1 Structure Flooding							
Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	6	25	0	900
Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.0 STREAM – 1.2 EROSION							
1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Habitable structures, residential (1 lot per structure) Address:	300	0	150	5	50	0	750
Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Arterial Road:	75	0	50	0	12	0	0
Collector Road:	35	0	25	0	6	0	0
Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-7 Date: 8/1/2025

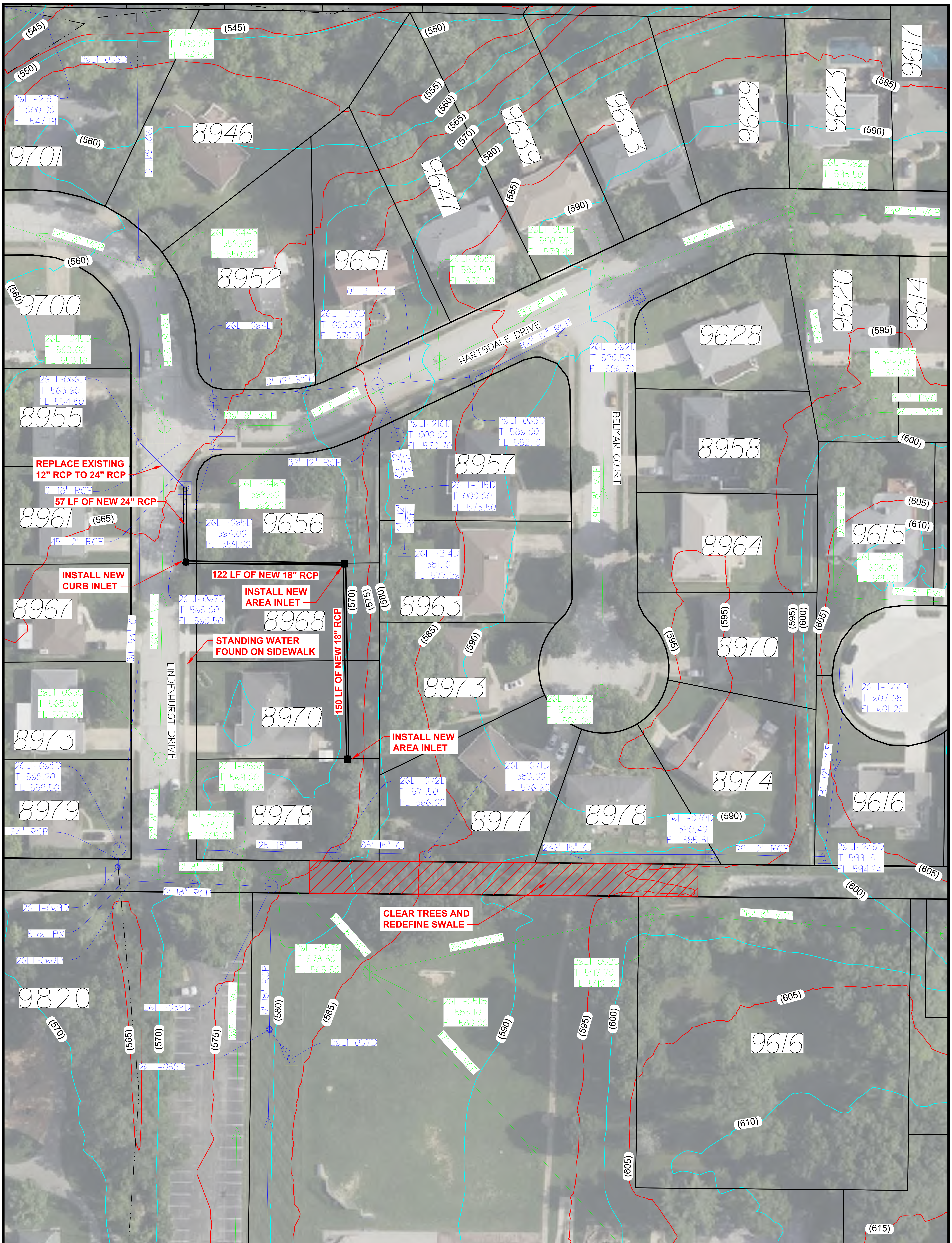
Table 6.c.iv-3: MC-7 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure	329	PER 10 LF	3		98.7
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Berm		PER 10 LF	2		0
	Swale Maintenance	300	PER 10 LF	2		60
	New Pipe	47	PER 10 LF	3		14.1
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
					TOTAL PROBLEM POINTS	1650
					TOTAL SOLUTION POINTS	172.8
					GRAND TOTAL POINTS	1477.2

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	217.9
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**6.779**



50' 0' 50' 100'

SCALE: 1" = 50'

8900 BLK. LINDENHURST DR.

DATE: 08/04/2025

PROJECT: MC-7

FIGURE: 6.c.iv-1

ENGINEER:
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636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
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Figure 6.c.iv-2 8900 Block Lindenhurst Drive





CONSTRUCTION
PERSONNEL
ONLY

v. MC-10 9000 Block Maple Grove/Sky Crest

The segment of the open channel located between Sky Crest Drive and Maple Grove Drive, upstream of Meadowfern Drive, exhibits significant erosion and degradation. This channel does not follow a naturally occurring alignment, and the existing longitudinal slope of approximately 2.6% generates flow velocities in the range of 15 to 20 feet per second, which are sufficient to cause erosive conditions. Active signs of erosion, including channel incision and downcutting, are present throughout the reach. In addition, structural failures have been observed along the channel banks, where timber retaining walls are deteriorating and brick masonry walls are also showing signs of instability. Certain low-lying sections of the channel contain ponded water with depths up to one foot, indicating poor drainage or grade control issues. The presence of overhead utility infrastructure, specifically power poles situated adjacent to the channel, presents additional constraints to performing maintenance or reconstruction activities without first relocating the utility poles.

To address the current drainage issue, the proposed improvement involves the installation of approximately 791 linear feet of 54-inch RCP. This conveyance system will be supported by the construction of four area inlets strategically located to intercept existing stormwater flows and integrate them into the new system.

The first area inlet is to be installed between Lots 9063 and 9057 Sky Crest, allowing for a connection to the existing 21-inch CMP designated as 26M3-108D. The second inlet will be located between 9054 and 9048 Maple Grove, serving to tie the existing 24-inch RCP labeled 26M3-063D into the new 54-inch RCP system. The third inlet will be constructed between 9033 and 9027 Sky Crest to connect the 15-inch RCP identified as 26M2-237D. Lastly, a fourth area inlet is proposed between 9012 and 9006 Maple Grove, aligned with the existing drainage channel, to convey stormwater to the existing curb inlet labeled 26M2-210D located beneath Meadowfern Drive.

This configuration ensures effective integration of the proposed infrastructure with the existing stormwater network, thereby improving flow capacity and reducing erosion in the rear yards. Alternative 1 from the previous report is the recommended course of action. The estimated probable project cost is approximately $600,300.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-10				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-10

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 10,000.00	$ 10,000.00
2	CLEARING	1	LS	$ 10,000.00	$ 10,000.00
3	EXCAVATION - GRADING	150	CY	$ 28.00	$ 4,200.00
4	54" RCP	799	LF	$ 225.00	$ 179,775.00
5	AREA INLET - SPECIAL 120 INCH DIAMETER	2	EA	$ 20,600.00	$ 41,200.00
6	MANHOLE - SPECIAL 120 INCH DIAMETER	2	EA	$ 20,600.00	$ 41,200.00
7	CURB INLET - SPECIAL 120 INCH DIAMETER	1	EA	$ 20,600.00	$ 20,600.00
8	TYPE 5 AGGREGATE BASE - 4 " THICK	7	SY	$ 10.26	$ 71.82
9	7" P.C. CONCRETE- NON REINFORCED	7	SY	$ 110.00	$ 770.00
10	SIDEWALK	7	SY	$ 50.00	$ 350.00
11	SEEDING	440	SY	$ 2.50	$ 1,100.00
12	EROSION CONTROL	1	LS	$ 10,000.00	$ 10,000.00
	SUBTOTAL:	≈			$ 319,300.00
	MOBILIZATION (8%)				$ 25,544
	UTILITY RELOCATION (20%)				$ 63,860
	DESIGN ENGINEERING (12%)				$ 38,316
	GEOTECHNICAL INVESTIGATION (8%)				$ 25,544
	CONSTRUCTION ADMINISTRATION (10%)				$ 31,930
	CONTINGENCY (30%)				$ 95,790
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 600,300.00**

PROJECT NAME: MC-10 Date: 8/1/2025

Table 6.c.v-2: MC-10 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
			Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	22	50	0	4400
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-10 Date: 8/1/2025

Table 6.c.v-3: MC-10 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure	791	PER 10 LF	3		237.3
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Berm		PER 10 LF	2		0
	New Pipe		PER 10 LF	3		0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
TOTAL PROBLEM POINTS						4400
TOTAL SOLUTION POINTS						237.3
GRAND TOTAL POINTS						4162.7

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	600.3
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**6.934**

50' 0' 50' 100'

SCALE: 1" = 50'

9000 BLK. MAPLE GROVE/SKY CREST

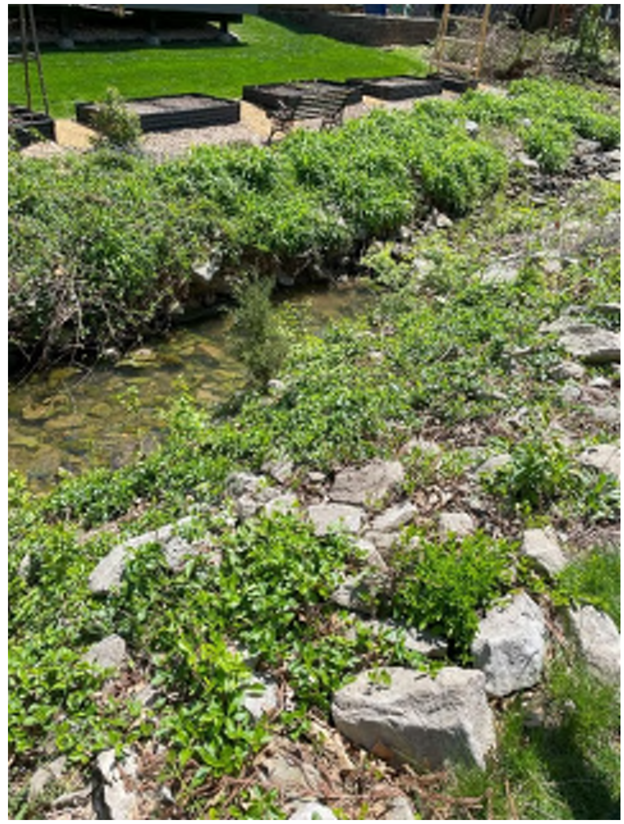
DATE:	08/04/2025
PROJECT:	MC-10
FIGURE:	6.c.v-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
DISCIPLINE: PROFESSIONAL ENGINEERING

Figure 6.c.v-2 9000 Block Maple Grove/Sky Crest

vi. MC-11 Existing Channel-Lowill Lane to Crest Oak Lane

Residents have reported stream bank erosion in the backyards of homes behind 9010 Lowill Lane and along a reach between 9004 Lowill Lane and 9904 Harwich Drive for both sides of Mulberry Creek. In addition to the erosion of this channel section, residents at 9904 and 9910 Harwich Drive and 10028 Harwich Drive have reported structural flooding. A larger cross-section and reduced longitudinal slope are needed to promote resiliency of the channel section. Without these alterations, the channel will continue to erode until these conditions stabilize naturally.

At the downstream end of the channel, houses 9904 and 9910 Harwich Drive are having flooding problems due to an undersized 10x10-foot RCBC (26M2-232D). From the field investigation, the two houses seem to have a lower-level finish flood elevation (FFE) elevation than the top of the existing box culvert. Floodproofing should be implemented for these structures due to the comparative elevation.

Going upstream of the channel, the north bank of the channel has grouted riprap in some places due to previously observed erosion. On the south bank, there is no grouted riprap and the bank is fully vegetated. The slopes seem to be in good condition and no erosion problems were found.

Upon reaching the vicinity of 10010 Harwich Drive, the channel exhibits a noticeable reduction in width. Several stormwater outlet pipes and sanitary sewer manholes are situated within the channel. Both banks are undergoing active erosion and vertical incision (downcutting) of the channel bed. Multiple pedestrian and vehicular bridges span the channel, with accumulated debris observed—likely due to elevated water surface elevations during high-intensity storm events. At 10050 Harwich Drive, a section of the channel is reinforced with gabion retaining walls, which appear to be structurally sound and functioning as intended.

Further downstream, at 9010 Lowill Lane, the proximity of the residential structure to the channel poses a risk, especially considering the insufficient channel depth to effectively convey peak stormwater flows. From 9010 to 9028 Lowill Lane, the channel continues to constrict in width. Multiple sanitary sewer manholes are located within the channel bed. Of particular concern is the manhole at 9004 Lowill Lane, which has a partially dislodged lid, presenting a potential public safety and contamination hazard. Additionally, two other manholes in this reach are fully exposed, likely a result of high stormwater velocity and erosive flow conditions.

At 9034 Lowill Lane, two distinct discharge points converge into a single outfall. A riprap energy dissipation basin is located at this confluence and is currently functioning effectively. However, based on field assessments, routine maintenance of the stilling basin is recommended to ensure continued performance and to prevent sediment accumulation and structural degradation.

The second component of the project involves the installation of approximately 3,740 linear feet of bio-engineered bank stabilization along both the left and right banks of Mulberry Creek. Prior to construction, existing riparian vegetation within the designated reach must be cleared, with efforts made to preserve mature, well-established trees where feasible. The existing streambanks will be regraded and re-contoured to achieve stable side slopes, and the channel realignment will incorporate enhanced sinuosity, including the construction of alternating pool and riffle sequences to emulate natural fluvial morphology. Bank stabilization will be achieved using TRMs in accordance with industry standards for bio-engineered streambank protection. Additionally, a downstream channel segment approximately 100 linear feet in length, located adjacent to 10028 Harwich Drive, may be widened based on bio-engineering criteria to alleviate localized flooding conditions. Restoration efforts will include replanting of native riparian tree species to reestablish ecological functions and improve corridor stability. The estimated probable project cost is approximately $307,800.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-11				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-11

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	EXCAVATION - CHANNEL WIDENING	530	CY	$ 30.00	$ 15,900.00
2	EXCAVATION - GRADING	100	CY	$ 30.00	$ 3,000.00
3	FLOODWALL - 4' HIGH	30	CY	$ 800.00	$ 24,000.00
4	MATERIAL TO BE HAULED OFFSITE	530	CY	$ 20.00	$ 10,600.00
5	SANITARY SEWER MAINTENANCE	3	EA	$ 1,500.00	$ 4,500.00
6	REFORESTATION	2.5	ACRE	$ 3,000.00	$ 7,500.00
7	SEEDING	1810	SY	$ 2.50	$ 4,525.00
8	TRM	4572	SY	$ 15.00	$ 68,580.00
9	EROSION CONTROL	1	LS	$ 25,000.00	$ 25,000.00
	SUBTOTAL:	≈			$ 163,700.00
	MOBILIZATION (8%)				$ 13,096
	UTILITY RELOCATION (20%)				$ 32,740
	DESIGN ENGINEERING (12%)				$ 19,644
	GEOTECHNICAL INVESTIGATION (8%)				$ 13,096
	CONSTRUCTION ADMINISTRATION (10%)				$ 16,370
	CONTINGENCY (30%)				$ 49,110
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 307,800.00**

PROJECT NAME: MC-11 Date: 8/1/2025

Table 6.c.vi-2: MC-11 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
			Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	22	25	0	3300
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	5	25	0	500
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-11 Date: 8/1/2025

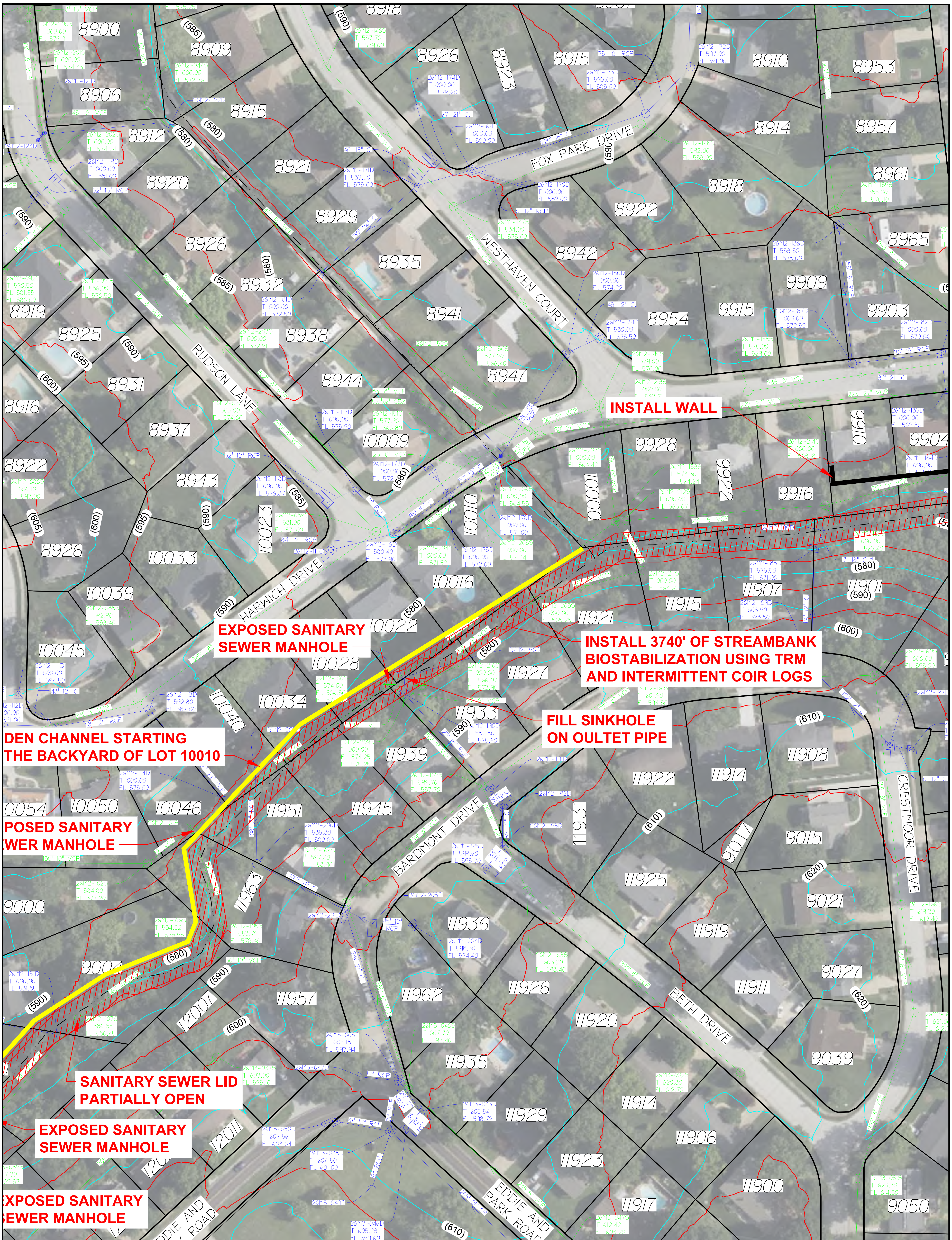
Table 6.c.vi-3: MC-11 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)	1	EACH	2		2
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)	1270	PER 10 LF	3		381
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization	3740	PER 10 LF	2		748
	Berm		PER 10 LF	2		0
	Flood Wall	215	PER 10 LF	3		64.5
	Sanitary Sewer Maintenance	3	EACH	5		15
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
					TOTAL PROBLEM POINTS	3800
					TOTAL SOLUTION POINTS	1210.5
					GRAND TOTAL POINTS	2589.5

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	307.8
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**8.413**



120' 0' 120' 240'

SCALE: 1" = 120'

EXISTING CHANNEL - LOWILL LN. TO CREST OAK LN.

DATE: 08/04/2025

PROJECT: MC-11

FIGURE: 6.c.vi-1

ENGINEER:
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101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
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Figure 6.c.vi-2 Lowill Lane to Crest Oak Lane

vii. MC-12 8900 Block Rudson Lane

The existing concrete-lined drainage channel located behind residential properties at 8884 through 8906 Rudson Lane and 8944 through 10009 Rudson Lane is exhibiting significant structural deterioration. Hydraulic analysis indicates that, under a 15-year design storm event, flow velocities within the channel exceed 20 feet per second. These velocities result from the current geometric configuration of the channel, which consists of an 8-foot bottom width, side slopes varying between 2:1 (horizontal to vertical) and 3:1, and a longitudinal slope of approximately 1.9 percent. The existing conditions contribute to high erosive forces and are a primary factor in the ongoing degradation of the channel infrastructure.

Based on field investigations and site assessments, full replacement of the existing drainage channel is determined to be the most appropriate and effective corrective measure. Portions of the channel have previously undergone replacement; however, the remaining sections exhibit significant structural degradation and are no longer considered serviceable. The proposed scope of work includes the construction of a new 990-foot-long cast-in-place concrete trapezoidal channel, designed with an eight-foot-wide bottom, 3:1 (horizontal to vertical) side slopes, and a longitudinal slope of 1.9 percent to match the existing geometry and maintain positive drainage. Additionally, continuous safety railings are to be installed along both sides of the channel to enhance public safety and comply with applicable design standards. The estimated probable project cost is approximately $624,800.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-12		DATE:	8/1/2025
CRESTWOOD, MISSOURI		EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000		CHK. BY:	SMR

MC-12

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	CLEARING	1	LS	$ 2,000.00	$ 2,000.00
2	CONCRETE OPEN CHANNEL	1656	SY	$ 150.00	$ 248,400.00
3	EXCAVATION OF EXISTING CHANNEL	1104	CY	$ 15.00	$ 16,560.00
4	HAND RAIL	1710	LF	$ 30.00	$ 51,300.00
5	OFFSITE REMOVAL OF EXISTING CHANNEL	642	CY	$ 15.00	$ 9,630.00
6	SEEDING	550	SY	$ 2.50	$ 1,375.00
7	EROSION CONTROL	1	LS	$ 3,000.00	$ 3,000.00
	SUBTOTAL:	≈			$ 332,300.00
	MOBILIZATION (8%)				$ 26,584
	UTILITY RELOCATION (20%)				$ 66,460
	DESIGN ENGINEERING (12%)				$ 39,876
	GEOTECHNICAL INVESTIGATION (8%)				$ 26,584
	CONSTRUCTION ADMINISTRATION (10%)				$ 33,230
	CONTINGENCY (30%)				$ 99,690
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 624,800.00**

Table 6.c.vii-1: MC-12 Preliminary Cost Estimate

PROJECT NAME: MC-12 Date: 8/1/2025

Table 6.c.vii-2: MC-12 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
		Note:Problem points are awarded only for those problems solved by the proposed solution	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	13	200	0	50	0	3900
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-12 Date: 8/1/2025

Table 6.c.vii-3: MC-12 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Berm		PER 10 LF	2		0
	Channel Repair	498	PER 10 LF	3		149.4
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
TOTAL PROBLEM POINTS						3900
TOTAL SOLUTION POINTS						149.4
GRAND TOTAL POINTS						3750.6

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	624.8
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**6.003**

50' 0' 50' 100'

SCALE: 1" = 50'

8900 BLK. RUDSON LN.

DATE: 08/04/2025

PROJECT: MC-12

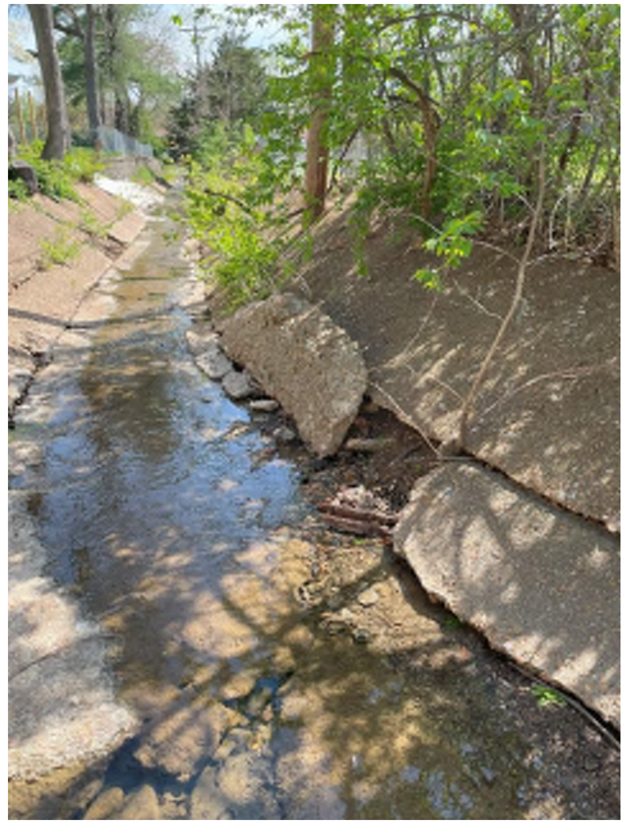
FIGURE: 6.c.vii-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
DISCIPLINE: PROFESSIONAL ENGINEERING

Figure 6.c.vii-2 8900 Block Rudson Lane






viii. MC-13 8866-8878 Rudson Lane

Residents between 8854 and 8872 Rudson Lane have reported recurring stormwater ponding, with an average depth of approximately six inches. This condition is attributed to inadequate surface grading, which prevents positive drainage and contributes to water accumulation following precipitation events.

The proposed solution entails the installation of two four-sided area inlets, strategically positioned behind the properties located at 8866 and 8872 Rudson Lane. Each of these area inlets will be integrated into the existing stormwater management system by connecting to the 21-inch diameter RCP, which currently extends from junction box 26M2-138D to outfall 26M2-141D. The connection of the area inlets to this existing RCP will ensure efficient water flow and adequate drainage capacity for the affected area. Furthermore, to optimize drainage efficiency, the backyards of the properties should undergo regrading. This regrading will be designed to direct surface water towards the newly installed area inlets, ensuring positive drainage flow that prevents water pooling and mitigates potential flooding concerns. By addressing both the inlet installation and the necessary regrading, this solution will improve the overall stormwater management for the area and enhance the functionality of the existing drainage infrastructure. Additional survey is needed to confirm the functional elevation of each area inlet. The estimated probable project cost is approximately $51,200.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-13				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-13

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMRPOVEMENTS	1	LS	$ 1,500.00	$ 1,500.00
2	21" RCP	84	LF	$ 125.00	$ 10,500.00
3	AREA INLET	2	EA	$ 3,000.00	$ 6,000.00
4	MANHOLE	2	EA	$ 3,000.00	$ 6,000.00
5	EXCAVATION - GRADING	80	CY	$ 28.00	$ 2,240.00
6	SEEDING	50	SY	$ 2.50	$ 125.00
7	EROSION CONTROL	1	LS	$ 750.00	$ 750.00
	SUBTOTAL:	≈			$ 27,200.00
	MOBILIZATION (8%)				$ 2,176
	UTILITY RELOCATION (20%)				$ 5,440
	DESIGN ENGINEERING (12%)				$ 3,264
	GEOTECHNICAL INVESTIGATION (8%)				$ 2,176
	CONSTRUCTION ADMINISTRATION (10%)				$ 2,720
	CONTINGENCY (30%)				$ 8,160
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 51,200.00**

Table 6.c.viii-1: MC-13 Preliminary Cost Estimate

PROJECT NAME: MC-13 Date: 8/1/2025

Table 6.c.viii-2: MC-13 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
			Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	5	0	0	500
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-13 Date: 8/1/2025

Table 6.c.viii-3: MC-13 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY							
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:		10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount			
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2			0
	Outlet Pipe Extension		PER 10 LF	1			0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3			0
	Gabion Wall		PER 10 LF	2			0
	Channel Enclosure		PER 10 LF	3			0
	Rip Rap Revetment		PER 10 LF	1			0
	Streambank Biostabilization		PER 10 LF	2			0
	Berm		PER 10 LF	2			0
	New Pipe	84	PER 10 LF	3			25.2
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)		
	Points for Easements						0
TOTAL PROBLEM POINTS							500
TOTAL SOLUTION POINTS							25.2
GRAND TOTAL POINTS							474.8

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	51.2
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**9.273**

50' 0' 50' 100'

SCALE: 1" = 50'

8866-8878 RUDSON LN.

DATE:	08/04/2025
PROJECT:	MC-13
FIGURE:	6.c.viii-1

ENGINEER:
HORNER SHIFRIN
101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
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DISCIPLINE: PROFESSIONAL ENGINEERING

Figure 6.c.viii-2 8866-8878 Rudson Lane

ix. MC-14 10069-10075 Barberton Drive

Excessive stormwater runoff originating from the field located behind 10069 Barberton Drive has been a consistent issue, with runoff flowing directly into the resident's backyard, causing significant drainage concerns. The property owner has formally reported that the source of the water contributing to the problem includes runoff from the church situated to the north of the property in addition to stormwater from three residential properties located along Manda Lane. The homes on Manda Lane, which are in close proximity to 10069 Barberton Drive, have interconnected downspouts, all of which channel their stormwater runoff into a shared drainage path. This collective drainage system results in increased volume and velocity of the runoff that ultimately discharges onto the backyard of 10069 Barberton Drive, exacerbating the flooding and erosion issues experienced by the resident. The cumulative effect of these multiple contributing sources highlights the need for a comprehensive evaluation and potential redesign of the stormwater management infrastructure in this area to mitigate further impact on the property.

The proposed drainage improvement plan comprises two integrated components intended to manage stormwater runoff more effectively and reduce the potential for localized flooding. The first component includes the construction of an earthen berm and an accompanying surface swale, strategically placed to intercept and direct runoff originating from the adjacent church property. The berm will serve as a physical barrier to prevent uncontrolled sheet flow, while the swale will function as a conveyance channel, guiding the collected runoff toward a designated collection point. The second component involves the installation of a new area inlet at the rear property boundary between 10075 and 10069 Barberton Drive. This inlet is intended to capture the concentrated flow from the swale and route it into an underground stormwater conveyance system.

The proposed stormwater infrastructure will include the placement of approximately 140 linear feet of 18-inch diameter RCP, which will connect the new area inlet to the existing curb inlet identified as 26M2-061D on Barberton Drive. This connection is essential to ensure that runoff collected from the upstream catchment area is efficiently conveyed to the municipal storm drainage network. Furthermore, the existing curb inlet (26M2-060D) will need to be replaced due to the connection of the proposed 18-inch RCP. During engineering design, the hydraulic capacity for the existing 18-inch RCP beneath Barberton Drive will be checked. The upsizing of the existing 18-inch RCP may be necessary if the hydraulic capacity does not meet the requirements. The estimated probable project cost is approximately $59,100.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-14				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR
	MC-14				
ITEM NUMBER	**DESCRIPTION**	**QUANTITY**	**UNIT**	**UNIT PRICE**	**TOTAL**
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 1,500.00	$ 1,500.00
1	18" RCP	140	LF	$ 120.00	$ 16,800.00
2	AREA INLET	1	EA	$ 3,000.00	$ 3,000.00
3	SIDEWALK	5	SY	$ 75.00	$ 375.00
4	CURB INLET	1	EA	$ 3,500.00	$ 3,500.00
5	EXCAVATION - GRADING	150	CY	$ 20.00	$ 3,000.00
6	SEEDING	480	SY	$ 2.50	$ 1,200.00
7	EROSION CONTROL	1	LS	$ 2,000.00	$ 2,000.00
	SUBTOTAL:	≈			$ 31,400.00
	MOBILIZATION (8%)				$ 2,512
	UTILITY RELOCATION (20%)				$ 6,280
	DESIGN ENGINEERING (12%)				$ 3,768
	GEOTECHNICAL INVESTIGATION (8%)				$ 2,512
	CONSTRUCTION ADMINISTRATION (10%)				$ 3,140
	CONTINGENCY (30%)				$ 9,420
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 59,100.00**

Table 6.c.ix-1: MC-14 Preliminary Cost Estimate

PROJECT NAME: MC-14 Date: 8/1/2025

Table 6.c.ix-2: MC-14 Priority Rating Sheet

PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM							
1.1 FLOODING							
1.1.1 Structure Flooding							
Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
Basement (1 lot per structure) Address:	200	0	100	1	15	0	100
Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	3	0	0	300
1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.2 EROSION							
1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Arterial Road:	75	0	50	0	12	0	0
Collector Road:	35	0	25	0	6	0	0
Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-14 Date: 8/1/2025

Table 6.c.ix-3: MC-14 Priority Rating Solutions Sheet

	SOLUTION BENEFIT CATEGORY					
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Berm	55	PER 10 LF	2		11
	New Pipe	140	PER 10 LF	3		42
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
	TOTAL PROBLEM POINTS					400
	TOTAL SOLUTION POINTS					53
	GRAND TOTAL POINTS					347

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	59.1
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**5.871**

50' 0' 50' 100'

SCALE: 1" = 50'

10069-10075 BARBERTON DR.

DATE:	08/04/2025
PROJECT:	MC-14
FIGURE:	6.c.ix-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
DISCIPLINE: PROFESSIONAL ENGINEERING

Figure 6.c.ix-2 10069-10075 Barberton Drive

x. MC-15 8901 Manda Lane

This project, in the original CDM report, was not identified as completed by MSD or the City. Therefore, a site visit was completed by Horner & Shifrin, and it appear the stormwater concerns have been repaired by adding two storm sewer inlets. The project has been left in the Addendum such that conformation can be received that this project has been completed and the new inlets have sufficient capacity. Additionally, the project has been ranked with a 0.00 benefit/cost ration since no work is proposed.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-15				DATE:	8/4/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-15

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	N/A	0	0	$ -	$ -
	SUBTOTAL:	≈			$ -
	MOBILIZATION (8%)				$ -
	UTILITY RELOCATION (20%)				$ -
	DESIGN ENGINEERING (12%)				$ -
	GEOTECHNICAL INVESTIGATION (8%)				$ -
	CONSTRUCTION ADMINISTRATION (10%)				$ -
	CONTINGENCY (30%)				$ -
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ -**

Table 6.c.x-1: MC-15 Preliminary Cost Estimate

PROJECT NAME: MC-15 Date: 8/4/2025

Table 6.c.x-2: MC-15 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
			Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

PROJECT NAME: MC-15 Date: 8/4/2025

Table 6.c.x-3: MC-15 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	1		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Berm	0	PER 10 LF	1		0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
					TOTAL PROBLEM POINTS	0
					TOTAL SOLUTION POINTS	0
					GRAND TOTAL POINTS	0

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	0
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**0**

50' 0' 50' 100'

SCALE: 1" = 50'

8901 MANDA LN.

DATE:	08/04/2025
PROJECT:	MC-15
FIGURE:	6.c.x-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
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Figure 6.c.x-2 8901 Manda Lane

xi. MC-16 8841 Cornish Drive

At the rear property line of 8841 Cornish Drive, a gabion retaining wall is installed along the north-facing slope adjacent to the creek. Structural distress has been observed in sections of the wall, primarily due to hydrodynamic forces from increased stormwater flow and root intrusion from nearby vegetation, which are exerting lateral pressure and causing displacement toward the watercourse. Additionally, failure at the toe of the structure has been identified, attributed to inadequate embedment and improper installation of the initial gabion course. The recommended corrective action involves full replacement of the existing gabion wall, constructed per recommended engineering standards for toe embedment to enhance structural stability and prevent future undermining. The estimated probable project cost is approximately $63,400.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-16				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-16

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 5,000.00	$ 5,000.00
2	CLEARING	1	LS	$ 3,000.00	$ 3,000.00
3	GABION WALL	484	FSF	$ 50.00	$ 24,200.00
4	EROSION CONTROL	1	LS	$ 1,500.00	$ 1,500.00
	SUBTOTAL:	≈			$ 33,700.00
	MOBILIZATION (8%)				$ 2,696
	UTILITY RELOCATION (20%)				$ 6,740
	DESIGN ENGINEERING (12%)				$ 4,044
	GEOTECHNICAL INVESTIGATION (8%)				$ 2,696
	CONSTRUCTION ADMINISTRATION (10%)				$ 3,370
	CONTINGENCY (30%)				$ 10,110
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 63,400.00**

Table 6.c.xi-1: MC-16 Preliminary Cost Estimate

PROJECT NAME: MC-16 Date: 8/1/2025

Table 6.c.xi-2: MC-16 Priority Rating Sheet

Section	PROBLEM SOLVED CATEGORY	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
	Note:Problem points are awarded only for those problems solved by the proposed solution	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM / 1.1 FLOODING	1.1.1 Structure Flooding							
	Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
	Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
	Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
	Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
	Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
	Yard Flooding/Poor Drainage (1 per lot) Address:	10	0	5	0	0	0	0
	1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
	Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
	Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
	Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
	Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.0 STREAM / 1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Habitable structures, residential (1 lot per structure) Address:	300	0	200	2	50	0	400
	Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
	Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
	Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
	Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
	1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
	1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
	Arterial Road:	75	0	50	0	12	0	0
	Collector Road:	35	0	25	0	6	0	0
	Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-16 Date: 8/1/2025

Table 6.c.xi-3: MC-16 Priority Rating Solutions Sheet

	SOLUTION BENEFIT CATEGORY					
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall	121	PER 10 LF	2		24.2
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Berm		PER 10 LF	2		0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
					TOTAL PROBLEM POINTS	400
					TOTAL SOLUTION POINTS	24.2
					GRAND TOTAL POINTS	375.8

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	63.4
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**5.927**

50' 0' 50' 100'

SCALE: 1" = 50'

MULBERRY CREEK CROSSING

DATE: 08/04/2025

PROJECT: MC-16

FIGURE: 6.c.xi-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
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Figure 6.c.xi-2 Mulberry Creek Crossing

xii. MC-17 8701-8715 Gayle Avenue

The properties located at 8701 through 8715 Gayle Avenue were inspected following reported issues. No deficiencies related to stormwater drainage were observed at 8701 and 8715. However, significant drainage concerns were identified at the rear yard of 8709. The backyard area of this lot exhibits multiple locations of standing water, indicative of poor surface drainage and the absence of a defined outfall or positive drainage path for stormwater runoff. Additionally, the accumulation of tree logs and other vegetative debris along the rear yard further impedes stormwater flow and will require removal as part of remediation.

An additional low-lying area was identified along the shared side yard boundary between 8701 and 8709, where stormwater accumulation is resulting in persistent puddling. The presence of a shed, utility poles, and dense vegetation in the backyard of 8701 may obstruct the implementation of a drainage solution and will need to be addressed prior to construction or installation of any corrective measures.

The proposed drainage improvement plan for 8709 Gayle Avenue includes the installation of a subsurface stormwater conveyance system in conjunction with a surface swale to effectively collect and redirect stormwater runoff. The scope of work entails the installation of approximately 260 linear feet of 12-inch RCP and three area inlets. The new storm sewer system will be connected to the existing 12-inch RCP located along Crestwood Drive to provide a downstream discharge point.

The proposed area inlets are strategically located to intercept stormwater from critical collection points. The first inlet is to be installed between 8709 and 8715 Gayle Avenue to capture upstream runoff. The second inlet will be placed between 8701 and 8709 to address ponding issues in the rear yard of 8709. The third inlet is proposed at the low point in the side yard of 8709 to collect localized runoff from that area.

To supplement the storm sewer system, a 190-foot swale will be constructed along the rear yards of Lots 8701 and 8709 to promote positive drainage and direct surface flow toward the area inlets. Field observations indicate the presence of an existing swale; however, it lacks adequate slope to convey stormwater effectively, resulting in ponding conditions. The proposed improvements are designed to mitigate these issues by enhancing both surface and subsurface drainage.

The estimated probable project cost is approximately $90,900.

HORNER SHIFRIN

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-17		DATE:	8/1/2025
CRESTWOOD, MISSOURI		EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000		CHK. BY:	SMR

MC-17

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 5,000.00	$ 5,000.00
2	CLEARING	1	LS	$ 1,500.00	$ 1,500.00
2	12" RCP	260	LF	$ 90.00	$ 23,400.00
3	AREA INLET	3	EA	$ 3,200.00	$ 9,600.00
4	ASPHALT PAVEMENT	2	SY	$ 100.00	$ 200.00
5	CONCRETE CURB	6	LF	$ 40.00	$ 240.00
6	CONNECTION TO EXISTING LINE	1	EA	$ 2,365.00	$ 2,365.00
7	EXCAVATION - GRADING	150	CY	$ 28.00	$ 4,200.00
8	SEEDING	80	SY	$ 2.50	$ 200.00
9	EROSION CONTROL	1	LS	$ 1,500.00	$ 1,500.00
	SUBTOTAL:	≈			$ 48,300.00
	MOBILIZATION (8%)				$ 3,864
	UTILITY RELOCATION (20%)				$ 9,660
	DESIGN ENGINEERING (12%)				$ 5,796
	GEOTECHNICAL INVESTIGATION (8%)				$ 3,864
	CONSTRUCTION ADMINISTRATION (10%)				$ 4,830
	CONTINGENCY (30%)				$ 14,490
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 90,900.00**

Table 6.c.xii-1: MC-17 Preliminary Cost Estimate

PROJECT NAME: MC-17 Date: 8/1/2025

Table 6.c.xii-2: MC-17 Priority Rating Sheet

PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM – 1.1 FLOODING							
1.1.1 Structure Flooding							
Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
Yard Flooding/Poor Drainage (1 per lot) Address:	150	2	100	0	0	0	300
1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.0 STREAM – 1.2 EROSION							
1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Arterial Road:	75	0	50	0	12	0	0
Collector Road:	35	0	25	0	6	0	0
Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-17 Date: 8/1/2025

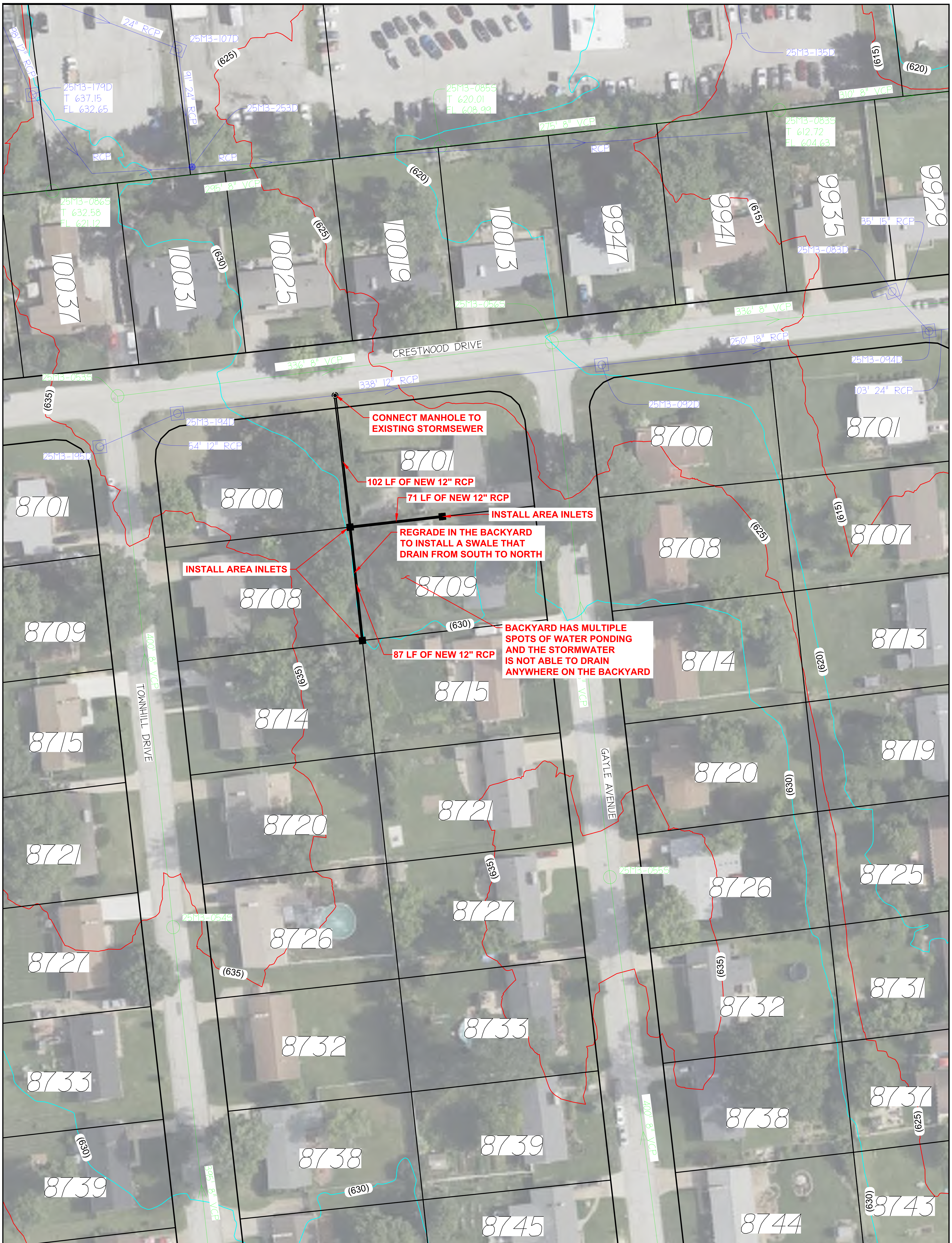
Table 6.c.xii-3: MC-17 Priority Rating Solutions Sheet

	SOLUTION BENEFIT CATEGORY					
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Swale	60	PER 10 LF	2		12
	New Pipe	260	PER 10 LF	3		78
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
	TOTAL PROBLEM POINTS					300
	TOTAL SOLUTION POINTS					90
	GRAND TOTAL POINTS					210

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	90.9
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**2.31**



50' 0' 50' 100'

SCALE: 1" = 50'

8701-8715 GAYLE AVE.

DATE:	08/04/2025
PROJECT:	MC-17
FIGURE:	6.c.xii-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
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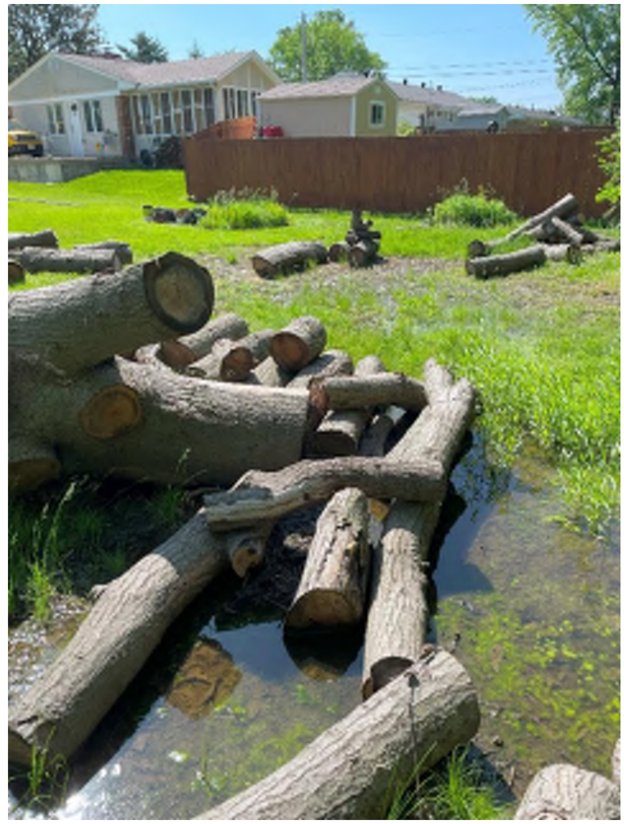
Figure 6.c.xii-2 8701-8715 Gayle Avenue



xiii. MC-18 8718-8722 Villa Crest Drive

A shallow swale is situated between the residential properties located at 8718 and 8722 Villa Crest Drive. Based on field observations, the swale lacks sufficient depth to effectively convey stormwater during higher intensity storm events. Both residences have basement windows that are recessed within window wells. Due to the limited depth of the swale, there is a potential risk that during significant rainfall, stormwater may overtop the window wells and enter the basement areas. Additionally, subsurface drainage infrastructure was observed within the swale, consisting of private grate inlets located near the upstream end adjacent to the fence line. These drains are connected via piping and discharge to the existing public roadway at the downstream terminus of the swale.

The proposed corrective action involves regrading the existing swale to a depth sufficient to position the top elevation of the swale below the adjacent basement window sills. This modification is intended to prevent stormwater intrusion into the basement through the window openings. Based on field observations and topographic evaluation, the swale can be lowered approximately two to three feet to achieve the required elevation differential. The estimated probable project cost is approximately $14,600.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-18		DATE:	8/1/2025
CRESTWOOD, MISSOURI		EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000		CHK. BY:	SMR

MC-18

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	CLEARING	1	LS	$ 2,500.00	$ 2,500.00
3	EXCAVATION - GRADING	67	CY	$ 28.00	$ 1,876.00
4	SEEDING	70	SY	$ 2.50	$ 175.00
5	EROSION CONTROL	70	SY	$ 50.00	$ 3,500.00
	SUBTOTAL:	≈			$ 8,100.00
	MOBILIZATION (8%)				$ 648
	UTILITY RELOCATION (20%)				$ 1,620
	DESIGN ENGINEERING (12%)				$ 972
	GEOTECHNICAL INVESTIGATION (0%)				$ -
	CONSTRUCTION ADMINISTRATION (10%)				$ 810
	CONTINGENCY (30%)				$ 2,430
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 14,600.00**

PROJECT NAME: MC-18 Date: 8/1/2025

Table 6.c.xiii-2: MC-18 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
		Note:Problem points are awarded only for those problems solved by the proposed solution	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	2	100	0	0	0	300
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-18 Date: 8/1/2025

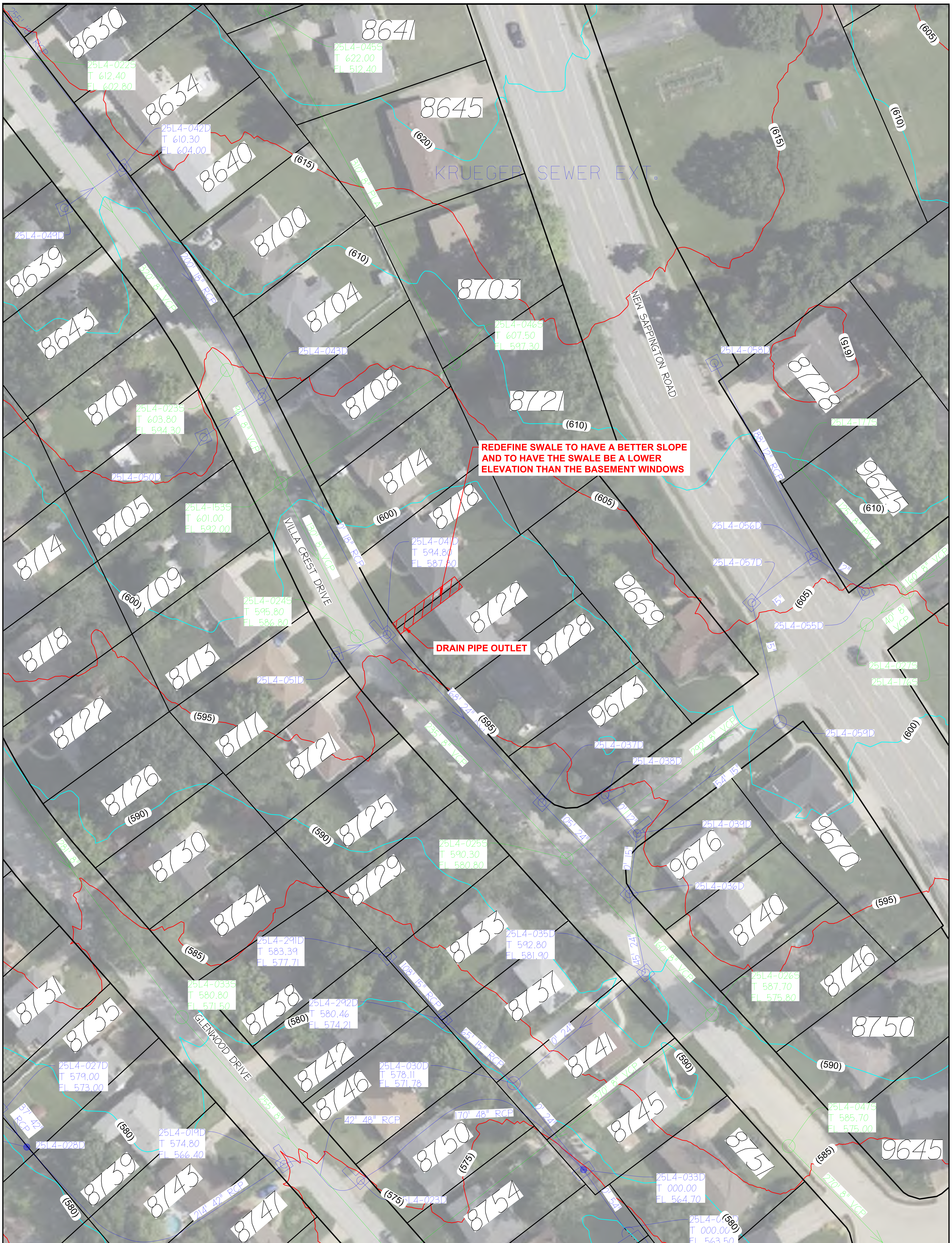
Table 6.c.xiii-3: MC-18 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Swale	60	PER 10 LF	2		12
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
					TOTAL PROBLEM POINTS	300
					TOTAL SOLUTION POINTS	12
					GRAND TOTAL POINTS	288

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	14.6
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**19.726**



50' 0' 50' 100'

SCALE: 1" = 50'

8718-8722 VILLA CREST DR.

DATE:	08/04/2025
PROJECT:	MC-18
FIGURE:	6.c.xi-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
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Figure 6.c.xiii-2 8718-8722 Villa Crest Drive

xiv. MC-19 9409 Sappington Greens Lane

The property owner at lot 9411 Sappington Greens Lane is having a flooding issue on the side yard. From the field investigation carried out by Horner & Shifrin, it was noted that there were two external sump pumps located in the side yard. One was found in the back yard of 9411 Sappington Greens Lane and the other was found in the side yard of 9415 Sappington Greens Lane. These sump pumps were probably added due to the flooding issue in the side yard and discharge onto Sappington Greens Lane. The addition of the sump pumps appears to resolve the side yard flooding. MSD or the City will need to check if sump pumps added by the property owner meet their respective requirements. Another issue that was found was an existing transformer located between lots 9407 and 9411 Sappington Greens Lane is in a low point. The homeowner at 9407 Sappington Greens Lane has stated to Horner & Shifrin that water ponding occurs at the transformer. Grading up around the transformer and making a high point around it to direct the stormwater towards the existing area inlet on the west or to drain towards the street will resolve this issue. The estimated probable project cost is approximately $9,200.

HORNER SHIFRIN

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-19				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-19

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	CLEARING	1	LS	$ 2,500.00	$ 2,500.00
3	EXCAVATION - GRADING	40	CY	$ 28.00	$ 1,120.00
4	SEEDING	260	SY	$ 2.50	$ 650.00
5	EROSION CONTROL	1	LS	$ 750.00	$ 750.00
	SUBTOTAL:	≈			$ 5,100.00
	MOBILIZATION (8%)				$ 408
	UTILITY RELOCATION (20%)				$ 1,020
	DESIGN ENGINEERING (12%)				$ 612
	GEOTECHNICAL INVESTIGATION (0%)				$ -
	CONSTRUCTION ADMINISTRATION (10%)				$ 510
	CONTINGENCY (30%)				$ 1,530
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 9,200.00**

Table 6.c.xiv-1: MC-19 Preliminary Cost Estimate

PROJECT NAME: MC-19 Date: 8/1/2025

Table 6.c.xiv-2: MC-19 Priority Rating Sheet

PROBLEM SOLVED CATEGORY	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
Note:Problem points are awarded only for those problems solved by the proposed solution	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM							
1.1 FLOODING							
1.1.1 Structure Flooding							
Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
Yard Flooding/Poor Drainage (1 per lot) Address:	150	2	100	0	0	0	300
1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.2 EROSION							
1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Arterial Road:	75	0	50	0	12	0	0
Collector Road:	35	0	25	0	6	0	0
Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-19 Date: 8/1/2025

Table 6.c.xiv-3: MC-19 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Swale	95	PER 10 LF	2		19
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
TOTAL PROBLEM POINTS						300
TOTAL SOLUTION POINTS						19
GRAND TOTAL POINTS						281

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	9.2
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**30.543**

50' 0' 50' 100'

SCALE: 1" = 50'

9409 SAPPINGTON GREENS LN.

DATE: 08/04/2025

PROJECT: MC-19

FIGURE: 6.c.xiv-1

ENGINEER:
HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
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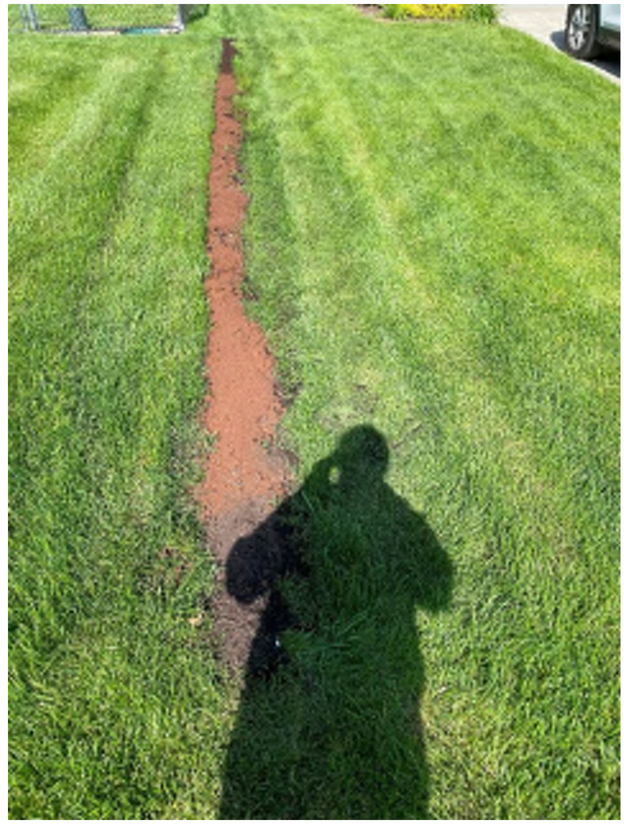
Figure 6.c.xiv-2 9409 Sappington Greens Lane



xv. MC-21 8856 Glen Rose Drive

A field investigation was performed at 8856 Glen Rose Drive for stormwater drainage issues in the area. Along the side yard of 8856 and 8862 Glen Rose Drive, a shallow swale was found along with a low point along the swale. The low point is located near a basement window and could cause an issue if a higher storm event occurs. The swale does not have a positive slope to drain towards the roadway. The front and back yard downspouts are collected and are being discharged at the downstream end of the swale towards the roadway.

To address the drainage issue, the existing swale will be regraded by lowering its elevation by approximately one to two feet and incorporating a continuous slope of two percent to promote positive flow. This design will mitigate the current ponding problem and effective drainage away from the property, preventing water accumulation near the basement window at 8856 Glen Rose Drive. The estimated probable project cost is approximately $9,600.

HORNER SHIFRIN

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-21				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-21

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 2,500.00	$ 2,500.00
2	EXCAVATION - GRADING	74	CY	$ 28.00	$ 2,072.00
3	SEEDING	80	SY	$ 2.50	$ 200.00
4	EROSION CONTROL	1	LS	$ 500.00	$ 500.00
	SUBTOTAL:	≈			$ 5,300.00
	MOBILIZATION (8%)				$ 424
	UTILITY RELOCATION (20%)				$ 1,060
	DESIGN ENGINEERING (12%)				$ 636
	GEOTECHNICAL INVESTIGATION (0%)				$ -
	CONSTRUCTION ADMINISTRATION (10%)				$ 530
	CONTINGENCY (30%)				$ 1,590
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 9,600.00**

Table 6.c.xv-1: MC-21 Preliminary Cost Estimate

PROJECT NAME: MC-21 Date: 8/1/2025

Table 6.c.xv-2: MC-21 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
			Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	2	100	0	0	0	300
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-21 Date: 8/1/2025

Table 6.c.xv-3: MC-21 Priority Rating Solutions Sheet

	SOLUTION BENEFIT CATEGORY					
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Swale	60	PER 10 LF	2		12
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
					TOTAL PROBLEM POINTS	300
					TOTAL SOLUTION POINTS	12
					GRAND TOTAL POINTS	288

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	9.6
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**30**

50' 0' 50' 100'

SCALE: 1" = 50'

8856 GLEN ROSE DR.

DATE:	08/04/2025
PROJECT: MC-21	
FIGURE:	6.c.xv-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
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Figure 6.c.xv-2 8856 Glen Rose Drive

xvi. MC-22 9875 Richter Lane

A swale is located along the side yard of 9875 Richter Lane. The swale is in good condition but does not have a constant slope along the length of the swale. Regrading the swale to have a constant slope will provide better drainage for the front yard and avoid ponding along the swale. The estimated probable project cost is approximately $6,100.

HORNER SHIFRIN

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-22				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-22

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	EXCAVATION - GRADING	106	CY	$ 28.00	$ 2,968.00
2	SEEDING	106	SY	$ 2.50	$ 265.00
3	EROSION CONTROL	1	LS	$ 500.00	$ 500.00
	SUBTOTAL:	≈			$ 3,800.00
	MOBILIZATION (8%)				$ 304
	UTILITY RELOCATION (0%)				$ -
	DESIGN ENGINEERING (12%)				$ 456
	GEOTECHNICAL INVESTIGATION (0%)				$ -
	CONSTRUCTION ADMINISTRATION (10%)				$ 380
	CONTINGENCY (30%)				$ 1,140
	TOTAL CONSTRUCTION ESTIMATE	=			**$ 6,100.00**

PROJECT NAME: MC-22 Date: 8/1/2025

Table 6.c.xvi-2: MC-22 Priority Rating Sheet

		PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding: Points per Category	Chronic (1-Yr) Flooding: No. Lots Affected	Frequent (10-Yr) Flooding: Points per Category	Frequent (10-Yr) Flooding: No. Lots Affected	Infrequent (100-Yr) Flooding: Points per Category	Infrequent (100-Yr) Flooding: No. Lots Affected	Total Points
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	1	100	0	0	0	150
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-22 Date: 8/1/2025

Table 6.c.xvi-3: MC-22 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Swale	60	PER 10 LF	2		12
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
					TOTAL PROBLEM POINTS	150
					TOTAL SOLUTION POINTS	12
					GRAND TOTAL POINTS	138

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	6.1
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**22.623**

50' 0' 50' 100'

SCALE: 1" = 50'

9875 RICHTER LN.

DATE: 08/04/2025

PROJECT: MC-22

FIGURE: 6.c.xvi-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
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Figure 6.c.xvi-2 9875 Richter Lane

xvii. MC-23 Eudora Court/Arban Drive

A rear yard swale is located between Eudora Court and Arban Drive within a residential area. Based on observations from the site visit, it was noted that the natural drainage path of the swale has been altered by adjacent property owners. Instead of following the intended east-to-west flow path, the swale has been modified to direct stormwater runoff from north to south. This redirection appears to have been achieved through the creation of artificial depressions or low points within individual rear yards, disrupting the original grading. A vertical grade differential of approximately two feet exists between the houses, creating a step down in the grade at each property, which contributes to the formation of concentrated flow paths in the side yards along Arban Drive. These concentrated flows lead to noticeable erosion and are discharging directly onto Arban Drive where a double curb inlet (25L4-240D) is located.

The existing rear yard swales are shallow, averaging only six inches in depth, and do not provide sufficient hydraulic capacity to convey the 15-year design storm runoff. As a result, during moderate to heavy rainfall events, excess surface runoff is likely overtopping the swale banks and contributing to localized yard flooding and sediment transport. At the terminus of Arban Drive, an area inlet (25L4-341D) was identified, but field observations revealed that only one side of the inlet is currently open and functional possibly due to residents adding vegetation, thereby limiting its intake capacity. Despite this, a significant portion of the overland flow from the rear yards appears to be draining toward this inlet due to residents adding vegetation

To mitigate the ongoing drainage and erosion issues, it is recommended that the side yard swales along Arban Drive be regraded and deepened as necessary to provide adequate flow capacity for the 15-year storm event, in accordance with local stormwater design standards. This improvement will reduce the erosive velocities in the side yards, minimize sediment transport, and decrease the volume of uncontrolled runoff reaching Arban Drive. Additionally, the existing area inlet (25L4-341D) should undergo routine maintenance and cleaning to ensure all openings are unobstructed, thereby enhancing the structure's capacity to capture and convey stormwater effectively. Homeowners should also be educated on how improvements to yards, such as planter boxes, sheds, vegetation, and build-up of debris can impact drainage, so that long-term maintenance of the drainage path will occur. Implementing these measures will restore appropriate drainage patterns and alleviate both erosion and flooding concerns within the affected properties. The estimated probable project cost is approximately $76,000.

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-23		DATE:	8/1/2025
CRESTWOOD, MISSOURI		EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000		CHK. BY:	SMR

MC-23

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	REMOVAL OF IMPROVEMENTS	1	LS	$ 5,000.00	$ 5,000.00
2	EXCAVATION - GRADING	965	CY	$ 28.00	$ 27,020.00
3	SEEDING	932	SY	$ 2.50	$ 2,330.00
4	AREA INLET MAINTENANCE	1	LS	$ 2,500.00	$ 2,500.00
5	EROSION CONTROL	1	LS	$ 3,500.00	$ 3,500.00
	SUBTOTAL:	≈			$ 40,400.00
	MOBILIZATION (8%)				$ 3,232
	UTILITY RELOCATION (20%)				$ 8,080
	DESIGN ENGINEERING (12%)				$ 4,848
	GEOTECHNICAL INVESTIGATION (8%)				$ 3,232
	CONSTRUCTION ADMINISTRATION (10%)				$ 4,040
	CONTINGENCY (30%)				$ 12,120
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 76,000.00**

Table 6.c.xvii-1: MC-23 Preliminary Cost Estimate

PROJECT NAME: MC-23 Date: 8/1/2025

Table 6.c.xvii-2: MC-23 Priority Rating Sheet

PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM							
1.1 FLOODING							
1.1.1 Structure Flooding							
Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	14	0	0	1400
1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.2 EROSION							
1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Arterial Road:	75	0	50	0	12	0	0
Collector Road:	35	0	25	0	6	0	0
Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-23 Date: 8/1/2025

Table 6.c.xvii-3: MC-23 Priority Rating Solutions Sheet

SOLUTION BENEFIT CATEGORY						
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
	Swale	840	PER 10 LF	2		168
	Maintenance	1	EACH	5		5
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
					TOTAL PROBLEM POINTS	1400
					TOTAL SOLUTION POINTS	173
					GRAND TOTAL POINTS	1227

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	76
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**16.145**

50' 0' 50' 100'

SCALE: 1" = 50'

EUDORA CT./ARBAN DR.

DATE:	08/04/2025
PROJECT:	MC-23
FIGURE:	6.c.xvii-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
636-329-9296 • FAX 844-339-2910 • WWW.HORNERSHIFRIN.COM
DISCIPLINE: PROFESSIONAL ENGINEERING

Figure 6.c.xvii-2 Eudora Court/Arban Drive

xviii. MC-24 9501-9503 Crain Court

Erosion was found in the lots between 9501 and 9503 Crain Court. This is creating a low point where the fence is located on 9501 Crain Court. The downspout for 9503 is discharging at this low point, as well as the downspout for the garage roof of 9501 Crain Court. This is creating ponding in the side yard that could flood the houses.

The proposed solution is to redefine the existing swale by increasing the slope. From field investigation, the swale can be deepened to provide a more constant slope throughout the entirety of the swale. This would resolve the ponding issue in the side yard and force the storm water to drain towards the existing roadway and then drain to an existing curb inlet. If an existing inlet gets clogged up due to homeowner debris, the homeowner causing the debris to reach the inlet should be contacted and address the issue to prevent more drainage issues. The estimated probable project cost is approximately $11,400.

HORNER SHIFRIN

ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE COST

CRESTWOOD STORMWATER UPDATE - MC-24				DATE:	8/1/2025
CRESTWOOD, MISSOURI				EST. BY:	BRA
HORNER & SHIFRIN PROJECT # 250103000				CHK. BY:	SMR

MC-24

ITEM NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	CLEARING	1	LS	$ 2,500.00	$ 2,500.00
3	EXCAVATION - GRADING	106	CY	$ 28.00	$ 2,968.00
4	SEEDING	106	SY	$ 2.50	$ 265.00
5	EROSION CONTROL	1	LS	$ 500.00	$ 500.00
	SUBTOTAL:	≈			$ 6,300.00
	MOBILIZATION (8%)				$ 504
	UTILITY RELOCATION (20%)				$ 1,260
	DESIGN ENGINEERING (12%)				$ 756
	GEOTECHNICAL INVESTIGATION (0%)				$ -
	CONSTRUCTION ADMINISTRATION (10%)				$ 630
	CONTINGENCY (30%)				$ 1,890
	TOTAL CONSTRUCTION ESTIMATE	**=**			**$ 11,400.00**

Table 6.c.xviii-1: MC-24 Preliminary Cost Estimate

PROJECT NAME: MC-24 Date: 8/1/2025

Table 6.c.xviii-2: MC-24 Priority Rating Sheet

PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM							
1.1 FLOODING							
1.1.1 Structure Flooding							
Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
Yard Flooding/Poor Drainage (1 per lot) Address:	150	2	100	0	0	0	300
1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
1.2 EROSION							
1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
Arterial Road:	75	0	50	0	12	0	0
Collector Road:	35	0	25	0	6	0	0
Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

PROJECT NAME: MC-24 Date: 8/1/2025

Table 6.c.xviii-3: MC-24 Priority Rating Solutions Sheet

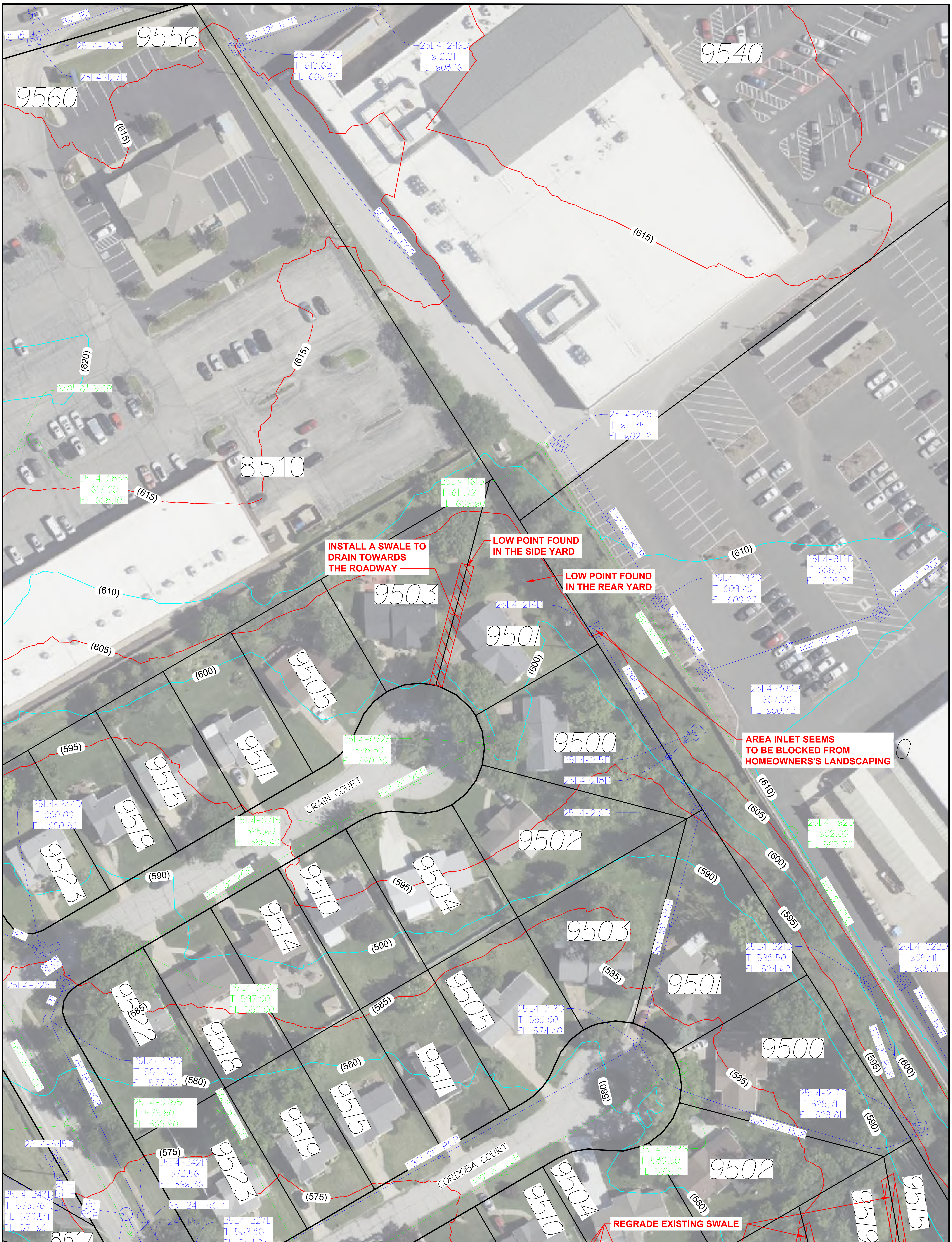
SOLUTION BENEFIT CATEGORY							
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10		0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount			
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	2			0
	Outlet Pipe Extension		PER 10 LF	1			0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3			0
	Gabion Wall		PER 10 LF	2			0
	Channel Enclosure		PER 10 LF	3			0
	Rip Rap Revetment		PER 10 LF	1			0
	Streambank Biostabilization		PER 10 LF	2			0
	Swale	95	PER 10 LF	2			19
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
							0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)		
	Points for Easements						0
					TOTAL PROBLEM POINTS		300
					TOTAL SOLUTION POINTS		19
					GRAND TOTAL POINTS		281

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS = 11.4

(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS = **24.649**



50' 0' 50' 100'

SCALE: 1" = 50'

9501-9503 CRAIN CT.

DATE:	08/04/2025
PROJECT:	MC-24
FIGURE:	6.c.xviii-1

ENGINEER:

HORNER SHIFRIN

101 LAURA K DRIVE, STE. 101 O'FALLON, MO 63366-3991
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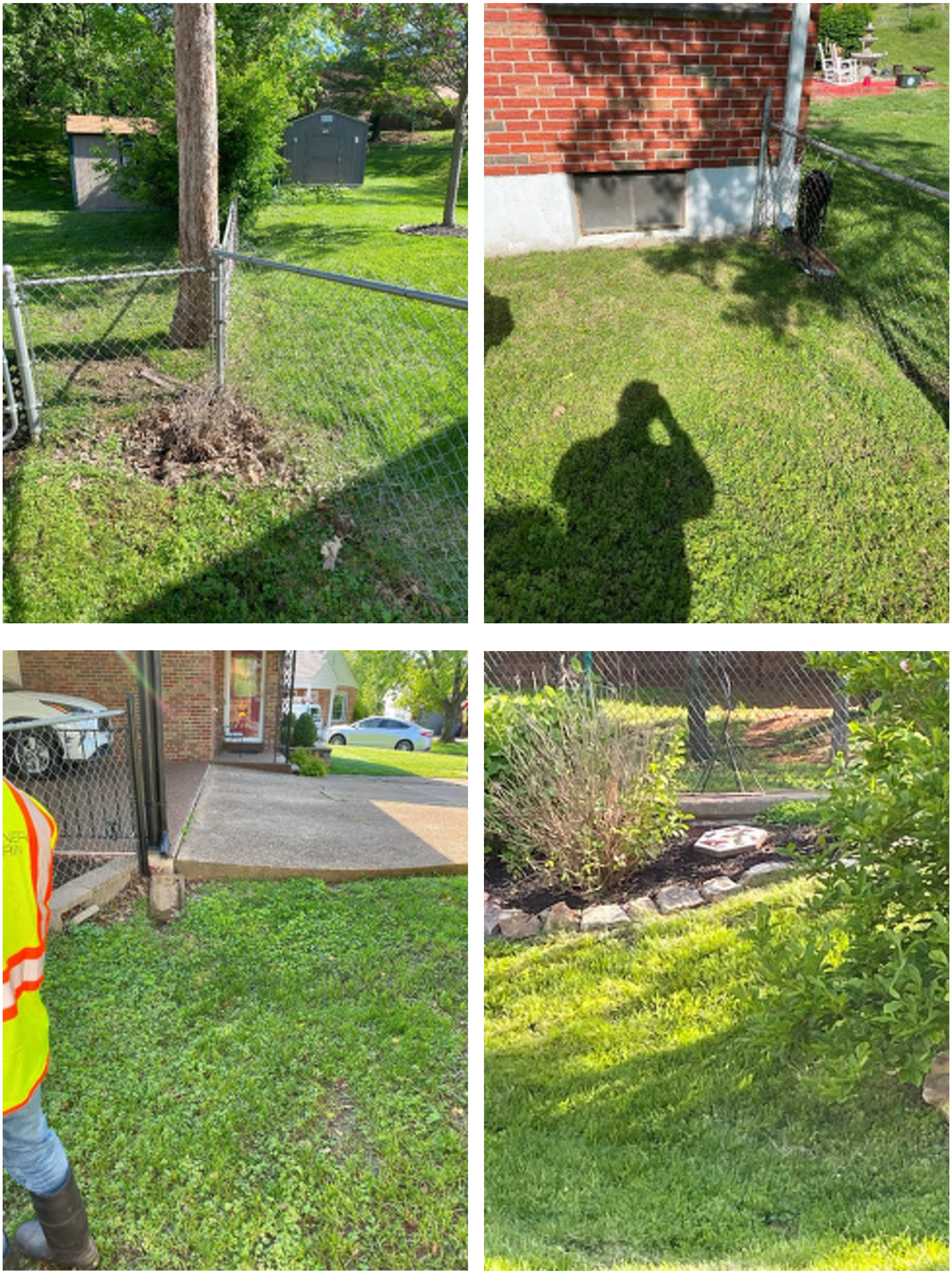
Figure 6.c.xviii-2 9501-9503 Crain Court



Appendix A – Stormwater Improvement Study by Camp Dresser & McKee (CDM)

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Section 2
Executive Summary

The City of Crestwood retained Camp Dresser & McKee (CDM) in association with Terra Technologies to develop a Stormwater Improvement Study (SWIP). The purpose of the SWIP was to identify existing stormwater problem areas and develop a prioritized list of recommended improvement projects that included both structural and biostabilization solutions.

The City of Crestwood encompasses approximately 2,292 acres and is located within portions of four primary watersheds, including the main branch of Gravois Creek, Kirkwood Creek, Mulberry Creek, and Sappington Creek. The main branch of Gravois Creek watershed is located on the east side of the City and generally flows in a southeasterly direction. Approximately 816 acres of the Gravois Creek watershed lie within the City limits. The Kirkwood Creek watershed is located in the northwest portion of the City and generally flows in a southeasterly direction, while the Mulberry Creek watershed is located in the southern portion of the City and generally flows in a northeasterly direction. The Kirkwood watershed encompasses approximately 530 acres of the City, while Mulberry covers approximately 914 acres. The Sappington Creek watershed is located in the southeast corner of the City and generally flows in a northeasterly direction, with 31 acres of the drainage basin located within the City.

The initial study evaluation included a comprehensive field investigation to assess localized flooding and erosion problems, and to conduct a geomorphic assessment of the natural streams within the City. The flooding and erosion problems were primarily identified from the questionnaire survey conducted by the City in February 2001. The City distributed 4,876 questionnaire surveys to the property owners within the City, and received 1,296 responses. The data collected during that survey was used to identify high priority flooding and erosion problem areas. In addition, past reports and complaint files were used to develop the preliminary list of problem areas. The purpose of the geomorphic assessment was to gain an understanding of the present condition of the channels, and to develop a list of potential project locations where biostabilization techniques could be applied. Biostabilization techniques are used to restore the natural appearance of the stream by using vegetation that is reinforced with structural components.

The field investigation and geomorphic assessment identified 29 high priority problem areas that resulted in the development of 29 recommended improvement projects. For each recommended improvement project, an evaluation was conducted that included a description of the advantages and disadvantages of several of the most feasible improvement alternatives. Each project was evaluated on the basis of cost, constructability, benefits, public acceptance, and environmental impacts. A construction cost estimate was developed for each recommended solution using unit cost information from recent stormwater construction projects in the St. Louis metropolitan area. A customized prioritization plan was used to rank the projects, which was based on the severity of the problem, benefits provided to the community, and construction cost. The following table provides the prioritized list of 29 improvement projects. The total estimated construction cost is approximately $4.2 million.

Table 2-1
Priority Rating of Recommended Projects

Ranking	Rating	Project Name	Cost Estimate
1	100	548-536 Aspen (KC-4)	$3,000
2	125	8901 Manda Lane (MC-15)	$6,000
3	133	9440 to 9448 Lodge Pole Drive (MC-1)	$4,000
4	150	9528 Craigwood Terrace (MC-4)	$15,000
5	188	631 Fieldcrest Drive (GC-9)	$21,000
6	260	9319 Lawndale Drive (MC-2)	$26,000
7	261	Whitecliff Park/Pardee Lane (GC-6)	$122,000
8	306	9518 to 9534 Pine Spray Court (MC-3)	$11,000
9	325	8900 Block Rudson Lane (MC-12)	$13,000
10	333	Spellman Park (KC-3)	$20,000
11	493	8900 Block Lindenhurst Drive (MC-7)	$150,000
12	545	Crestwood Park Entrance (MC-8)	$12,000
13	700	8940 Craighurst Terrace (MC-9)	$21,000
14	868	10069 to 10075 Barberton Dr. (MC-14)	$50,000
15	875	9107 Grant Park Drive (GC-3)	$42,000
16	972	9781 to 9783 Twin Vista Drive (MC-6)	$42,000
17	1,302	1000 to 1012 Banyon Drive (KC-2)	$125,000
18	1,468	Lowill Lane to Crest Oak Lane (MC-11)	$229,000
19	1,577	8854 to 8866 Rudson Lane (MC-13)	$41,000
20	1,588	Pardee Road (GC-5)	$343,000
21	1,857	9724 to 9700 Greenview Drive (KC-1)	$78,000
22	1,935	9000 to 9012 Cordoba Lane (GC-4)	$89,000
23	3,690	1022 Diversey Drive (GC-10)	$155,000
24	3,819	9000 Block Maple Grove/Sky Crest (MC-10)	$443,000
25	4,467	9600 Block Yorkshire Estates Drive (MC-5)	$536,000
26	4,553	7600 Block Capilia Drive (GC-2)	$173,000
27	5,906	Blackthorn Drive to Grant Road (GC-7)	$756,000
28	9,208	9000 Block Whitehaven Drive (GC-1)	$221,000
29	9,619	700 Block Fieldcrest Drive (GC-8)	$404,000

Each project's cost estimates and alternative solutions identified in this report involve a preliminary analysis of the stormwater problem. This information is intended to be used only as a general planning tool. The cost estimates and solutions presented may vary significantly from the final project costs and scope. A full detailed analysis as well as the selection of specific construction methods and materials will be determined during the project design phase. Once the project design has been completed, a more accurate construction cost estimate can be determined.

Stormwater quality is regulated under the National Pollutant Discharge Elimination System (NPDES) Program. Specifically, the regulations are enforced by U.S. Environmental Protection Agency (EPA) and will be enforced by the Missouri Department of Natural Resources (MDNR). The NPDES program includes two separate programs, called Phase I and II. The City of Crestwood falls under the Phase

II program, due to the population of the City, and will be required to comply with the regulations by March 2003. The Phase II program will require the development of a stormwater management program to reduce the discharge of pollutants and to protect water quality. The City has the option of submitting an individual permit or to be included as part of a co-permit application administered by the St. Louis Metropolitan Sewer District.

Section 3
Introduction

3.1 Purpose

The City of Crestwood retained Camp Dresser & McKee (CDM) in association with Terra Technologies to develop a Stormwater Improvement Study (SWIP). The purpose of the SWIP was to identify existing stormwater related problems and develop recommended improvements using both traditional and biostabilization solutions. Four major watersheds were evaluated within the city limits, including the Upper Gravois Creek, Kirkwood Creek, Mulberry Creek and Sappington Creek.

3.2 Scope of Work

This report presents an assessment of the City's stormwater management system and identifies the needs of the existing drainage network. The scope of this study included the following major components:

- An assessment and evaluation of existing stormwater related reports and data to develop a firm understanding of the stormwater issues and types of programs that have been implemented in the past
- A field investigation to identify and investigate the historical flooding and erosion problems along the major tributaries within the City
- An detailed analysis of 29 high priority stormwater problems which included the development of alternative solutions and recommendations
- The development of a systematic prioritization plan to ensure improvement projects are implemented according to a logical sequence of construction
- A description of the advantages and disadvantages of the most technically feasible alternative, including cost, constructability, benefits, operations and maintenance, political and public acceptance, and environmental impacts
- The development of construction cost estimates for each alternative solution using unit cost information from recent stormwater construction projects in the St. Louis metropolitan area
- The utilization of bioengineering technology where appropriate to provide stream bank stabilization options
- An explanation of the City's and the Metropolitan Sewer District's (MSD) role and responsibility regarding the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Phase II regulations
- The compilation of a master report that summarizes the results of the study

3.3 Definition of Terms

The following terms and abbreviations are used in this report:

- 2-year design storm - a rainfall event with a probability of occurrence of 50 percent in any given year.

- 15-year design storm - a rainfall event with a probability of occurrence of 7 percent in any given year.

- 100-year design storm - a rainfall event with a probability of occurrence of 1 percent in any given year.

- AC – acre or acres, a unit of measurement for labeling area.

- AC-FT – acre-foot or acre-feet, a unit of measurement for labeling volume.

- Berm – a shelf that breaks the continuity of a slope; a linear embankment or dike.

- Bioengineering – see biostabilization.

- Biogabion - a flexible woven-wire basket composed of two to six rectangular cells filled with small stones and soil, as well as seeds of local plants and treatments to spur seed germination, and may be used in revetments, retaining walls, channel liners, and drop structures.

- Biostabilization – a scientific and ancient method of restoring the landscape of ecosystems using the physical properties of plants, such as their sheer resistance, tensile strength, and flexibility, to rebuild the terrestrial or aquatic foundation in a manner that is both physically and ecologically stable. (see stream bank stabilization, synonymous with bioengineering)

- BMP – best management practice, a structural or non-structural device designed to temporarily store or treat urban stormwater runoff in order to mitigate flooding, reduce pollution and provide other amenities.

- CFS – cubic feet per second, a unit of measurement for labeling flow of water.

- CMP – corrugated metal pipe.

- Coir log – a bank stabilization technique based on a long bundle of coir (coconut fiber) bound together with coir or synthetic netting, promoting sedimentation, providing an ecologically sound medium for plant growth, and typically degrading after the establishment of a stable, non-erosive plant foundation.

- Conveyance system – natural channels and manmade structures that convey stormwater downstream.

- CY – cubic yard or yards, a unit of measurement for labeling volume.

- Detention basin – a stormwater facility that collects and temporarily stores runoff to reduce peak flowrates and alleviate downstream flooding and erosion problems.

- Flood bench – a technique used in stormwater control, when horizontal space is available, that removes earth from one or both stream banks such that the result is a visible bench when the stream is viewed in cross-section, and done to reduce water velocity, shear stresses, and water surface elevation.

- Fluvial geomorphology – a class of geomorphology where the underlying structure focus is on streams, creeks, or rivers.

- Gabion – a flexible woven-wire basket composed of two to six rectangular cells filled with small stones. Gabions may be assembled into many types of structures such as revetments, retaining walls, channel liners, and drop structures.

- Gabion mattress – a thin gabion, usually six or nine inches thick, used to line channels for erosion control.

- Geocell – a bank stabilization technique used to stabilize and revegetate over-steep vertical banks, where slopes are 1.5 horizontal: 1 vertical, and geo-synthetic cells are stacked in layers exposing the face geocell, like the run and rise of a staircase, containing a graded mixture of rock, soil, and either native seed or live root cuttings along the run of each step.

- Geogrid – a bank stabilization technique used to stabilize and revegetate gently sloped banks, where slopes are 2 horizontal: 1 vertical, and composed of a vegetated synthetic biaxial geogrid material (which wraps each layer), placed upon another layer in lifts, and varied in regards to the material's openings or density depending on the earth fill being wrapped.

- Geomorphology – the study of the nature and origin of landforms and their underlying structures, regarding the history of geologic changes recorded by these structures. (see also fluvial geomorphology)

- GIS – geographical information system.

- GPS – global positioning system.

- Grouted riprap – an assemblage of broken stones bonded together with mortar and built along streams or beaches for erosion protection.

- EA – each, a unit of measurement for quantifying a unique part.
- FEMA – Federal Emergency Management Agency.
- FF - face-foot or face feet, a unit of measurement for labeling items that have an exposed vertical or elevation face in terms of the horizontal length.
- FIS – flood insurance study.
- Floodplain – the area of land that is inundated with water during a given storm event.
- FPS – feet per second, a unit of measurement for labeling velocity of water.
- Freeboard – defined as the distance between the maximum water surface elevation anticipated in design and the top of retaining banks or structures, and provided to prevent overtopping due to unforeseen conditions.
- FSF – face square-foot or face square feet, a unit of measurement for labeling items that have an exposed vertical or elevation face in terms of area.
- Gully – a channel or miniature valley cut by concentrated runoff through which water commonly flows only during and immediately after heavy rains and is sufficiently deep that it would not be obliterated by normal tillage operations.
- Hydrology analysis – the study of the occurrence, distribution, movement, and properties of waters of the earth and their environmental relations.
- Hydraulic analysis – the study of stormwater flow through the conveyance system that includes underground pipelines, culverts, improved open channels, and natural creeks.
- Hyetograph – a plot of rainfall depth or intensity versus time.
- Illicit connections – the illegal and/or unauthorized connections that result in untreated wastewater discharges into storm drainage systems and receiving waters.
- Illicit discharge – any discharge to a municipal separate storm sewer system that is not composed entirely of storm water, except for discharges allowed under an NPDES permit or waters used for certain emergency situations.
- Impervious – the characteristic of a material which prevents the infiltration or passage of liquid through it. This may apply to roads, streets, parking lots, rooftops and sidewalks.

- LF – linear-foot or linear feet, a unit of measurement for labeling length.
- Manning's formula – a formula used to predict the velocity of water flow in an open channel or pipeline: $V = 1.486/n^* R^{2/3} {}^*S^{1/2}$, where V is the mean velocity of flow in feet per second; R is the hydraulic radius; S is the slope of the channel, in feet per foot; and n is the roughness coefficient of the channel lining.
- MSD – Metropolitan St. Louis Sewer District.
- Municipal stormwater permit – an NPDES permit issued to municipalities to regulate discharges from municipal separate storm sewers for compliance with EPA established water quality standards and/or to specify specific stormwater control strategies.
- NPDES – the National Pollutant Discharge Elimination System, established by Section 402 of the Clean Water Act, is a federally mandated system used for regulating point source and stormwater discharges.
- Normal depth – depth of flow in an open conduit during uniform flow for the given conditions. (see Manning's equation)
- Open channels – also known as swales, grass channels, streams, and biofilters. These systems are used for the conveyance, retention, infiltration and filtration of stormwater runoff.
- Outfall – the point where water flows from a conduit, stream, or drain.
- Perennial stream – a stream channel that has running water throughout the year.
- Pollution prevention plan – a requirement for some land uses or activities (e.g., industrial sites) that outlines techniques to prevent pollutants from being washed off in stormwater runoff (e.g., spill response, material handling, employee training, etc.)
- Rational Method – a simple and widely accepted method of estimating peak runoff flowrates from urban watersheds smaller than 600 acres.
- RCB – reinforced concrete box.
- RCP – reinforced concrete pipe.
- RECP – rolled erosion control product, a coir or synthetic blanket or carpet that may be used with sod or seed to prevent stormwater erosion.

- RPM – root-prune method, a technique used in bank stabilization for initiating woody plant growth along banks by placing living, woody plant cuttings, like willows.

- Rill – defined as of lessor depth than a gully and would be smoothed by ordinary farm tillage. (see gully)

- Riparian – characteristic of an area bordering a stream or river.

- Riprap – a loose assemblage of broken stones built along streams or beaches for erosion protection.

- Runoff – the portion of precipitation that is discharged from a drainage area.

- Sedimentation – soil particles suspended in stormwater that can settle in stream beds and disrupt the natural flow of the stream.

- Side slopes – the slope of the sides of a channel, dam or embankment, where customary naming is the horizontal distance first, as 1.5 to 1, or frequently, 1 ½: 1, meaning a horizontal distance of 1.5 feet to 1 foot vertical.

- SF – square-foot or square feet, a unit of measurement for labeling area.

- Slope – defined by change in vertical elevation divided by horizontal distance and typically expressed as a percentage.

- Stream bank stabilization – the use of the structural properties of live plants to rebuild washed out stream banks and flood terraces, including live slope fascines, hedge brush layers, and live willow brush mattresses.

- Stabilization – providing adequate measures, vegetative and/or structural that will prevent erosion from occurring.

- Subarea – a portion of a watershed which drains and concentrates at point, typically at a catch basin, within a system of drainage pipes, or along a stream.

- Surcharge – a condition of a stormwater system, where the water surface exceeds the freeboard and overflows.

- Swale – an open drainage channel or depression explicitly designed to detain and promote the filtration of stormwater runoff.

- Tail water – water, in a river or channel, immediately downstream from a structure.

- Time of concentration – time required for water to flow from the most remote point of a watershed, in a hydraulic sense, to a point of concentration described within a subarea.

- Toe (of slope) – where the slope stops or levels out. Bottom of the slope.

- TR-55 – Technical Release 55, a report compiled by the Natural Resources Conservation Service that presents procedures for stormwater calculations.

- TRM – turf reinforced matrix, an erosion control solution that strengthens soil to resist lateral stresses.

- Watershed – a region of land that drains to a river, creek, or body of water.

- Wing wall – side wall extensions of a structure, typically at the head or tail end of a system of stormwater pipes or a culvert, which is used to prevent sloughing of banks or channels and to direct runoff.

- WTRM – wire turf reinforced matrix, an erosion control solution that strengthens soil to resist lateral stresses.

- XP-SWMM – a proprietary computer program, based on the US Environmental Protection Agency's Stormwater Management Model, used to compute the behavior of stormwater systems.

Section 4
Description of Watersheds

4.1 Watershed Description

The City of Crestwood is located entirely within the 14,558-acre (22.7 square mile) Gravois Creek watershed, in south St. Louis County, Missouri. The Gravois Creek watershed is coupled to a network of six major tributaries, including St. George Creek, Mehlville Creek, Union Creek, Sappington Creek, Mulberry Creek and Kirkwood Creek. Unimproved open channel systems provide the lowland areas with 112,464 feet (21.3 miles) of drainage; a total length of 129,888 feet (24.6 miles) of known closed conduit drainage systems greater than 36-inches in diameter dewater much of the upland areas. Nineteen detention basins control flows within the Gravois Creek basin (CH2MHill, 1997). The City of Crestwood occupies 16 percent of the Gravois Creek watershed or 2,292 acres (3.6 square miles).

4.2 Subwatershed Description

The City of Crestwood lies within portions of four subwatersheds of the Gravois Creek watershed, including the upper main branch of the Gravois Creek, Mulberry Creek, Kirkwood Creek and Sappington Creek, as shown in Figure 4-1. A general overview of the four subwatersheds is presented below. Figure 4-2 and Table 4-1 display the land use characteristics for each subwatershed, which illustrate that the dominant land use category is residential.

4.2.1 Gravois Creek - Upper Main Branch

The headwaters of the upper main branch of the Gravois Creek watershed are located near the City of Kirkwood, Missouri at an elevation of 634 feet above mean sea level. A southwesterly flow characterizes the predominant drainage pattern of Gravois Creek. The upper main branch of the Gravois Creek watershed has a total drainage area of 2,885 acres (4.5 square miles) and a main channel length of 21,648 feet (4.1 miles).

Within the City of Crestwood, the upper main branch of the Gravois Creek watershed occupies 816 acres (1.3 square miles) or 36 percent of the city. This watershed contains 10,240 feet (1.9 miles) of main channel and 8,529 feet (1.6 miles) of tributary open channel within the city limits. A tributary channel is defined as the drainage stream that empties into the main channel.

4.2.2 Kirkwood Creek

The headwaters of Kirkwood Creek watershed are located 900 feet east of Lindbergh Boulevard in Kirkwood at an elevation of 610 feet above sea level. A southeasterly flow characterizes the predominant drainage pattern of Kirkwood Creek. The Kirkwood Creek watershed has a total drainage area of 1,885 acres (2.9 square miles) and a main channel length of 12,144 feet (2.3 miles).

Within the City of Crestwood, the Kirkwood Creek watershed occupies 530 acres (0.8 square miles) or 23 percent of the city. This watershed contains 6,420 feet (1.2 miles) of main open channel and 3,985 feet (0.75 miles) of tributary open channel within the city limits.

4.2.3 Mulberry Creek

The headwaters of Mulberry Creek watershed are near Eddie and Park Road at an elevation of 620 feet above sea level. A northeasterly flow characterizes the predominant drainage pattern of Mulberry Creek. The Mulberry Creek watershed has a total drainage area of 1,241 acres (1.9 square miles) and a main channel length of 8,976 feet (1.7 miles).

Within the City of Crestwood, the Mulberry Creek watershed occupies 914 acres (1.4 square miles) or 40 percent of the city. This channel contains 9,342 feet (1.8 miles) of main open channel and 5,686 feet (1.1 miles) of tributary open channel within the city limits.

4.2.4 Sappington Creek

The headwaters of Sappington Creek watershed are located 4,200 feet southwest of the intersection of Baptist Church Road and Gravois Road at an elevation of 550 feet above sea level. A northeasterly flow characterizes the predominant drainage pattern of Sappington Creek. The upper main branch of Sappington Creek watershed has a total drainage area of 1,447 acres (2.3 square miles) and a main channel length of 9,504 feet (1.8 miles).

Within the City of Crestwood, the Sappington Creek watershed occupies 31 acres (0.05 square miles) or 1 percent of the city. No open channel is present within the city limits in this watershed.

Table 4-1
Land Use Characteristics

	Drainage Area (acres)	Percent of Total Watershed Area
Gravois Creek		
Residential	716	87.7
Commercial	63	7.7
Industrial	37	4.5
Mulberry Creek		
Residential	804	86.8
Commercial	106	11.4
Industrial	4	0.4
Kirkwood Creek		
Residential	381	71.7
Commercial	73	13.7
Industrial	77	14.5
Sappington Creek		
Residential	31	100.0
Commercial	0	0.0
Industrial	0	0.0

Section 5
Data Collection and Study Methodology

5.1 Data Collection and Review

The data used to conduct the study was a compilation of information provided by the City of Crestwood and field data collected by CDM and Terra Technologies. The following is a summary of data used to conduct the study.

5.1.1 City Data Files

The City of Crestwood provided CDM with a comprehensive data set of stormwater related problems occurring in the City. The data included a collection of historical and present accounts of problems presented in both written graphical and digital formats. The stormwater data set included the following items:

- Various tables regarding most recent stormwater issues
- Culvert inventory map and report
- Problem areas located in Crestwood parks or areas maintained by the Crestwood Parks department
- Synopsis of MSD's 2000-2001 Capital Improvement and Replacement Program Budget Report
- Field investigation meeting minutes
- Historical problems area map provided by the Director of Public Works
- Noteworthy Sharkware files related to stormwater problems
- City of Crestwood storm and waste water committee field investigation minutes
- Flood accounts and investigations
- Miscellaneous reports and letters from/to MSD, City, residents, and Army Corps of Engineers
- Summary of wet weather bypasses
- MSD and City complaint logs from Crestwood residents
- MSD project listing and projects map
- City street guide base map
- MSD facilities maps and contour maps

- FEMA flood insurance studies and firm maps
- Resident stormwater questionnaire results, maps, and noteworthy responses

5.1.2 Field Investigations

CDM and Terra Technologies conducted four field investigations to supplement the written accounts of the current stormwater issues in the City. Two primary watershed assessments were made on May 1, 2001 and June 26, 2001. Prior to conducting the primary assessments, a preliminary list of approximately 60 problem areas were identified based on the information provided by the City. The objective in the primary assessments were to field verify the problem areas from the initial list of 60 problems to classify the problem areas as either high or low priority. After discussing the results of primary watershed assessments with City staff, 29 potential high priority problem areas were identified for further evaluation.

CDM made two secondary assessments on July 9, 2001 and August 8, 2001. The objective of the secondary assessments was to define the extent of the problems, collect data required for engineering calculations and develop a conceptual solution for the problem areas. Appendix A displays key photos taken from the field investigations.

5.1.3 Geomorphic Assessment

As part of the field investigation conducted on May 1, 2001, Terra Technologies led a geomorphic assessment of the open channels directly connected to one of the three the main channels within the city limits. The purpose of the geomorphic assessment was to gain an understanding of the present condition of the channels, and develop a list of potential project locations where biostabilization techniques could be applied. Section 6 discusses the details of this assessment.

5.1.4 Existing Mapping

MSD provided CDM with both hard copies and electronic copies of the MSD maintained infrastructure within the City. This data contained a location and listing of sanitary sewer details, stormwater details, right-of-way locations, 2-foot contours and parcel information. Additionally, MSD provided orthographically corrected digital aerial photographs. In addition, the City provided mapping data to CDM in both digital and hard copy format. The mapping data included an inventory of city-owned culverts, stormwater-questionnaire survey data, right-of-way locations, and parcel information.

5.1.5 Previous Studies

CDM reviewed the *Gravois Creek Watershed Study*, completed by CH2MHill in May of 1997, prior to the development of the study. The study provided background information and was used as an initial assessment for identifying problem areas within the City.

5.1.6 Stormwater Questionnaire Data

The City conducted a resident stormwater questionnaire survey in February 2001. The data collected during that survey was used to identify high priority problem areas with flooding and erosion concerns. The response rate to the stormwater survey, as of March 29, 2001, was 27 percent, with 1,296 responses out of 4,876 questionnaires mailed. In addition to questionnaire statistics, written comments from residents provided an additional level of detail.

5.2 Study Methodology

5.2.1 General Design Standards

The design standards used to develop solutions for this study were based on the design criteria listed in Section 4.0 of the *MSD Rules and Regulations and Engineering Design Requirements for Sanitary Sewage and Stormwater Drainage Facilities,* February 1997. Appendix B presents these calculations.

5.2.2 Hydrology

The hydrology design standards used to develop the stormwater improvement projects were based on the Rational Method. As specified by the MSD design manual, a 15-year return interval was used as the design storm, as well as a 20-minute time of concentration for the design of local drainage systems. Times of concentration were randomly checked for flow paths and calculated for detention basin design by using the TR-55 method (NRCS, 1986). An assessment of imperviousness for each Rational Method calculation was based upon MSD standards and digital aerial photographs.

5.2.3 Hydraulics

5.2.3.1 Inlet Control

For culvert improvements, inlet control calculations were developed according to criteria listed in the *Urban Drainage Design Manual-Hydraulic Engineering Circular #22* (U.S. Department of Transportation Federal Highway Administration, 1996). Inlet control designs were also based on standards printed in the *Stormwater Collection Systems Design Handbook* (Mays, 2001), and through the use of nomographs published in *Hydraulic Charts for the Selection of Highway Culverts-Hydraulic Engineering Circular #5* (U.S. Department of Transportation-Federal Highway Administration, 1965).

5.2.4 Regional Detention

Regional detention is an effective way to reduce local and regional flooding if undeveloped land is available upstream of the flooding locations. The recommended improvements discussed in Section 8 could not be solved with the implementation of detention storage as a cost-effective improvement due to the lack of available land at the appropriate locations. The proper time for consideration of regional storage should occur during the planning stages of undeveloped watersheds.

Section 6
Stream Assessment

6.1 General Observations

After reviewing the general conditions of streams within the City of Crestwood, there are two overall conditions present. The main channel of Gravois Creek is located in the heart of Crestwood and is generally abutted by commercial and industrial facilities. Due to the cumulative effects of watershed development, Gravois Creek demonstrates the greatest amount of stream transition impacts. This channel carries the highest flow rates of all streams evaluated and would require the greatest amount of lateral space for necessary cross-section and alignment changes to create a stable natural channel. Unfortunately, the proximity of surrounding development to the riparian corridor limits the available space, creating difficulty in implementing necessary changes to create stable natural channel conditions. The remaining stream areas within the City of Crestwood are predominantly surrounded by residential development. These watershed areas are smaller in size and show less cumulative effect from watershed development primarily due to smaller watershed size. The watersheds described by this general condition include portions of Kirkwood Creek, Mulberry Creek, and Gravois Creek.

6.2 Field Observations

Gravois Creek exhibits the greatest level of erosion of all evaluated streams. The greater size of this watershed creates the need for a larger stream cross-section. When erosion occurs on this stream due to stream transition, the associated problems are of a much larger magnitude due solely to the larger stream size. A percentage increase in stream cross-section for a stream of this magnitude represents a greater volume of erosion than the same percentage increase in a smaller stream. Consequently, the exhibited erosion problems on Gravois Creek are potentially the most costly to address since a greater area would be impacted. Addressing stream transition issues on Gravois Creek via bioengineering measures may be difficult since a greater level of infrastructure would be potentially impacted. Affected infrastructures might include bridges, utilities, roadways, and buildings. Recommended solutions for problems on Gravois Creek are likely to be more reliant upon structural stabilization measures than vegetative stabilization solutions due to space limitations. However, environmental concerns can still be met with appropriate combinations of structural and bioengineering improvements.

The remaining watersheds are more likely candidates for less structurally oriented erosion control solutions since total space required will be less due to the smaller size of the watersheds. Bioengineered erosion control solutions might be more appealing to property owners since these types of approaches cause a less dramatic change in appearance to the stream corridor. Basic changes to stream cross-section and alignment could eliminate many of the erosion problems that exist on these streams. If these types of changes are not possible, combinations of structural and bioengineering erosion control solutions could be effective.

6.3 Fluvial Geomorphology

The evaluation of the fluvial geomorphology of a stream is a critical step in the development of a plan to incorporate both hard concrete and biostabilization solutions. Fluvial geomorphology can be defined as the science of evaluating all parameters within a watershed that shape a stream. The resulting cross-section and alignment of a stream are a result of all geomorphic parameters within the watershed. To simplify the evaluation process, a series of classifications and measurements are often used to determine stream type and the level of transition if the geomorphic parameters have been altered.

6.4 Channel Formation

Natural streams are formed and maintained by hydraulic regimes that are classified as channel forming flows. Due to the infinite variables that affect a watershed, defining precise flow rates of the channel forming flows is nearly impossible. Generally, channel forming flows consist of the hydrograph representing the 1- to 2-year return interval flow event. This flow range usually contains the precise flow regime that provides the balance between erosion and sedimentation. The channel forming flows shape the channel and create stream features. If the channel capacity is too small, the channel forming flows create a condition where erosion exceeds sedimentation. If the channel capacity is too large, the channel forming flows create a condition where sedimentation exceeds erosion.

6.4.1 Sedimentation/Erosion Balance

Streams naturally transition to a point where the balance exists between erosion and sedimentation. When changes are made to the geomorphic conditions of the watershed, the result is typically a change in channel forming flows that result in changes to the stream features. Since man-made changes typically result in an increase to the total hydrograph volume for frequent storm events, these changes typically cause erosion throughout the stream system. The erosion will continue until the stream reaches a new balance of erosion and sedimentation based upon channel forming flows for the changed conditions.

6.5 Field Observations

Representatives from CDM and Terra Technologies physically observed the stream conditions within the City of Crestwood. A general geomorphic evaluation was conducted for each natural stream section as described below. Figure 6-1 displays layout of the extents of the geomorphic field investigation.

6.5.1 Gravois Creek Watershed

6.5.1.1 Section 1

Gravois Creek from the mouth of Mulberry Creek to the southern city limit boundary of Crestwood exists in a natural channel configuration. Whitecliff Park bounds the channel on the south side the entire length of this reach. Private property through the upstream portion and Pardee Road through the downstream portion bound the north side of the channel. Biological indicators through this reach indicate a somewhat healthier ecosystem than existed throughout Mulberry Creek. This apparent biological improvement could be directly related to magnitude of the stream, since larger stream systems have a greater ability to buffer pollutants than smaller streams. Fish, snakes, crayfish, and waterfowl were observed. No taxonomy was performed on observed species to determine if biological forms were tolerant or intolerant of poor habitat conditions. This reach of Gravois Creek had strong transition indicators of geomorphic disturbance. Large volumes of erosion were observed with steep eroding banks occurring throughout. A sanitary sewer line at the upstream end of this reach was exposed and nearly undercut. Conditions in the channel indicate significant down cutting along with lateral widening. Significant acreage would need to be disturbed to create a geomorphicaly stable alignment due to the large size of the stream cross-section.

6.5.1.2 Section 2

Gravois Creek from the mouth of Mulberry Creek north to the intersection with Kirkwood Creek generally exists in a natural channel configuration, however some structural improvements were noted within the section. A sanitary sewer line at the downstream end of this reach was exposed and nearly undercut. The City of Crestwood Public Works Department Maintenance Facility is located on the eastern side of the channel along Pardee Lane. Areas of the stream bank within this section have been armored with rip rap, grouted rip rap, and concrete and asphalt rubble, especially in the vicinity of the Public Works Department Maintenance Facility and downstream adjacent to the salt storage dome facility. Generally, the section exhibited forms of transition in isolated locations; areas of limited vegetation and minor erosion were observed throughout the section. Landforms generally control the stream alignment.

6.5.1.3 Section 3

Gravois Creek from the mouth of Kirkwood Creek to the northern city limit boundary at Big Bend Road was observed. The lower end of the reach is bounded by a shopping center complex to the east and office buildings to the west. Minor forms of transition and erosion were observed in the lower end of the reach with areas with concrete and asphalt rubble used to armor the toe and stream banks. One area of significant erosion was observed on the west bank across from the northern end of the shopping center complex. This area of the stream has strong transition indicators of geomorphic disturbance. Non-structural measures could be used to address erosion concerns. The east bank south from Liggett Road parallel to Shoppers Lane was armored with reno mattresses while the right bank was vegetated. The channel from Liggett Road north to Sanders Park generally exists in a natural channel configuration with very little signs of transition; this reach appeared to be in generally good condition with no space constraints or stream constrictions. Discontinuous areas of gabion wall systems are present throughout Sanders Park, and a utility crossing is present near the downstream end of Sanders Park. Continuous gabion wall systems are present between Sanders Park and Big Bend Road. The entire wire basket foundation of the lower baskets is corroded and failing for about 200 feet of channel reach within the Park. In addition, higher flows have caused the wall to topple in a 40-foot section of this reach.

6.5.1.4 Tributary 1

A tributary to Gravois Creek, located near the southern end of Whitecliff Park, was observed. The lower reaches of this stream exhibited severe erosion along a steep gradient streambed. Major transition was noted through this reach. The upper reaches of this tributary cross Cordoba Lane and run generally parallel to Lavant Drive in a series of enclosed systems. While erosion was severe and transition forms significant, the location of the channel within the park threatens no significant infrastructure. Erosion at the point where the channel changes from an enclosed system to an open system was noted. This erosion occurs near maintained areas of private property. Non-structural methods of addressing erosion in this reach appear to be viable.

6.5.1.5 Tributary 2

A tributary to Gravois Creek, running from Whitehaven Drive to General Grant Lane was observed. Development near the stream appears to be causing instability and a strong potential for flooding. Generally, the stream did not exhibit strong forms of transition except in isolated locations. Non-structural measures could address erosion concerns, however, structural measures are probably necessary to address flooding. The lower reach of this stream contained significant flows that were reported to occur continuously. The presence of an upstream spring is suspected of being the source of these flows although a spring could not be located. The upper portions of this channel do not carry constant flows except during wet weather. Some structural improvements were noted along the stream corridor. Generally, sufficient space exists to address erosion problems in a non-structural manner.

6.5.1.6 Tributary 3

A tributary to Gravois Creek, beginning at the northern section of Whitecliff Park at 8729 Pardee Lane to the city limits, between Heather Drive and Blackthorn Drive was observed. Generally, this tributary of Gravois Creek had strong transition indicators of geomorphic disturbance. Severe bank erosion was observed behind 40 Heather Drive, and a culvert at this location pointed upstream. The presence of yard waste dumped by residents along the length of the tributary is contributing to erosion near 8 Heather Drive. Fences in the area of 8 Heather Drive are being compromised by a failing railroad-tie wall and erosion. Erosion exists at the upstream end of the culvert under the Missouri Pacific Rail Road (MPRR) right-of-way and the headwall at this location is in need of repair. Downcutting was observed upstream from the MPRR right-of-way.

6.5.1.7 Tributary 4

Fieldcrest Road and Paddock Court border Tributary 4 of the Gravois Creek to the north and south, respectively, and the tributary extends to the city limits. In this short section of tributary, a degree of erosion was observed. The erosion was located in the vicinity of 626 Fieldcrest.

6.5.1.8 Tributary 5

Tributary 5 located northeast of Ferndale Avenue and continuing to the city limits, was observed. No major problems or transition issues were observed in this channel section.

6.5.1.9 Enclosed Tributaries

All other tributaries to Gravois Creek, within the City of Crestwood, exist in an enclosed system or in an engineered open channel system. If problem areas exist within these engineered sections of channel, strong consideration should be given to restoring these channels to configurations that mimic natural streams.

6.5.2 Kirkwood Creek Watershed

6.5.2.1 Section 1

Section 1 spans from the confluence of Kirkwood Creek and Gravois Creek to Sappington Road. Severe bank erosion was evident at the confluence of Kirkwood Creek and Gravois Creek. This erosion appeared to be due to high velocities at the outlet of Kirkwood Creek. An industrial building near 9292 Watson Industrial Drive had been constructed so that a side of the building served as a channel wall. An abundant number of bush honeysuckle plants were present in a section of channel that spanned the length of Watson Industrial Drive. The channel transitions from a natural channel configuration to stone bed channel configuration approximately near 9420 Watson Industrial Drive. This section of channel appears to be well developed, and generally free of erosion.

6.5.2.2 Section 2

Section 2 stretches from Sappington Road upstream to Holmes Avenue. Numerous erosion problems were identified along this section of Kirkwood Creek. Dislodged rip-rap covered the channel bed in a short section behind 1173 Reco Drive. High bank erosion has exposed the root systems of several trees behind 769 Samoa. Erosion that has occurred behind 1012 Banyon Drive was threatening a fence along a bank of the channel. Bank erosion was observed throughout a length of channel behind 1000-1012 Banyon Drive. Significant erosion was present in this section of the channel. Exposed roots of channel vegetation were common, and a resident-constructed gabion wall had failed due to the erosive forces of the channel. Near 10014 Camera Drive, bank erosion was again evident, and trees were blocking one of three sections of a box culvert under Holmes Avenue. Due to the erosion found throughout the length of the channel, it appears that the geomorphic structure of the channel is changing to accommodate increased flows.

6.5.2.3 Tributary 1

Tributary 1 is located between homes on Greenview Drive and the Crestwood Plaza shopping center. The channel ends at the south end of Greenview Drive. In the upstream section of the tributary, near the 9700 block of Greenview Drive, signs of channel erosion and downcutting were present. Two sections of the channel in this area were enclosed in an RCP section. The construction of these enclosures may have been an attempt to reconcile early signs of erosion.

6.5.2.4 Tributary 2

Tributary 2 is located between Crestwood Elementary School and the Watson Industrial Drive cul-de-sac. This channel travels through an industrial area. No major problems or transition issues were observed in this channel section.

6.5.2.5 Tributary 3

This tributary flows from southwest to northeast and is located to the north of Twincrest Drive. This channel crosses through a commercially developed area. No major problems were observed in this tributary.

6.5.2.6 Tributary 4

Tributary 4 parallels New Sappington Road crossing Reco Drive and the Missouri Pacific Railroad. Near Reco Avenue, several problems were observed. The headwall on the south side of the box culvert, under Reco Avenue, had collapsed and was blocking flow at the box culvert. Grouted rip-rap was present 30 feet upstream from the box culvert, which appeared to serve as a detention basin overflow. Some minor down cutting is present in the area downstream of the rip-rap. Problems found in this tributary appear to be primarily associated with stream maintenance.

6.5.3 Mulberry Creek Watershed

6.5.3.1 Section 1

The reach of Mulberry Creek from the mouth at Gravois Creek to Old Sappington Road does not exhibit major signs of transition. The lower portion of this reach appears to be in an original alignment and is bordered by Whitecliff Park on the south and by residential property on the north. Some signs of transition are apparent, although minimal imminent threat to infrastructure exists. Starting behind 9404 Lodge Pole Lane and continuing upstream to Old Sappington Road, the stream has apparently been straightened with the north bank being structurally protected via a series of gabions, grouted rip rap installations and concrete slope protection. Stream down cutting has occurred and is undermining the toe of the structural systems. Attention to this down cutting should be a future priority before the integrity of the structural systems is compromised. Vegetative stabilization could be utilized in lieu of structural systems due to availability of sufficient lateral space. Stream transition is not expected to threaten infrastructure in the near future for this reach.

6.5.3.2 Section 2

The reach of Mulberry Creek between Old Sappington and New Sappington roadway crossings exists in a natural stream alignment and appears to be generally stable. No infrastructure improvements encroach upon the stream corridor except at the roadway crossings. The floor of the Old Sappington Road RCB is significantly deteriorated with steel reinforcement exposed. The alignment of the reach appears to be relatively stable and no alterations are recommended.

6.5.3.3 Section 3

The reach of Mulberry Creek from New Sappington Road on the downstream end to the start of a trapezoidal concrete channel section at the western end of Crestwood Park exists in a natural state and alignment. Moderate stream transition appears to have occurred as evidenced by erosion and minor down cutting throughout the reach. Some constructed wall systems near New Sappington Road have been undermined as evidence of stream transition. Newer wall systems in this same area appear to be in good condition but are expected to deteriorate eventually. Landforms in the area limit the potential for stream re-alignment on the south bank. Property encroachment on the north bank is aggravating stream stability. As this reach enters Crestwood Park, the encroachment is more limited. Stream cross-section does not appear sufficient to convey channel-forming flows as evidenced by bank erosion and stream down cutting. The stream through this reach is expected to transition to a wider overbank cross-section than currently exists. Geomorphic channel alterations could be performed in this reach to provide a stable alignment.

6.5.3.4 Section 4

The reach of Mulberry Creek from the western end of Crestwood Park to a point immediately upstream of the Crest Oak roadway crossing consists of a trapezoidal concrete lined cross-section. The condition of the lower portion of this reach is extremely poor. Concrete slabs have been undermined and lifted. This deterioration will continue upstream unless remedial action is taken. Geomorphic evaluation of this reach is not useful since the stream exists in an engineered state. As the concrete deteriorates, the stream will eventually return to a natural state similar to what exists upstream and downstream.

6.5.3.5 Section 5

The remaining reach of Mulberry Creek from Crest Oak roadway crossing upstream to the Crestwood city limits exists in a natural state. Some channelization appears to have occurred when the area was developed since the channel generally follows the property lines in a linear fashion. Stream transition is evident in this reach due to bank erosion and apparent channel down cutting. The entire reach has been encroached upon by residential development. The channel requires a larger cross-section and longer flow path in order to be naturally stable. If space is available, this reach of channel can be made stable with basic cross-section and alignment alterations. If alterations are not made, stream transitions will continue until they are achieved naturally.

6.5.3.6 Tributary 1

There are several tributaries to Mulberry Creek that exist in a natural state. The first tributary observed begins behind 9324 Lodge Pole Lane and continues south through Whitecliff Park crossing under Vauk Lane near the upstream terminus. The channel is in generally good condition and is not demonstrating significant signs of transition. The upper limits of this reach exist as a swale through backyard areas and do not appear to be causing any problems of significance. No geomorphic changes appear necessary for this area to remain stable.

6.5.3.7 Tributary 2

The Mulberry Creek tributary with the mouth located behind 9530 Anchorage Lane and continuing south to the roadway crossing of Lawndale Drive exists as a natural channel. This channel has a steep gradient with a series of natural step structures occurring in an unmaintained area. The steep gradient of this channel is likely to cause significant down cutting over time. However, no infrastructure is located near this channel to be threatened. The upper portion of this stream is located in a channelized system located in the backyards of various residences. If the vacant property that contains a majority of this stream is ever developed, strong consideration should be given to limiting development near this stream alignment.

6.5.3.8 Tributary 3

The Mulberry Creek tributary located between Crestwood Park and Long Elementary School exists as an open channel through Crestwood Park becoming channelized behind 9073 Doercrest Drive. The open channel is non-structural although probably not in a natural alignment. No major evidence of stream transition exists even though the alignment is probably not natural. If stream transition were to occur, sufficient space is available to allow that to happen naturally without causing threat to significant infrastructure.

6.5.3.9 Tributary 4

The Mulberry Creek tributary located between Eddie and Park Road and Meadowfern Drive is an open channel that parallels property lines. This alignment is probably not naturally occurring. Wall systems have been constructed throughout this reach, further encroaching upon the stream. Down cutting and erosion are evident throughout the reach. Limited space is available to make the necessary stream alterations that would provide a stable natural channel system.

6.5.3.10 Tributary 5

The only remaining natural open channel tributary to Mulberry Creek is a short reach of channel in Crestwood Park. This channel is located behind 8940 Craighurst Terrace. Upper portions of this tributary exist in an enclosed system. The channel empties into Mulberry Creek downstream of the trapezoidal concrete lined section. No major transition issues were observed in this channel section.

6.5.3.11 Tributary 6

This segment of drainage channel is a concrete trapezoid man-made channel that is beginning to show signs of deterioration in certain locations.

6.5.3.12 Enclosed Tributaries

All other tributaries to Mulberry Creek, within the City of Crestwood, exist in an enclosed system or in an engineered open channel system. If problem areas exist within these engineered sections of channel, strong consideration should be given to restoring these channels to configurations that mimic natural streams.

Section 7
Project Rating System

7.1 Purpose

A prioritization plan was developed to rank the recommended improvement projects identified in Section 8. The process of prioritizing the projects includes identifying the type and frequency of the problem, the severity, area affected, upstream and downstream impacts, and probable cost.

7.2 Evaluation Categories

For purposes of evaluating the severity of the problem areas at each location, the following categories were developed.

Flooding - This condition applies to floodwaters on property, the entry of stormwater into structures, and streamflow overtopping streets in such a manner that it slows vehicles or forces motorist to select alternate routes.

Erosion - Erosion applies to streamflow or overland flow that is causing excessive scour of channels and overland flow paths.

Maintenance of Existing Facilities - This condition applies to existing drainage facilities, such as culverts, curb inlets, improved channels or other stormwater improvements that are in need of repair or require replacement.

Poor Drainage - This condition applies to water standing in streets and on public and private property for extended periods.

Benefits to Properties - This category is used to account for the number of properties that benefit from the project improvements.

7.3 Adjustment Factors

Frequency - This category takes into consideration the frequency the problem is occurring. For example, if flooding of a property occurs every rainy season, versus once every 5 years, the problem area will be given a higher priority.

Risk to Persons or Property - This category accounts for the degree of risk to persons or property associated with the problem area. For example, a low water crossing that historically floods every year and has the potential to threaten a person's life, would receive a high priority versus an icy sidewalk caused by isolated ponding that could result in a broken limb.

Number of Major Locations Affected - This category takes into consideration the benefits of alleviating flooding of major developments and roadways. A multiplier of

2 should be used if flooding impacts a shopping center, residential subdivision, roadway, or significant public structure.

7.4 Priority Rating Form

A priority rating form, as shown in Figure 7-1, was developed and used to prioritize each recommended project. The first step in completing the form is to identify the applicable evaluation categories as discussed above. The next step is to assign benefits points and multipliers using the values presented in Table 7-1.

Table 7-1
Project Name

Evaluation Category	Problem Type	Benefit Points			
		Very High	**High**	**Medium**	**Low**
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2
Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
One	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Insert Figure 7-1

For example, for a given problem area, the user identifies the applicable evaluation categories, including Flooding, Erosion, Maintenance, and Poor Drainage. Each evaluation category can have multiple sub-categories, such as Residence Structure and Impassible Traffic under the Flooding category. The next step is to assign benefit points relative to the severity of the problem. The severity ranges from Very High, which indicates a life-threatening situation, to Low, which is a condition that does not need immediate attention. For the Benefits of Adjacent Properties category, the benefit points are assigned based on the number properties affected. Once the benefit points are assigned to all of the evaluation categories, the points are summed to provide an initial subtotal. The next step is to assign applicable multipliers as discussed in the previous section. The benefit point subtotal is then multiplied by each assigned multiplier that results in the final benefit point total.

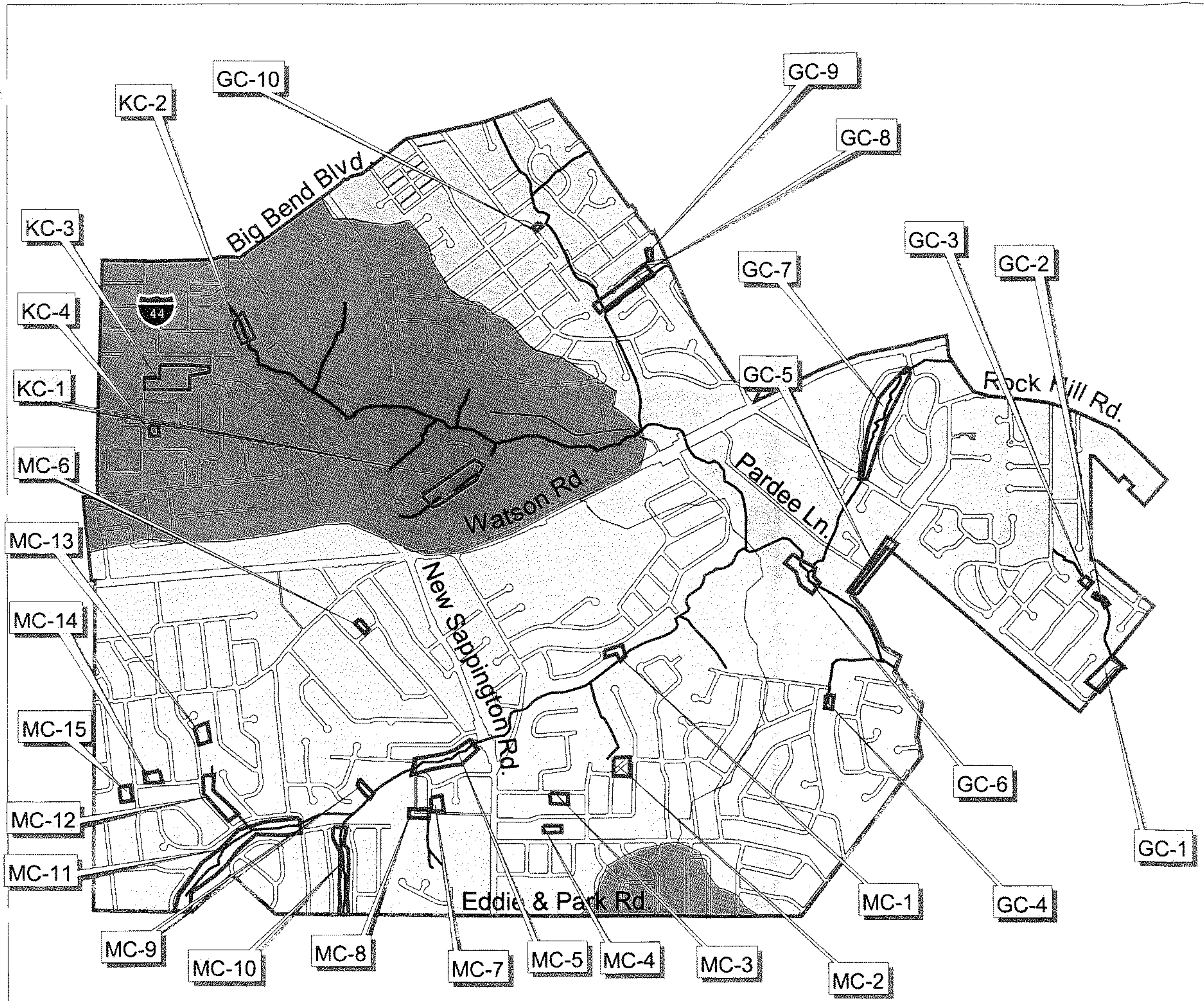
The final step is to calculate the cost/benefit rating, which is the estimated cost of the improvement, divided by the sum of the total benefit points. The lower the cost/benefit rating, the higher the priority ranking. For example, the project with the lowest cost/benefit rating would be the highest priority project.

7.5 Priority Evaluation Results

Once the priority evaluations were completed, the projects were prioritized from 1 to 29 according to their respective ranking. Projects with low cost/benefit ratings were assigned the highest priority. Table 7-2 displays the prioritized project order.

Table 7-2
Priority Rating of Recommended Projects

Ranking	Rating	Project Name	Cost Estimate
1	100	548-536 Aspen (KC-4)	$3,000
2	125	8901 Manda Lane (MC-15)	$6,000
3	133	9440 to 9448 Lodge Pole Drive (MC-1)	$4,000
4	150	9528 Craigwood Terrace (MC-4)	$15,000
5	188	631 Fieldcrest Drive (GC-9)	$21,000
6	260	9319 Lawndale Drive (MC-2)	$26,000
7	261	Whitecliff Park/Pardee Lane (GC-6)	$122,000
8	306	9518 to 9534 Pine Spray Court (MC-3)	$11,000
9	325	8900 Block Rudson Lane (MC-12)	$13,000
10	333	Spellman Park (KC-3)	$20,000
11	493	8900 Block Lindenhurst Drive (MC-7)	$150,000
12	545	Crestwood Park Entrance (MC-8)	$12,000
13	700	8940 Craighurst Terrace (MC-9)	$21,000
14	868	10069 to 10075 Barberton Dr. (MC-14)	$50,000
15	875	9107 Grant Park Drive (GC-3)	$42,000
16	972	9781 to 9783 Twin Vista Drive (MC-6)	$42,000
17	1,302	1000 to 1012 Banyon Drive (KC-2)	$125,000
18	1,468	Lowill Lane to Crest Oak Lane (MC-11)	$229,000
19	1,577	8854 to 8866 Rudson Lane (MC-13)	$41,000
20	1,588	Pardee Road (GC-5)	$343,000
21	1,857	9724 to 9700 Greenview Drive (KC-1)	$78,000
22	1,935	9000 to 9012 Cordoba Lane (GC-4)	$89,000
23	3,690	1022 Diversey Drive (GC-10)	$155,000
24	3,819	9000 Block Maple Grove/Sky Crest (MC-10)	$443,000
25	4,467	9600 Block Yorkshire Estates Drive (MC-5)	$536,000
26	4,553	7600 Block Capilia Drive (GC-2)	$173,000
27	5,906	Blackthorn Drive to Grant Road (GC-7)	$756,000
28	9,208	9000 Block Whitehaven Drive (GC-1)	$221,000
29	9,619	700 Block Fieldcrest Drive (GC-8)	$404,000



City of Crestwood Stormwater Master Plan

Legend

Improvement Project Areas

Streets

Open Channels

Kirkwood Creek Watershed

Mulberry Creek Watershed

Sappington Creek Watershed

Upper Gravois Watershed

Crestwood City Limits

N W E S

SCALE (1: 15,000)
1 INCH = 1,250 FEET

1250 0 1250 Feet

Improvement Project Locations

Figure 8-1

Section 8
Stormwater Improvement Projects

The study area encompasses the area bounded by the Crestwood city limit lines, which includes portions of four watersheds: upper Gravois Creek, Kirkwood Creek, Mulberry Creek and Sappington Creek. A total of 29 high priority problem areas were evaluated, which resulted in 29 improvement projects. During the course of the study, several other lower priority problem areas were identified, which are listed in Appendix B.

The total estimated probable cost for the 29 improvement projects is approximately $4,151,000. Figure 8-1, located on the following page, illustrates the location of each improvement project. The following is a brief description of the stormwater problem, alternative solutions, recommendation, project layout, priority ranking, cost estimate, and photographs for each problem area. Appendix A contains average unit cost information from past stormwater construction projects in the St. Louis metropolitan area and surrounding communities which were used for cost estimating purposes.

8.1 Gravois Creek Watershed

This section presents recommended improvements for the Gravois Creek watershed, including a brief description of the stormwater problem, alternative solutions, recommendation, project layout, priority ranking, cost estimate, and photographs for each problem area.

8.1.1 Project GC-1 9000 Block Whitehaven Drive

Residents located between 9047 and 9071 Whitehaven Drive are reporting building flooding along the northwest bank upstream of the existing 8- by 4-foot box culvert, labeled 26K1-006D, under Whitehaven Drive. The box culvert is undersized for the 15-year event, which is the cause of the flooding.

The recommended solution involves increasing the conveyance capacity of the culvert by either replacing the existing culvert with 300 feet of 12- by 4-foot RCB with walls at angles between 30 to 70 degrees, or installing 300 feet of parallel 4- by 4-foot RCB. The recommended solution is to construct the parallel RCB. This solution was selected because the existing RCB is in good structural condition, which makes it cost-effective to install a smaller parallel RCB. The estimated probable project cost of the recommended solution is approximately $221,000.

50 0 50 100 Feet

N E S W

CDM

Project: GC-1

9000 Whitehaven Drive

Figure: 8-2

Table 8-1
Storm Sewer Priority Rating Sheet

cation: GC-1 9000 Block Whitehaven Drive Inspection Date: 12/17/2001

Tributary: Gravois Creek

Problem Description: Residents located between 9047 and 9071 Whitehaven Drive are reporting flooding. Flooding is due to box culvert 26K1-006D, which is undersized for the 15-year event.

Recommended Action: Increase the conveyance capacity of the culvert by installing 300 feet of 4-ft by 4-ft RCB

Preliminary Estimated Cost: $221,000 By: KL Date: 12/17/2001

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1	20				20		40
	Item 2							0
	Item 3							0
		20	0	0	0	20	Subtotal	40

Item 1 Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Yard
Other
Describe:

Multiplier				
Multiplier	Number of Major Locations Affected	x	1	40
Multiplier	Frequency Rating (flooding only)	x	0.3	12
Multiplier	Degree of Risk	x	2	24

24
Total Benefit Points

Comments:
Residents at 9047, 9059 and 9071 benefit from improvements.

Estimated Cost = $221,000
Divided by
Total Benefit Points = 24
Cost/Benefit Rating = **9,208**

Table 8-2
GC-1 9000 Block Whitehaven Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-3
Preliminary Cost Estimate
9000 Block Whitehaven Drive

Site ID #	*Item Description*	*Unit*	*Estimated Quantity*	*Unit Price*	*Cost*
GC-1	**Installation of Box Culvert Whitehaven Drive**				
	4' x 4' RCB	LF	300	$ 350	$ 105,000
	Seeding	SY	330	$ 1	$ 330
	Construction Subtotal=				$ 105,330
	Utility Relocation @ 20%	LS			$ 21,066
	Mobilization @ 4%	LS			$ 4,213
	Construction with Percent Allowances Subtotal=				$ 130,609
	Contingency @ 30%				$ 39,183
	Probable Cost Estimate=				$ 169,792
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 50,938

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 221,000**

Figure 8-3. 9000 Whitehaven Drive (GC-1)

8.1.2 Project GC-2 7600 Block Capilia Drive

The channel downstream from Grant Park Drive, between 7630 and 7638 Capilia Drive, is experiencing erosion on the north bank. The backyards appear to have adequate space to implement the necessary changes to create a stable natural channel. Two alternatives were evaluated:

- **Alternative 1 – Streambank Bio-stabilization.** This alternative involves clearing 250 feet of the channel of debris to improve conveyance, and installing biotechnical erosion control measures to improve the bank stability. The stream banks would be stabilized through the use of TRMs and structural assistance, such as organic logs or stone, to insure the toe remains stable. The streambanks should be revegetated with native riparian and woodland species, and trees should be planted to enhance the riparian corridor. The estimated probable project cost is approximately $173,000.

- **Alternative 2 – Gabion Channel Sidewall.** This alternative involves clearing the channel of debris to improve the conveyance and to construct concrete channel sidewalls to stabilize the streambanks. The gabion wall would be approximately 3 feet high, and 250 feet in length, extending approximately 340 feet downstream from Grant Park Drive on both sides of the channel. The estimated probable project cost is approximately $275,000.

The recommended solution is to implement Alternative 1, streambank bio-stabilization, because this solution is more cost-effective and will provide an aesthetic enhancement to the backyards of several property owners.

50 0 50 100 Feet N W E S CDM	Project: GC-2 7600 Capilia Drive	Figure: 8-4

Table 6-4
Storm Sewer Priority Rating Sheet

cation: GC-2 7600 Block Capilia Drive   Inspection Date: 12/17/2001

Tributary: Gravois Creek

Problem Description: The channel downstream from Grant Park Drive, between 7630 and 7638 Capilia Drive, is experiencing erosion on the north bank.

Recommended Action: Clear 250 feet of channel debris to improve conveyance, and install biotechnical erosion control measures to improve bank stability.

Preliminary Estimated Cost: $173,000   By: KL   Date: 12/17/2001

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1		8			30		38
Item 2							0
Item 3							0
	0	8	0	0	30	Subtotal	38

Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Item 1 Unimproved Channel
Yard
Other
Describe:

Multiplier Number of Major Locations Affected	x	1	38
Multiplier Frequency Rating (flooding only)	x	1	38
Multiplier Degree of Risk	x	1	38

38
Total Benefit Points

Comments:
Residents at 7640 and 7636 Capilia Drive benefit from improvements.

Estimated Cost = $173,000
Divided by
Total Benefit Points = 38
Cost/Benefit Rating = **4,553**

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Table 8-5
GC-2 7600 Capilia Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-6
Preliminary Cost Estimate
7600 Block Capilia Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-2a	**Streambank Bio-stabilization and Stream Maintenance**				
	Excavation - Grading	CY	20	$ 12	$ 240
	Seeding	SY	330	$ 1	$ 330
	Reforestation	ACRE	0.75	$ 2,500	$ 1,875
	TRM	SY	670	$ 7	$ 4,690
	Major Stream Maintenance	LF	250	$ 300	$ 75,000
	Construction Subtotal=				$ 82,135
	Utility Relocation @ 20%	LS			$ 16,427
	Mobilization @ 4%	LS			$ 3,285
	Construction with Percent Allowances Subtotal=				$ 101,847
	Contingency @ 30%				$ 30,554
	Probable Cost Estimate=				$ 132,402
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 39,720
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 173,000**

Table 8-7
Preliminary Cost Estimate
7600 Block Capilia Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-2b	**Gabion Channel Sidewall and Stream Maintenance**				
	Gabions	CY	300	$ 180	$ 54,000
	Major Stream Maintenance	LF	250	$ 300	$ 75,000
	Reforestation	ACRE	0.75	$ 2,500	$ 1,875
	Seeding	SY	330	$ 1	$ 330
	Construction Subtotal=				$ 131,205
	Utility Relocation @ 20%	LS			$ 26,241
	Mobilization @ 4%	LS			$ 5,248
	Construction with Percent Allowances Subtotal=				$ 162,694
	Contingency @ 30%				$ 48,808
	Probable Cost Estimate=				$ 211,502

Design Engineering, Geotechnical, & Construction Management @ 30% $ 63,451

Total Conceptual Cost Estimate= **$ 275,000**
(Rounded up to the nearest $1000)

Figure S-5. 7600 Capilla Drive (GC-2)

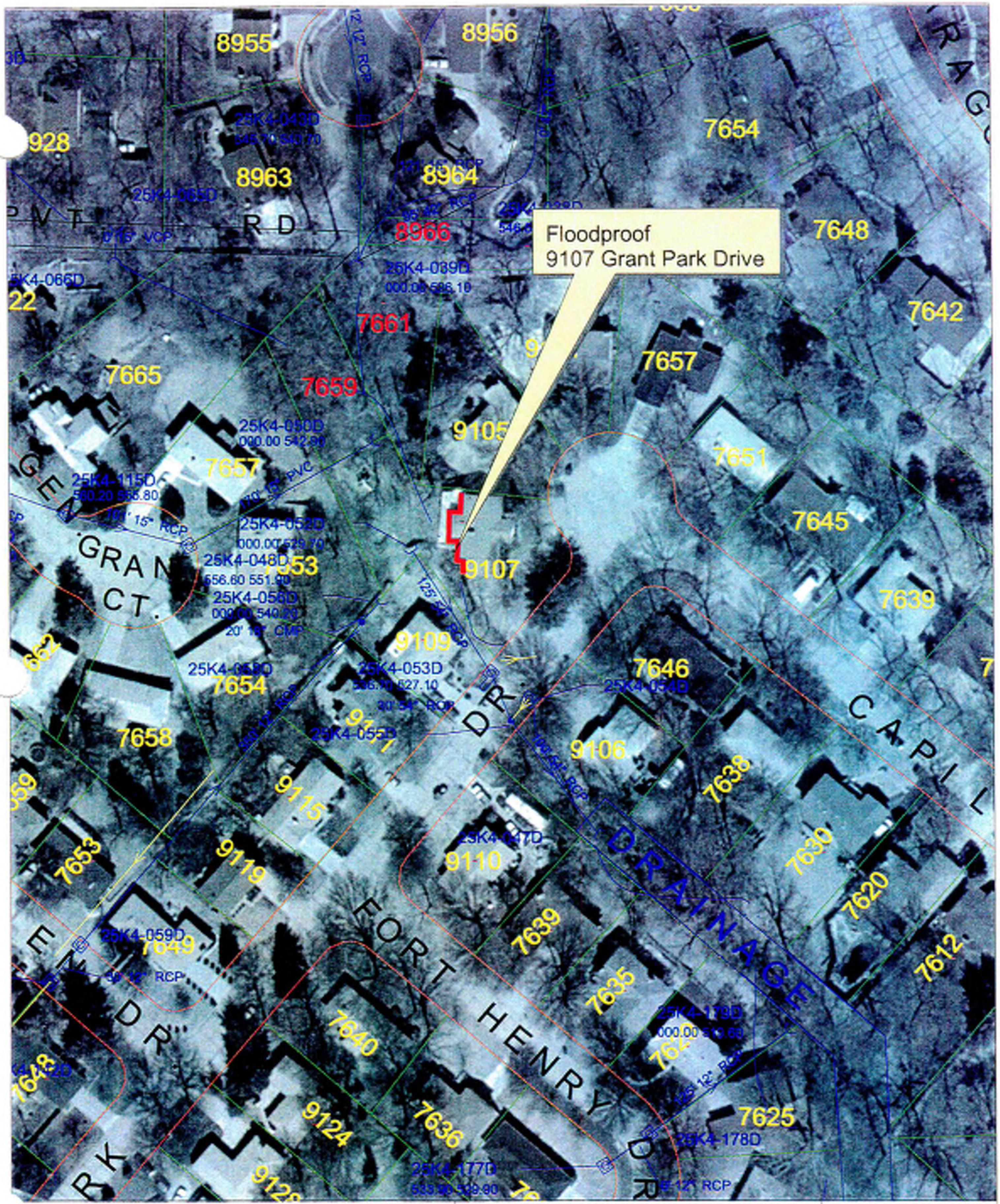
8.1.3 Project GC-3 9107 Grant Park Drive

Resident at 9107 Grant Park Drive is reporting flooding in the backyard. An open channel enters an enclosed system behind 9107 Grant Park Drive. The flooding is caused by the lack of adequate headwater depth and no overflow channel at the entrance of the 54-inch RCP, labeled 25K4-052D, which causes flooding of adjacent buildings. Two alternative solutions were evaluated:

- **Alternative 1 – Upgrade Enclosed System.** Installing an overflow swale to convey excess flows is not feasible due to the surrounding topography and the elevation of Grant Park Drive. Therefore, the 54-inch RCP will need to be replaced with 275 feet of 5- by 5-foot RCB to adequately convey the 100-year design storm underground. Also, energy dissipaters would be installed at the RCB outlet to mitigate erosive conditions. The estimated probable project cost is approximately $203,000.

- **Alternative 2 – Flood proof Building.** This alternative includes flood proofing the building by eliminating the basement windows and building entrance adjacent to the creek. The estimated probable project cost is approximately $42,000.

The recommended solution is to implement Alternative 2, flood proofing, which is more cost-effective than replacing several hundred feet of drainage system.



50 0 50 100 Feet

N W E S

CDM

Project: GC-3

9107 Grant Park Drive

Figure: 8-6

Table 8-8
Storm Sewer Priority Rating Sheet

cation: GC-3 9107 Grant Park Drive Inspection Date: 12/17/2001

Tributary: Gravois Creek

Problem Description: Resident at 9107 Grant Park Drive is reporting flooding in the backyard.

Recommended Action: Floodproof the building by eliminating the basement windows and building entrance adjacent to the creek.

Preliminary Estimated Cost: $42,000 By: KL Date: 12/17/2001

Stormwater Problem

Item 1 Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Yard
Other
Describe:

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1	20				10		30
Item 2							0
Item 3							0
	20	0	0	0	10		
						Subtotal	30

Multiplier			
Number of Major Locations Affected	x	1	30
Frequency Rating (flooding only)	x	0.8	24
Degree of Risk	x	2	48

48
Total Benefit Points

Comments:
Residents at 9107 Grant Park Drive benefit from improvements.

Estimated Cost = $42,000
Divided by
Total Benefit Points = 48
Cost/Benefit Rating = **875**

Table 8-9
GC-3 9107 Grant Park Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-10
Preliminary Cost Estimate
9107 Grant Park Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-3a	Upgrade Enclosed System				
	5' x 5' RCB	LF	275	$ 350	$ 96,250
	Seeding	SY	460	$ 1	$ 460
	Construction Subtotal=				$ 96,710
	Utility Relocation @ 20%	LS			$ 19,342
	Mobilization @ 4%	LS			$ 3,868
	Construction with Percent Allowances Subtotal=				$ 119,920
	Contingency @ 30%				$ 35,976
	Probable Cost Estimate=				$ 155,897
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 46,769
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 203,000**

Table 8-11
Preliminary Cost Estimate
9107 Grant Park Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC3b	**Floodproof Building**				
	Residence	EA	1	$ 20,000	$ 20,000
	Construction Subtotal=				$ 20,000
	Utility Relocation @ 20%	LS			$ 4,000
	Mobilization @ 4%	LS			$ 800
	Construction with Percent Allowances Subtotal=				$ 24,800
	Contingency @ 30%				$ 7,440
	Probable Cost Estimate=				$ 32,240
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 9,672
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 42,000**

Figure 8-7. 9107 Grant Park Drive (GC-3)

Figure 8-8. 9107 Grant Park Drive (GC-3)

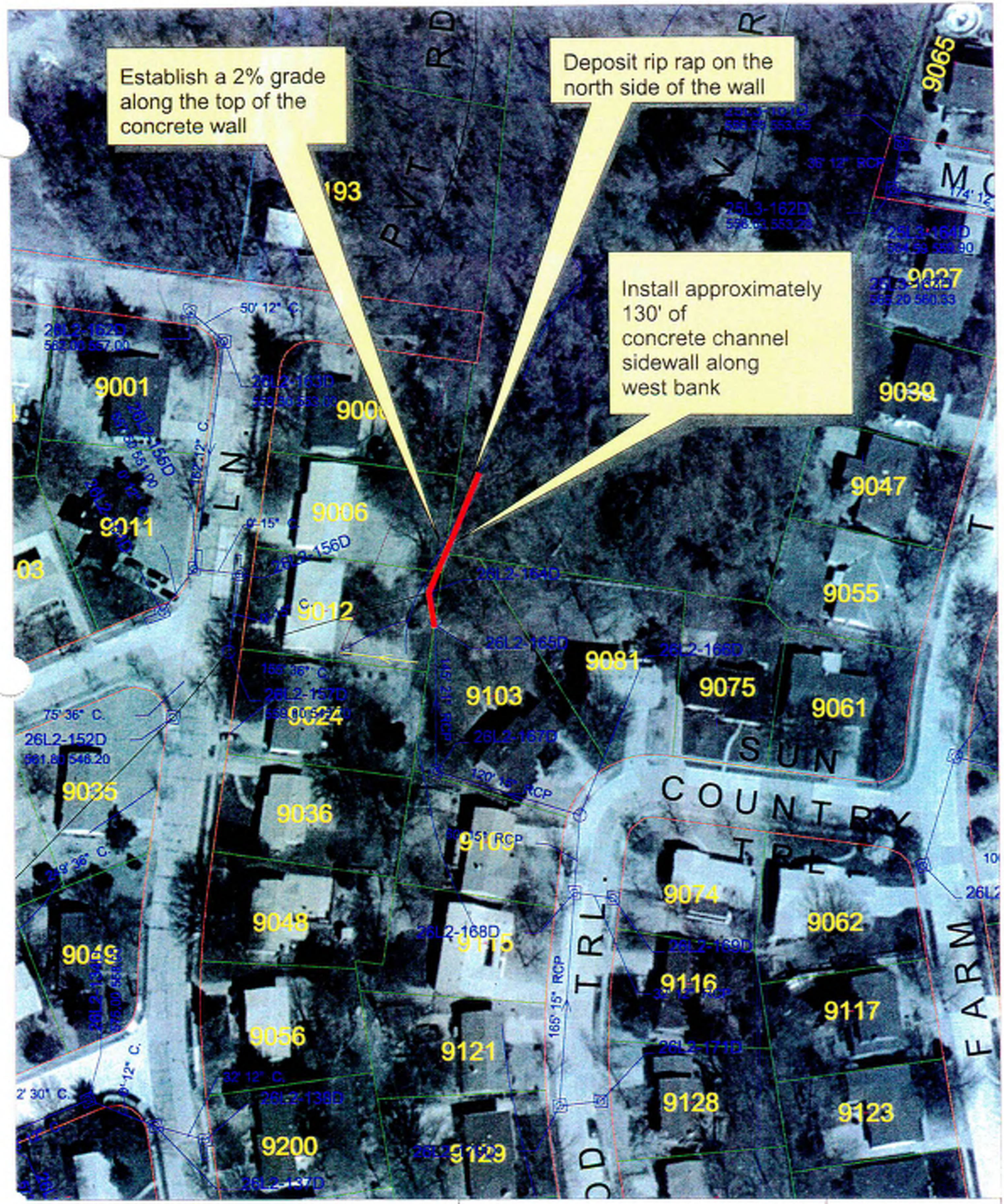
8.1.4 Project GC-4 9000-9012 Cordoba Lane

Yard drainage is eroding the west creek bank and yards behind homes located from 9006 to 9024 Cordoba Lane. The erosion is affecting the outlet headwall, which is directly behind 9012 Cordoba, and has resulted in a washed out area adjacent to the headwall. The outlet headwall provides structural support for two outfall pipes, labeled 26L2-164D and 26L2-165D. Bank erosion was observed just downstream of structural wall systems behind 9006 Cordoba. Two alternative solutions were evaluated:

- **Alternative 1 – Streambank Biostabilization.** This alternative consists of providing erosion protection using 12-foot high biogabions, which would extend 130 feet downstream from the outlet headwall along the west bank of the channel, which would tie into an existing modular block retaining wall. A deteriorating wooden tie wall at this location should be removed. Depending on the location, a second tier of gabions could be installed on top of the first. However, in most instances, the slopes from the gabion basket in the toe up to the top of slope, which should be graded to 2 percent to slow velocities, could be stabilized with vegetation. A mixture of native woodland, riparian and fescue species should be planted. The slopes above the baskets should be graded back and stabilized with a TRM. Final grading will be necessary to prepare the slopes for RECP. Residents should be informed not to place yard waste or compost piles along the banks of the creek, which compromises the integrity of the channel. The estimated probable project cost is approximately $95,000.

- **Alternative 2 – Concrete Channel Sidewall.** This alternative consists of providing a 12-foot high concrete channel sidewall, which would extend 130 feet downstream from the outlet headwall along the west bank, which would tie into an existing retaining wall. The approach requires establishing a 2 percent grade at the top of the wall and adequate drainage for the wall, including weep holes, to prevent the reoccurrence of erosion along the backside of the wall. In addition, a longitudinal grade (parallel to the channel) needs to complement the wall's design, where the grade is minimized along the 130-foot length. The north end of the wall should be protected by riprap, characterized by small stone gradations (D50 about four inches). The grade and riprap should wrap around the front face of the wall to reduce potential erosion, which is due to concentrated flows from the steep slopes of the backyards. The estimated probable project cost is approximately $89,000.

The recommended solution is to implement Alternative 2, concrete channel sidewall, due to the steepness of channel bank, which lends itself to a traditional structural solution. Also, the concrete channel wall can be easily connected to the existing concrete headwall.



50 0 50 100 Feet

CDM

Project: GC-4

9000 - 9012 Cordoba Ln.

Figure: 8-9

Table 8-12
Storm Sewer Priority Rating Sheet

Location: GC-4 9000-9012 Cordoba Lane   Inspection Date: 12/17/2001

Tributary: Gravois Creek

Problem Description: Yard drainage is eroding the west creek bank and yards behind homes located from 9006 to 9024 Cordoba Lane. The erosion is affecting the outlet headwall, which is directly behind 9012 Cordoba, and has resulted in a washed out area adjacent to the headwall.

Recommended Action: Install a 12-ft high concrete channel sidewall, which would extend 130 feet downstream from the outlet headwall along the west bank, which would tie into an existing retaining wall.

Preliminary Estimated Cost: $89,000   By: KL   Date: 12/17/2001

Stormwater Problem

	Residential Structure
	Commercial Structure
	Street
	Public Structure
	Owner:
Item 2	Drainage Structure
	Type: Headwall
	Improved Channel
Item 1	Unimproved Channel
Item 3	Yard
	Other
	Describe:

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1		8			20		28
Item 2		12					12
Item 3		6					6
	0	26	0	0	20	Subtotal	46

Multiplier Number of Major Locations Affected	x	1	46
Multiplier Frequency Rating (flooding only)	x	1	46
Multiplier Degree of Risk	x	1	46

46
Total Benefit Points

Comments:
Residents at 9006, 90012 and 9024 will benefit from improvements.

Estimated Cost = $89,000
Divided by
Total Benefit Points = 46
Cost/Benefit Rating = **1,935**

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Table 8-13
GC-4 9000-9012 Cordoba Lane

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-14
Preliminary Cost Estimate
9000-9012 Cordoba Lane

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-4a	Streambank Biostabilization				
	12' Bio Gabions	FSF	1560	$ 28	$ 43,680
	Reforestation	ACRE	0.25	$ 2,500	$ 625
	Seeding	SY	70	$ 1	$ 70
	TRM	SY	130	$ 7	$ 910
	Construction Subtotal=				$ 45,285
	Utility Relocation @ 20%	LS			$ 9,057
	Mobilization @ 4%	LS			$ 1,811
	Construction with Percent Allowances Subtotal=				**$ 56,153**
	Contingency @ 30%				$ 16,846
	Probable Cost Estimate=				**$ 72,999**

Design Engineering, Geotechnical, & Construction Management @ 30% $ 21,900

Total Conceptual Cost Estimate= **$ 95,000**
(Rounded up to the nearest $1000)

Table 8-15
Preliminary Cost Estimate
9000-9012 Cordoba Lane

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price		Cost	
GC-4b	**Concrete Channel Sidewall**						
	12' High Concrete Wall	CY	60	$	600	$	36,000
	Excavate - 2% grade at top of the wall	CY	130	$	12	$	1,560
	Rip Rap - North end of wall	SY	80	$	60	$	4,800
	Seeding	SY	70	$	1	$	70
	Construction Subtotal=					$	42,430
	Utility Relocation @ 20%	LS				$	8,486
	Mobilization @ 4%	LS				$	1,697
	Construction with Percent Allowances Subtotal=					$	52,613
	Contingency @ 30%					$	15,784
	Probable Cost Estimate=					$	68,397

Design Engineering, Geotechnical, & Construction Management @ 30% $ 20,519

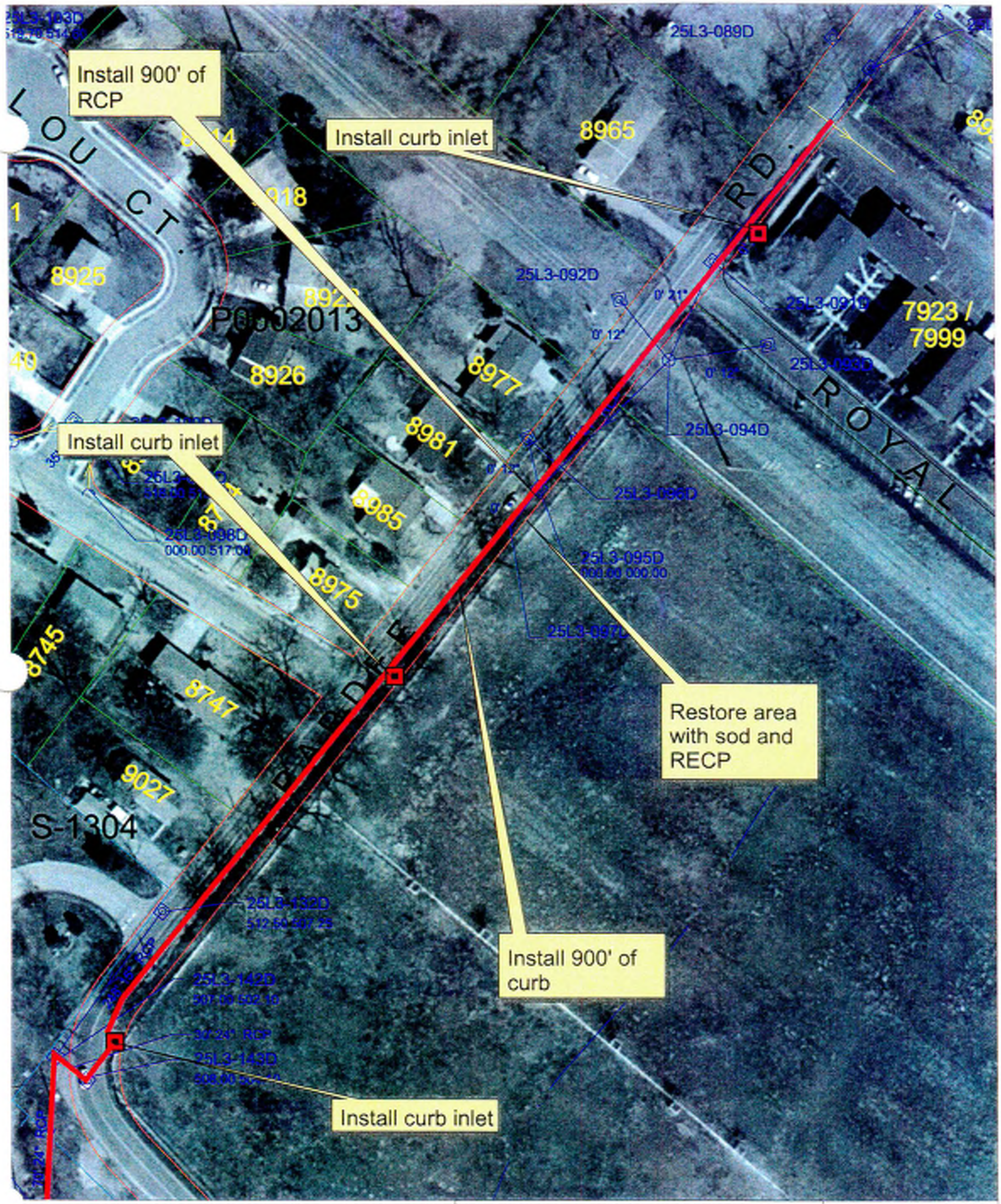
Total Conceptual Cost Estimate= **$ 89,000**
(Rounded up to the nearest $1000)

Figure 8-10. 9000 - 9012 Cordoba Lane (GC-4)

Figure 8-11. 9000 - 9012 Cordoba Lane (GC-4)

8.1.5 Project GC-5 Pardee Road

Pardee Road contains inadequate roadside drainage that is causing flooding on the south side of the road between 8951 Pardee Road and Gravois Creek. The recommended improvements include installing 900 feet of s-curb, and 900 feet of RCP that ranges from 12- to 30-inch diameter, and three curb inlets to adequately drain the surface of the road. In addition, the restoration measures will include sod using a RECP for stabilization due to the steep slopes adjacent to the roadway. The estimated probable project cost is approximately $343,000.



50 0 50 100 Feet

N W E S

CDM

Project: GC-5

Pardee Road

Figure: 8-12

Table 8-16
Storm Sewer Priority Rating Sheet

ocation: GC-5 Pardee Road   Inspection Date: 12/17/2001

Tributary: Gravois Creek

Problem Description: Pardee road contains inadequate roadside drainage that is causing flooding on the south side of the road between 8951 Pardee Road and Gravois Creek.

Recommended Action: Install 900-feet of S-curb, and 900 feet of RCP that ranges from 12 to 30-inches in diameter and three curb inlets.

Preliminary Estimated Cost: $343,000   By: KL   Date: 12/17/2001

Stormwater Problem

	Residential Structure
	Commercial Structure
Item 1	Street
	Public Structure
	Owner:
	Drainage Structure
	Type:
	Improved Channel
	Unimproved Channel
Item 2	Yard
Roadside ditch	Other
	Describe:

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1	8				30		38
Item 2		16					16
Item 3							0
	8	16	0	0	30	Subtotal	54

Multiplier Number of Major Locations Affected	x	2	108
Multiplier Frequency Rating (flooding only)	x	1	108
Multiplier Degree of Risk	x	2	216

216
Total Benefit Points

Comments:
Residents along Pardee Road will directly benefit from the improvements. The general public will benefit from the improvements to the road.

Estimated Cost = $343,000
Divided by
Total Benefit Points = 216
Cost/Benefit Rating = **1,588**

Table 8-17
GC-5 Pardee Road

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-18
Preliminary Cost Estimate
Pardee Road

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-5	**Pardee Road Storm Drainage Improvements**				
	12" RCP	LF	100	$ 115	$ 11,500
	18" RCP	LF	300	$ 115	$ 34,500
	24" RCP	LF	400	$ 115	$ 46,000
	30" RCP	LF	100	$ 115	$ 11,500
	Compaction	CY	300	$ 17	$ 5,100
	Curb & Gutter	LF	900	$ 15	$ 13,500
	Curb Inlets	EA	3	$ 2,100	$ 6,300
	Earth Fill	CY	300	$ 14	$ 4,200
	Seeding	SY	1000	$ 1	$ 1,000
	Soil Stabilization and Vegetative Cover (Sodding with Erosion Control Measures - Also Includes Clearing and Grubbing)	SY	1000	$ 30	$ 30,000
	Construction Subtotal=				$ 163,600
	Utility Relocation @ 20%	LS			$ 32,720
	Mobilization @ 4%	LS			$ 6,544

Construction with Percent Allowances Subtotal=	$ 202,864
Contingency @ 30%	$ 60,859
Probable Cost Estimate=	$ 263,723
Design Engineering, Geotechnical, & Construction Management @ 30%	$ 79,117
Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 343,000**

Figure 8-13. Pardee Road (GC-5)

Figure 8-14. Pardee Road (GC-5)

8.1.6 Project GC-6 Whitecliff Park/Pardee Lane

Two problems are occurring in Whitecliff Park along Gravois Creek. The creek, from the mouth of Mulberry Creek to the city limit boundary of Crestwood, exists in a natural channel configuration. The first problem is erosion that is damaging the banks of the channel. The other problem is the flooding in the parking area southeast of the Park Service Road Bridge and rear yards of 8711-8737 Pardee Lane. The majority of the park is flooded during the 15-year event, with 5 feet of water overtopping the bridge.

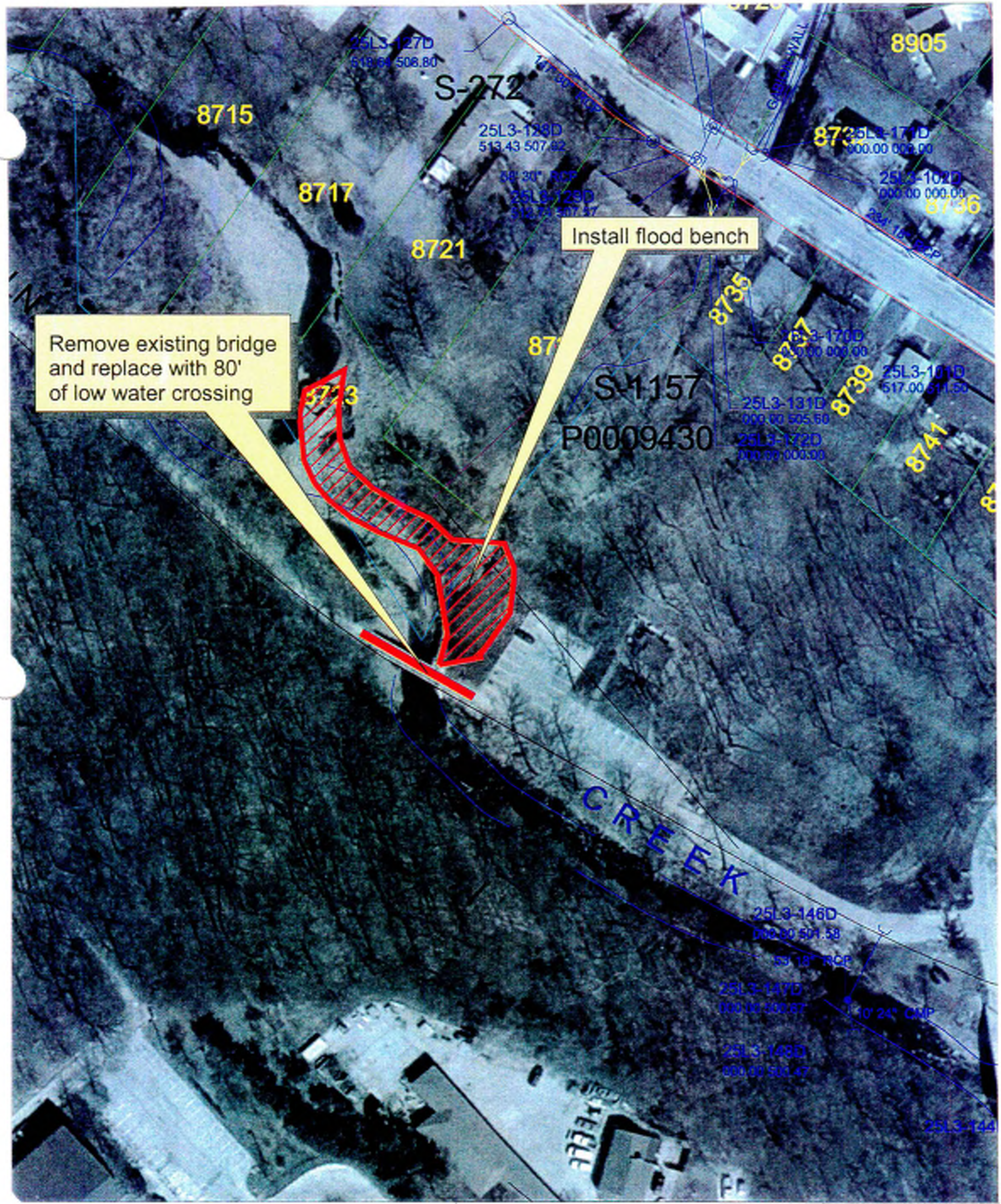
Severe erosion was observed along this reach that included steep eroding banks occurring throughout. A sanitary sewer line at the upstream end of this reach was exposed and nearly undercut. Conditions in the channel indicate significant down cutting along with lateral widening. Significant acreage would need to be disturbed to create a geomorphically stable alignment due to the large size of the stream cross-section.

Metropolitan St. Louis Sewer District (MSD) has recently stabilized a short section of bank upstream of the Park Service Road Bridge using riprap. However, the bank on the same side of the channel downstream of this area is experiencing erosion and the gabion walls on the opposite bank just upstream of the bridge are failing. The recommended solution to the flooding and erosion involves two components:

- **Component 1 - Replace maintenance crossing.** The flooding of the Park Service Road Bridge, which basically acts as a maintenance crossing, is primarily caused by two factors. First, the current bridge skew is 25 degrees, but at 40 feet upstream the stream is making a turn from a path that is actually parallel to the orientation of the bridge. Because of momentum and the current skew, higher flows do not make the turn in the contraction zone on the upstream face of the existing bridge. The result is high water flowing into the parking area. The proposed alignment for any replacement structure should have a skew closer to 90 degrees. The second contributing problem is the small flow opening and low elevation of the bridge deck. For a new bridge, the design should be 5 feet higher and have a wider opening than the existing bridge if the City wishes to permit storm water flows to pass through the bridge more efficiently. The recommended solution includes removing the bridge and constructing 80 feet of low flow crossing in the form of a bendway weir with a low flow culvert. Bendway weirs are upstream angled low elevation sills. The weir acts to redirect water flowing over the weir at an angle perpendicular to the channel. Weirs angled upstream direct water away from the outer bank toward the inner part of the bend. This crossing would still provide vehicular access for park maintenance. However, the new alignment would require changes to the vertical alignment of the existing road on the north end of the bridge.

- **Component 2 - Flood bench.** Basic grading changes are recommended for the areas upstream of the service road bridge. A flood bench area of about 9,925 square feet should be excavated on the northeast side of the stream to allow for more efficient conveyance of flows during large flood events. If this flood bench is created, the stream may ultimately realign itself through the flood bench area eliminating the erosion concerns on the opposite bank. Even if realignment does not occur, the erosive forces on the opposite bank will be reduced during large flood events due to the large channel cross-section. Some introduction of native riparian species should be performed in the flood bench area to promote the establishment of desirable plant species and preclude the establishment of undesirable vegetation. However, in general, the flood bench area should be allowed to develop naturally.

The estimated probable project cost is approximately $122,000.



50 0 50 100 Feet

N W E S

CDM

Project: GC-6

Whitecliff Park/Pardee Lane

Figure: 8-15

Table S-19
Storm Sewer Priority Rating Sheet

Location: GC-6 Whitecliff Park/Pardee Lane

Inspection Date: 12/17/2001

Tributary: Gravois Creek

Problem Description: Erosion damage to Gravois Creek, from the mouth of Mulberry Creek to the city limit boundary of Crestwood. Flooding in the parking area southeast of the Park Service Road Bridge and rear yards of 8711-8737 Pardee Lane.

Recommended Action: Replace the maintenance crossing with a low-water crossing; Install a flood bench

Preliminary Estimated Cost: $122,000 By: KL Date: 12/17/2001

Stormwater Problem

Item 2 — Residential Structure
Commercial Structure
Street
Item 3 — Public Structure
Owner: Crestwood
Drainage Structure
Type:
Improved Channel
Item 1 — Unimproved Channel
Yard
Other
Describe:

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1		8			30		38
Item 2	20						20
Item 3	20						20
	40	8	0	0	30	Subtotal	78

		Multiplier	
Multiplier Number of Major Locations Affected	x	2	156
Multiplier Frequency Rating (flooding only)	x	1	156
Multiplier Degree of Risk	x	3	468

468
Total Benefit Points

Comments:
No adjacent residents would benefit directly from improvements. The city and parks department would benefit from improvements.
A degree of risk multiplier of 2 was used because severe erosive velocities are occurring in an area where public access is not restricted.

Estimated Cost = $122,000
Divided by
Total Benefit Points = 468
Cost/Benefit Rating = **261**

Table 8-20
GC-6 Whitecliff/Pardee Lane

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-21
Preliminary Cost Estimate
Whitecliff Park/Pardee Lane

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-6	**Bioengineering Restoration**				
	15" RCP - low water crossing	LF	80	$ 115	$ 9,200
	Concrete - low water crossing	SY	210	$ 100	$ 21,000
	Flood Bench (Excavation)	CY	1100	$ 12	$ 13,200
	Reforestation	ACRE	1.25	$ 2,500	$ 3,125
	Removal of existing bridge	LS	1	$ 10,000	$ 10,000
	Reseeding - flood bench	SY	1100	$ 1	$ 1,375
	Construction Subtotal=				$ 57,900
	Utility Relocation @ 20%	LS			$ 11,580
	Mobilization @ 4%	LS			$ 2,316
	Construction with Percent Allowances Subtotal=				$ 71,796
	Contingency @ 30%				$ 21,539

Probable Cost Estimate= $ 93,335

Design Engineering, Geotechnical, & Construction Management @ 30% $ 28,000

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 122,000**

Figure 8-16. Whitecliff Park/Pardee Lane (GC-6)

Figure 8-17. Whitecliff Park/Pardee Lane (GC-6)

8.1.7 Project GC-7 Blackthorn Drive to Grant Road

The natural channel between Grant Road and Blackthorn Drive, for the block lying parallel to Heather Drive, is eroding. This channel alignment has an existing slope of 2.2-percent with flow velocities of 7 feet per second (fps) for the 2-year storm. Some portions of the channel have concrete linings, which increase the erosive velocities in these areas. Bank stabilization is needed throughout the reach. Two alternative solutions were evaluated:

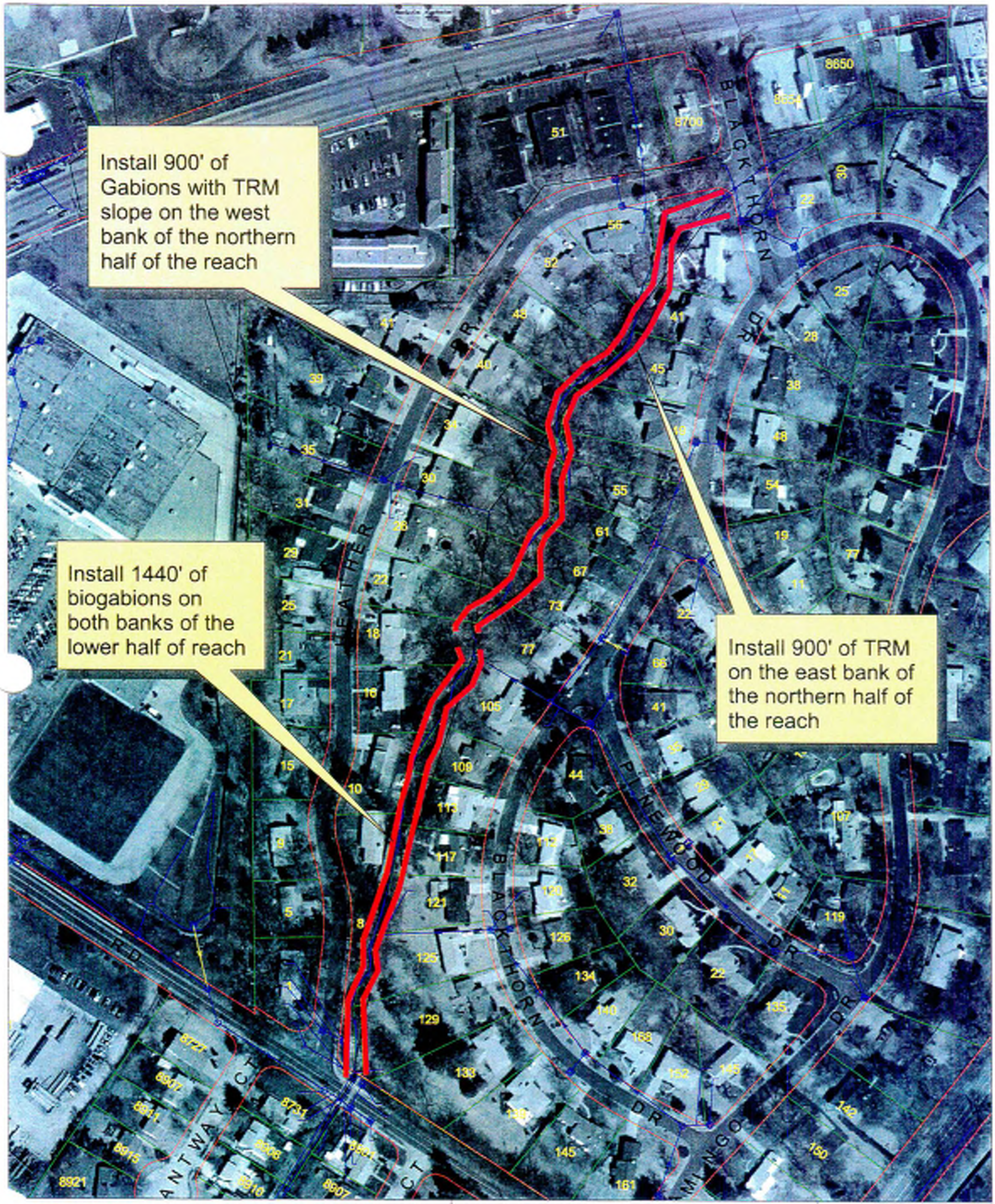
- **Alternative 1 – Channel Biostabilization.** This solution involves installing bioengineered bank stabilization on both sides of the streambank along approximately 1,600 feet of channel. Channel velocities do not indicate a need for highly durable armoring solutions assuming the implementation of a fairly uniform channel cross section. Sections of this area have been previously armored with concrete indicating some concerns for grade stability. These concerns require the implementation of stone grade control weirs at regular intervals to limit future down cutting. Stone weirs should be constructed so that the entire width of the channel cross-section is protected preventing the flows from circumventing the structure.

  The proposed stream bank treatments include bio-gabions throughout the reach. Velocities would be less than half those of a concrete lined channel. The channel would be graded to a depth to convey the 2-year storm. The existing trees and swimming pools adjacent to the channel could be incorporated into the bio-technical solution. Existing walls will be replaced with the bio-gabions, and the existing degree of meandering of the channel will be preserved, which will help reduce velocities. Additional plantings of trees will complete the re-vegetation of the stream corridor, adjacent to the streambank, to supplement the native riparian and woodland species.

  The stabilization of the streambank toe will be dependent on the varying physical characteristics of the channel bottom. The resident at 18 Heather Drive marks the division for two types of stabilization that will be needed at the toe of the banks on both sides of the stream. Upstream of 18 Heather Drive, 1,800 feet (including both banks) of coir log should be installed. Downstream of this residence, 1,460 feet (including both banks) of gabion to stabilize the toe for the lower reach should be constructed. In locations where bedrock is exposed on the channel bottom, the use of 18-inch high gabions is recommended as toe stabilization. These gabions will protect the naturally occurring weak zones where thin layers of soil cannot be sufficiently stabilized with vegetation. Additionally, the use of wire reinforced TRM's is recommended in zones where localized velocities are expected to exceed 12 fps. The estimated probable project cost is approximately $756,000.

- **Alternative 2 – Enclosed System.** This solution involves installing approximately 1,530 feet of 6x3-foot RCB with an overflow swale. In addition, three area inlets would be required to drain the overland flow into the RCB. A concrete trapezoid channel was considered, however, due to extreme velocities, this option was eliminated for safety concerns. The estimated probable project cost is approximately $938,000.

The recommended solution is Alternative 1, biostablization, which will provide an aesthetically pleasing improvement in the backyards of several properties and will provide lower stream velocities.



CDM

Project: GC-7

Blackthorn Drive to Grant Road

Figure: 8-18

Table 8-22
Storm Sewer Priority Rating Sheet

xation: GC-7 Blackthorn Drive to Grant Road Inspection Date 12/17/2001

Tributary: Gravois Creek

Problem Description: Natural channel between Grant Road and Blackthorn Drive, for the block lying parallel to Heather Drive, is eroding.

Recommended Action: Install bioengineered bank stabilization (coir logs and gabions) on both sides of the channel for approximately 1,600 feet. Stone weirs should be constructed.

Preliminary Estimated Cost: $756,000 By: KL Date: 12/17/2001

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1		14			50		64
Residential Structure	Item 2							0
Commercial Structure	Item 3							0
Street		0	14	0	0	50		
Public Structure							Subtotal	64
Owner:		**Multiplier**						
Drainage Structure		Number of Major Locations Affected			x		2	128
Type:								
Item 1 Improved Channel								
Unimproved Channel		**Multiplier** Frequency Rating (flooding only)			x		1	128
Yard								
Other								
Describe:		**Multiplier** Degree of Risk			x		1	128

128
Total Benefit Points

Comments.
Residents at 10, 16,18, 22, 26, 30, 34, 40, 48, 52, and 56 Heather Drive will be affected by improvements.
Residents at 39, 41, 43, 49, 55, 61, 67, 73, 77, 105, 109, 113, 117, 121, 125 and 129 Balckthorn Drive will be directly affected by improvements.

Estimated Cost = $756,000
Divided by
Total Benefit Points = 128
Cost/Benefit Rating = **5,906**

Table 8-23
GC-7 Blackthorn Drive to Grant Road

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		**14**	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	**50**				
11-20	40				
5-10	30	>1/yr	**1.0**	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	**1.0**

Table 8-24
Preliminary Cost Estimate
Blackthorn Drive to Grant Road

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-7a	**Channel biostabilization**				
	Bio-Gabions	FSF	7650	$ 28	$ 214,200
	Coir Log	LF	3250	$ 19	$ 61,750
	Excavation - grading	CY	3260	$ 12	$ 39,120
	Gabion Toe	LF	800	$ 30	$ 24,000
	Reforestation	ACRE	3.32	$ 2,500	$ 8,300
	Seeding	SY	1810	$ 1	$ 1,810
	TRM	SY	1600	$ 7	$ 11,200
	Construction Subtotal=				$ 360,380
	Utility Relocation @ 20%	LS			$ 72,076
	Mobilization @ 4%	LS			$ 14,415
	Construction with Percent Allowances Subtotal=				**$ 446,871**
	Contingency @ 30%				$ 134,061
	Probable Cost Estimate=				**$ 580,933**
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 174,280
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 756,000**

Table 8-25
Preliminary Cost Estimate
Blackthorn Drive to Grant Road

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-7b	**Enclosed System**				
	Area Inlets	EA	3	$ 1,850	$ 5,550
	Excavation - grading	CY	3260	$ 12	$ 39,120
	RCB 6'X3'	LF	1600	$ 250	$ 400,000
	Seeding	SY	2720	$ 1	$ 2,720
	Construction Subtotal=				$ 447,390
	Utility Relocation @ 20%	LS			$ 89,478
	Mobilization @ 4%	LS			$ 17,896
	Construction with Percent Allowances Subtotal=				$ 554,764
	Contingency @ 30%				$ 166,429
	Probable Cost Estimate=				$ 721,193

Design Engineering, Geotechnical, & Construction Management @ 30% $ 216,358

Total Conceptual Cost Estimate= **$ 938,000**
(Rounded up to the nearest $1000)

Figure 8-19. Blackthorn Drive to Grant Road (GC-7)

Figure 8-20. Blackthorn Drive to Grant Road (GC-7)

8.1.8 Project GC-8 700 Block Fieldcrest Drive

Street and home flooding is occurring in the vicinity of 644 to 708 Fieldcrest Drive due to inadequate gutters and curb inlets, and the undersized twin 48-inch RCP under Fournier Drive. MSD identifies this project as GCMB-130, which recommends replacing the existing culvert under Fournier Drive with a larger double box culvert, flood proofing 736 Paddock Court for 100-year protection, and providing approximately 400 feet of stream maintenance along drainage ditch.

The City is currently addressing the flooding issue at Fournier Drive by constructing a new 12- by 6-foot RCB that will replace the existing twin 48-inch RCP. This will alleviate the flooding in the surrounding area. Construction is scheduled for summer, 2003. In addition to the new RCB, the erosion problems downstream from Fournier Drive should be addressed. Two alternative solutions were evaluated to alleviate the downstream erosion:

- **Alternative 1 – Streambank Biostabilization** This alternative includes installing approximately 8-foot high bio-gabion channel sidewalls for approximately 600 feet downstream of Fournier Drive, on both sides of the channel. Transition zones immediately upstream and downstream of the new box culvert should be stabilized with vegetation. Channel slopes should be graded and re-vegetated with riparian and woodland species. A TRM should be installed at the top of the channel slope. The estimated probable project cost is approximately $591,000.

- **Alternative 2 – Gabion Basket Channel Sidewall.** This alternative includes installing approximately 8-foot high gabion basket channel sidewalls for approximately 600 feet downstream of Fournier Drive, on both sides of the channel. The estimated probable cost is approximately $404,000.

The recommended solution is Alternative 2. Space limitations make it difficult to implement the necessary biostabilization components; therefore, structural solutions are advised at this location. Vegetative stabilization may be implemented in conjunction with the gabion basket solutions in zones of transition adjacent to the structural systems to provide a more aesthetically pleasing improvement in the backyards of several properties.

50 0 50 100 Feet

CDM

Project: GC-8

700 Block Fieldcrest Drive

Figure:8-21

Table 8-26
Storm Sewer Priority Rating Sheet

Location: GC-8 700 Block Fieldcrest Drive   Inspection Date: 12/17/2001

Tributary: Gravois Creek

Problem Description: Bank erosion is occurring in the rear yards of 706-724 Fieldcrest Drive downstream of Fournier Drive.

Recommended Action: Install approximately 8-foot high gabion basket channel sidewalls for 300 feet.

Preliminary Estimated Cost: $404,000   By: KL   Date: 12/17/2001

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1	12				30		42
Item 2							0
Item 3							0
	12	0	0	0	30	Subtotal	42

Type	Item
Residential Structure	
Commercial Structure	
Street	
Public Structure (Owner:)	
Drainage Structure (Type:)	
Improved Channel	
Unimproved Channel	Item 1
Yard	
Other (Describe:)	

Multiplier Number of Major Locations Affected	x	1	42
Multiplier Frequency Rating (flooding only)	x	1	42
Multiplier Degree of Risk	x	1	42

42
Total Benefit Points

Comments:
Residents at 706, 712, 718 and 724 Fieldcrest Dr. will be affected; Residents at 707, 711, 715 and 719 Paddock Ct. will be affected; Residents at 1401 and 1415 Fournier will be affected.
The home at 736 Paddock Ct. warrants a 100-year level of flood protection. This level of protection prompted a 30 rating for the structure flooding.

Estimated Cost = $404,000
Divided by
Total Benefit Points = 42
Cost/Benefit Rating = **9,619**

Table 8-27
GC-8 700 Block Fieldcrest Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-28
Preliminary Cost Estimate
700 Block Fieldcrest Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-8a	**Streambank Biostabilization**				
	Bio-Gabions	FSF	9600	$ 28	$ 268,800
	Reforestation	ACRE	1.6	$ 2,500	$ 4,000
	Seeding	SY	1330	$ 1	$ 1,330
	TRM	SY	1070	$ 7	$ 7,490
	Construction Subtotal=				$ 281,620
	Utility Relocation @ 20%	LS			$ 56,324
	Mobilization @ 4%	LS			$ 11,265
	Construction with Percent Allowances Subtotal=				$ 349,209
	Contingency @ 30%				$ 104,763
	Probable Cost Estimate=				$ 453,971

Design Engineering, Geotechnical, & Construction Management @ 30% $ 136,191

Total Conceptual Cost Estimate= **$ 591,000**
(Rounded up to the nearest $1000)

Table 6-29
Preliminary Cost Estimate
700 Block Fieldcrest Drive

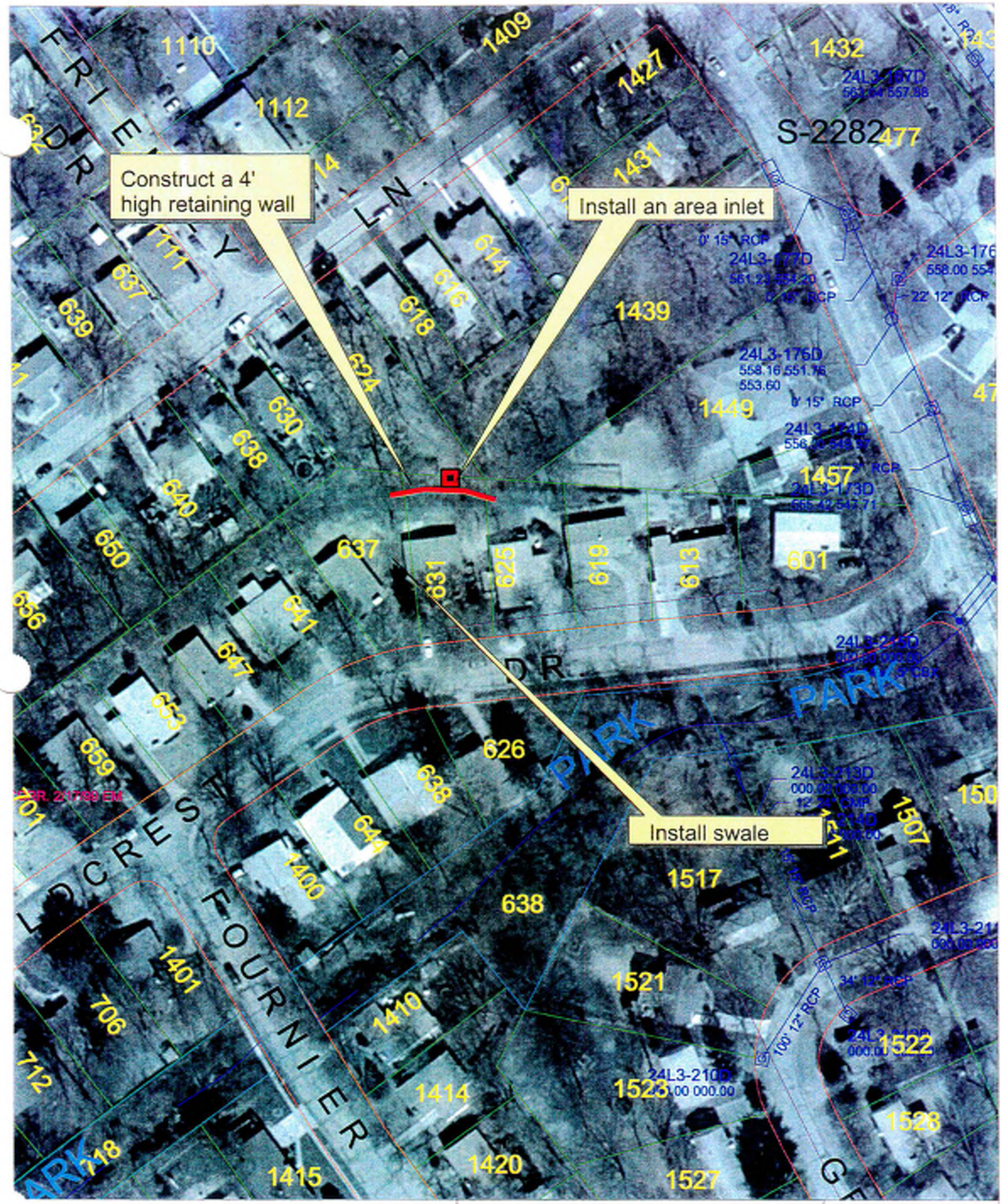
Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-8b	**Gabion Basket Channel Sidewall**				
	Gabions	FSF	9600	$ 20	$ 192,000
	Seeding	SY	670	$ 1	$ 670
	Construction Subtotal=				$ 192,670
	Utility Relocation @ 20%	LS			$ 38,534
	Mobilization @ 4%	LS			$ 7,707
	Construction with Percent Allowances Subtotal=				$ 238,911
	Contingency @ 30%				$ 71,673
	Probable Cost Estimate=				$ 310,584
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 93,175
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 404,000**

Figure 8-22. 700 Block Fieldcrest Drive (GC-8)

8.1.9 Project GC-9 631 Fieldcrest Drive

The resident at 631 Fieldcrest Drive has a severe erosion problem. Runoff from an upgradient backyard is depositing sediment and silt, which has accumulated enough to cause the runoff to pond in the backyard, causing damage to the home.

The recommended solution involves re-grading the yard to provide positive drainage from the house and installing a 4-foot high retaining wall, 50 feet in length. In addition, an area inlet constructed at the top of the retaining wall should be installed to collect the majority of the runoff. A swale would be required to transport the stormwater from the area inlet to the street curb and gutter system. The estimated probable project cost is approximately $21,000.



50 0 50 100 Feet

CDM

Project: GC-9

631 Fieldcrest Drive

Figure: 8-23

Table 8-30
Storm Sewer Priority Rating Sheet

.ocation: GC-9 631 Fieldcrest Drive   Inspection Date: 12/17/2001

Tributary: Gravois Creek

Problem Description: Resident at 631 Fieldcrest Drive has a severe erosion problem. Runoff from an upgradient backyard is depositing sediment and silt, which has accumulated enough to cause the runoff to pond in the backyard, causing damage to the home.

Recommended Action: Regrading the yard to provide positive drainage from the house and installing a 4-foot high retaining wall, 50 feet in length.

Preliminary Estimated Cost: $21,000   By: KL   Date: 12/17/2001

Stormwater Problem

Item 1 — Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Item 2 — Yard
Other
Describe:

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1	20				20		40
Item 2		16					16
Item 3							0
	20	16	0	0	20	Subtotal	56

Multiplier Number of Major Locations Affected	x	1	56
Multiplier Frequency Rating (flooding only)	x	1	56
Multiplier Degree of Risk	x	2	112

112
Total Benefit Points

Comments:
The resident at 631 Fieldcrest Drive will benefit from this improvement.

Estimated Cost = $21,000
Divided by
Total Benefit Points = 112
Cost/Benefit Rating = **188**

Table 8-31
GC-9 Fieldcrest Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-32
Preliminary Cost Estimate
631 Fieldcrest Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-9	**Backyard Erosion - Residence**				
	15" RCP and Catchment Drainage System	LF	10	$ 170	$ 1,700
	4' High Concrete Retaining Wall	CY	10	$ 600	$ 6,000
	Area Inlet	EACH	1	$ 1,850	$ 1,850
	Swale	CY	20	$ 11	$ 220
	Seeding	SY	100	$ 1	$ 100
	Construction Subtotal=				$ 9,870
	Utility Relocation @ 20%	LS			$ 1,974
	Mobilization @ 4%	LS			$ 395
	Construction with Percent Allowances Subtotal=				**$ 12,239**
	Contingency @ 30%				$ 3,672
	Probable Cost Estimate=				**$ 15,910**
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 4,773
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 21,000**

Figure 8-24. 631 Fieldcrest Drive (GC-9)

8.1.10 Project GC-10 1022 Diversey Drive

The existing gabion walls along the west bank of Gravois Creek in the vicinity of 1022 Diversey Drive are damaged. The entire wire basket foundation of the lower baskets is corroded and failing for about 200 feet of channel reach. In addition, higher flows have caused the wall to topple in a 40-foot section of this reach. Two alternatives were evaluated:

- **Alternative 1 - Streambank Biostabilization.** The failing gabion baskets should be removed and replaced with properly constructed biogabions. In order to stabilize the toe of the channel, a buried traditional gabion should be used for the base of the biogabions wall system. The use of traditional stone filled gabions for toe stabilization is extremely effective when built upon a solid base and used in conjunction with a wire TRM. The gabion toe could be constructed at or below the streambed grade and will act as an anchor, as well as reinforcement of the stream bank toe. If buried, only the uppermost portion of the gabion toe is visible during low flow conditions. However, based on the channel bed conditions along this reach, burying the toe may not be possible. The existing gabion wall rests directly on exposed bedrock.

  A flood bench should be developed on the east side of the channel to allow for more efficient conveyance of flows during large flood events. An area of 4,682 square feet should be excavated to a depth of 3 feet to create the flood bench. Stream realignment, through the flood bench, may occur over time, thus eliminating erosion on the opposite bank. The flood bench will reduce the amount of erosion occurring on the opposite bank by allowing a greater conveyance of flow through a channel cross-section of greater area. Some introduction of native riparian species should be performed in the flood bench area to promote the establishment of a desirable plant species and preclude the establishment of undesirable vegetation.

  The stream banks above the biogabion baskets could be stabilized through the use of a Wire Turf Reinforced Matrix (WTRM) and Turf Reinforced Matrix (TRM). A combination of a WTRM and TRM is another RECP that could be installed and used to stabilize the slope of the bank above the biogabions. The WTRM should be installed on the lower section of the bank and the TRM should be used to stabilize the upper section of the bank.

  The planting of trees will be necessary to restore the riparian corridor to mimic the original conditions on the channel. Plantings should include a mix of woody perennial cuttings, non-spiral root greenhouse plugs, and root-prune method (RPM) tree stock. In all instances, the materials should be planted at a favorable time of year, and should be protected where feasible with engineered erosion control materials. The estimated probable project cost is approximately $155,000.

- **Alternative 2 - Concrete Channel.** This solution involves replacing 200 feet of failing gabion basket with a 3:1 side-sloped concrete channel. The channel walls would be constructed to an approximate height of 3 feet and the channel bottom would have an approximate width of 30 feet. The estimated probable project cost is approximately $109,000.

The recommended solution is Alternative 1, which includes the development of a flood bench and biotechnical stabilization to restore the aesthetic park setting.

Project: GC-10

1022 Diversey Drive

Figure: 8-25

Table 8-33
Storm Sewer Priority Rating Sheet

ocation: GC-10 1022 Diversey Drive   Inspection Date: 12/17/2001

Tributary: Gravois Creek

Problem Description: The existing gabion walls along the west bank of the Gravois Creek in the vicinity of 1022 Diversey Drive are damaged.

Recommended Action: The failing gabion baskets should be removed and replaced with properly constructed biogabions. A flood bench should be developed on the east side of the channel to allow for more efficient conveyance of flows during large flood events.

Preliminary Estimated Cost: $155,000   By: KL   Date: 12/17/2001

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1	6	16			20		42
Item 2							0
Item 3							0
	6	16	0	0	20	Subtotal	42

_____ Residential Structure
_____ Commercial Structure
_____ Street
_____ Public Structure
Owner: _____
_____ Drainage Structure
Type: _____
Item 1 Improved Channel
_____ Unimproved Channel
_____ Yard
_____ Other
Describe: _____

Multiplier Number of Major Locations Affected x 1 = 42

Multiplier Frequency Rating (flooding only) x 1 = 42

Multiplier Degree of Risk x 1 = 42

42
Total Benefit Points

Comments:
Residents at 1022, 1026, 1030, and 1034 will be affected by the improvements.

Estimated Cost = $155,000
Divided by
Total Benefit Points = 42
Cost/Benefit Rating = **3,690**

Table 8-34
GC-10 1022 Diversey Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	**6**	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		**16**	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	**1.0**	Danger to Life	3.0
2-4	**20**	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	**1.0**

Table 8-35
Preliminary Cost Estimate
1022 Diversey Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-10a	**Gabion Basket Replacement**				
	18" high gabion toe	LF	400	$ 30	$ 12,000
	Bio-gabions	FSF	1200	$ 28	$ 33,600
	Excavation - flood benching	CY	540	$ 11	$ 5,940
	Excavation - grading	CY	30	$ 12	$ 360
	Excavation - removal of failed gabion walls	CY	180	$ 12	$ 2,160
	Material to be hauled off site - removed gabion walls	CY	180	$ 10	$ 1,800
	Reforestation	ACRE	0.5	$ 2,500	$ 1,250
	Seeding	SY	4790	$ 1	$ 4,790
	TRM	SY	400	$ 7	$ 2,800
	WTRM	SY	400	$ 23	$ 9,000
	Construction Subtotal=				$ 73,700
	Utility Relocation @ 20%	LS			$ 14,740
	Mobilization @ 4%	LS			$ 2,948

Construction with Percent Allowances Subtotal=	$ 91,388
Contingency @ 30%	$ 27,416
Probable Cost Estimate=	$ 118,804
Design Engineering, Geotechnical, & Construction Management @ 30%	$ 35,641
Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 155,000**

Table 8-36
Preliminary Cost Estimate
1022 Diversey Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-10b	**Concrete Trapazoidal Channel**				
	3:1 Sloped Concrete Channel	SY	420	$ 100	$ 42,000
	Excavation - removal of failed gabion walls	CY	180	$ 12	$ 2,160
	Material to be hauled off site - removed gabion walls	CY	180	$ 10	$ 1,800
	Seeding	SY	4790	$ 1	$ 4,790
	Reforestation	ACRE	0.5	$ 2,500	$ 1,250
	Construction Subtotal=				$ 52,000
	Utility Relocation @ 20%	LS			$ 10,400
	Mobilization @ 4%	LS			$ 2,080
	Construction with Percent Allowances Subtotal=				$ 64,480
	Contingency @ 30%				$ 19,344
	Probable Cost Estimate=				$ 83,824
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 25,147
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 109,000**

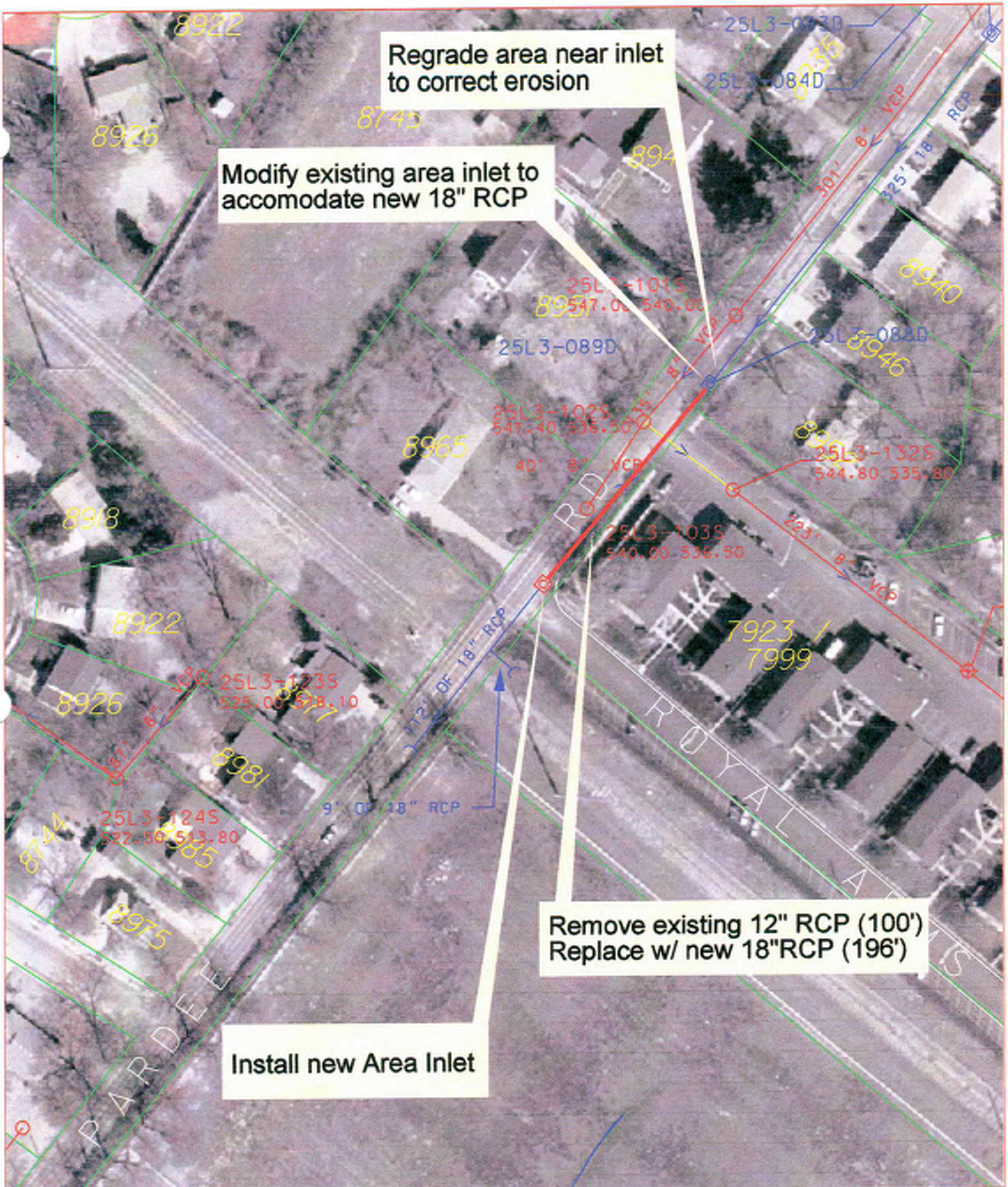
Figure 8-26. 1022 Diversey Drive (GC-10)

Figure 8-27. 1022 Diversey Drive (GC-10)

8.1.11 Project GC-11 Royal Arms Condominiums

The existing grass parkway between Pardee Road and the sidewalk at the Royal Arms Condominium Complex is eroding. Storm water discharges from an existing 12" RCP and flows in a ditch within the parkway until it collects again at an 18" RCP just north of the south entrance to Royal Arms Condominiums. The ditch is eroding, aesthetically unpleasing, and a potential hazard for motorists driving off the edge of Pardee Road.

The recommended solution involves constructing a new area inlet and approximately 196 LF of 18" RCP. The new 18" RCP will connect the new area inlet to an existing area inlet at 8952 Pardee Road, which will be modified to accommodate the 18" RCP. The new area inlet will be constructed just north of the south entrance to Royal Arms Condominiums, and will connect the new 18" RCP to the existing 18"RCP leading to the Trailnet Property. In addition, the ground around the existing area inlet at 8952 Pardee Road should be regraded to repair erosion near the area inlet. The estimated project cost of the recommended solution is approximately $53,000.



PLAN SCALE:

50 0 50 100 Feet

North

Project: GC - 11

Royal Arms Condominiums

Figure: 8-76

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Table 8-110
Storm Sewer Priority Rating Sheet

Location: GC-11 Royal Arms Condominiums   Inspection Date: 1/10/2003

Tributary: Gravois Creek

Problem Description: Parkway at Royal Arms Condominiums is experiencing erosion due to gap in storm water collection system along Pardee Road.

Recommended Action: Construct approx. 196 LF of 18" RCP and one new area inlet which will connect to an existing storm water collection system along Pardee Road.

Preliminary Estimated Cost: $53,000   By: JAE   Date: 2/5/2003

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1		16			50		66
Item 2							0
Item 3							0
	0	16	0	0	50	Subtotal	66

Residential Structure
Commercial Structure
Item 1 Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Yard
Other
Describe:

Multiplier Number of Major Locations Affected	x	2	132
Multiplier Frequency Rating (flooding only)	x	1	132
Multiplier Degree of Risk	x	2	264

264
Total Benefit Points

Comments:
Residents at Royal Arms Condominiums and motorists/pedestrians that travel Pardee Road will benefit from this project.

Estimated Cost = $53,000
Divided by
Total Benefit Points = 264
Cost/Benefit Rating = **201**

Table 8-111
GC-11 Royal Arms Condominiums

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-112
Preliminary Cost Estimate
Royal Arms Condominiums

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-11	**Improved Drainage System**				
	18" RCP	LF	196	$ 115	$ 22,540
	Removal of Existing 12" Storm Pipe	LS	1	$ 500	$ 500
	Area Inlet	EA	1	$ 1,850	$ 1,850
	Modify Existing Area Inlet to Accommodate New Storm Sewr	EA	1	$ 1,500	$ 1,500
	Earth Fill	CY	30	$ 50	$ 1,500
	Asphalt Repair	TON	5	$ 100	$ 500
	Sod	SY	200	$ 8	$ 1,600
	Construction Subtotal=				$ 29,990
	Mobilization @ 4%	LS			$ 1,200

Construction with Percent Allowances Subtotal=	**$ 31,190**
Contingency @ 30%	$ 9,357
Probable Cost Estimate=	**$ 40,546**
Design Engineering, Geotechnical, & Construction Management @ 30%	$ 12,164
Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 53,000**

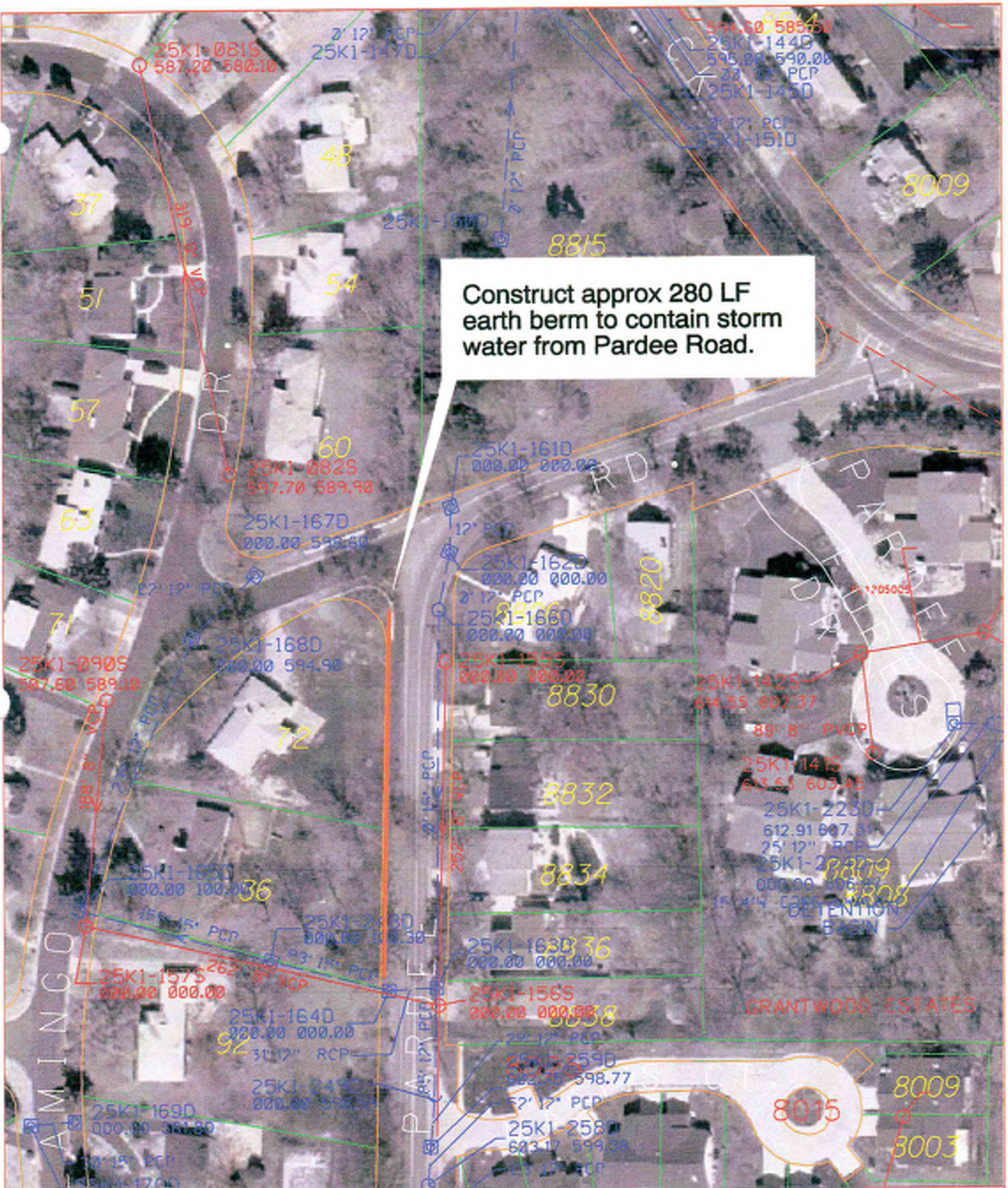
Royal Arms (GC-11)

Royal Arms (GC-11)

8.1.12 Project GC-12 72-92 Flamingo Drive

Residents at 72, 86, and 92 Flamingo Drive are experiencing erosion and minor yard flooding associated with storm water runoff from Pardee Road. Storm water from Pardee Road exits the road right of way through the rear yard of 72 Flamingo, and travels toward an area inlet at 86 Flamingo, causing minor erosion and sediment deposition. Some of this water bypasses the area inlet, causing minor yard flooding at 86 and 92 Flamingo Drive.

The recommended solution involves constructing an earth berm along the west side of Pardee Road between Flamingo Drive and an existing area inlet in the right of way of Pardee Road at 86/92 Flamingo Drive. This earth berm will contain the storm water from Pardee Road and transport the water to the existing area inlet. These improvements will require tree and brush removal along the west side of Pardee Road. The estimated project cost of the recommended solution is approximately $22,000.



PLAN SCALE:

50 0 50 100 Feet

CITY OF CRESTWOOD

North

Project: GC-12

72-92 Flamingo Drive

Figure: 8-80

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Table 8-116
Storm Sewer Priority Rating Sheet

Location: GC-12 72-92 Flamingo Drive Inspection Date: 1/17/2003

Tributary: Gravois Creek

Problem Description: Residents at 72, 86, and 92 Flamingo are receiving storm water runoff from Pardee Road. Storm water is causing minor erosion and yard flooding on these properties.

Recommended Action: Construct earth berm in the right of way on the west side of Pardee Road. Berm will prevent water from entering these properties and and will transport water to an existing area inlet on the west side of Pardee Road.

Preliminary Estimated Cost: $22,000 By: JAE Date: 2/5/2003

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1	2	6			20		28
Residential Structure	Item 2							0
Commercial Structure	Item 3							0
Street		2	6	0	0	20		
Public Structure							Subtotal	28

Owner:

Drainage Structure

Type:

Improved Channel

Unimproved Channel

Item 1 Yard

Other

Describe:

Multiplier
Number of Major Locations Affected x 1 28

Multiplier Frequency Rating (flooding only) x 1 28

Multiplier Degree of Risk x 1 28

28
Total Benefit Points

Comments:
Residents at 72, 86, and 92 Flamingo Drive will benefit from the improvements.

Estimated Cost = $22,000
Divided by
Total Benefit Points = 28
Cost/Benefit Rating = 786

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Table 8-117
GC-12 72-92 Flamingo Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	Hig h	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-118
Preliminary Cost Estimate
72-92 Flamingo Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-12	**Improved Drainage System**				
	Tree Removal	LS	1	$ 5,000	$ 5,000
	Earth Fill and Grading for Berm	CY	70	$ 60	$ 4,200
	Sodding for Berm	SY	400	$ 8	$ 3,200
	Construction Subtotal=				$ 12,400
	Mobilization @ 4%	LS			$ 496

Construction with Percent Allowances Subtotal=	**$ 12,896**
Contingency @ 30%	$ 3,869
Probable Cost Estimate=	**$ 16,765**
Design Engineering, Geotechnical, & Construction Management @ 30%	$ 5,029
Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 22,000**

8.1.15 Project GC-15 Grantwood Cove Lane

Residents on Grantwood Cove Court are experiencing a constant flow of water on the street from a sump pump and roof drains that are discharging an unusually large amount of water from the property at 7917 Grantwood Cove Lane. Currently these discharge on the property in a swale adjacent to the property line, which allows the water to flow down grade to the street over the sidewalk. The water flow is constant and has created a black and green stain on the pavement as well as an ice patch during freezing conditions. It is recommended that the sump pump discharge be routed to an inlet that is accross the cul-de-sac by excavating around the exterior of the cul-de-sac and installing an additional length of drain tile. The estimated probable project cost of the recommended solution is approximately $10,000.

Table 8-1
Storm Sewer Priority Rating Sheet

Location: GC-15 Grantwood Cove Lane   Inspection Date: 12/5/2004

Tributary: Mulberry Creek

Problem Description: Residents on Grantwood Cove Lane are experiencing constant flows from a discharge 7917 Grantwood Cove Lane.

Recommended Action: Tie sump discharge into storm inlet

Preliminary Estimated Cost: $10,000   By: ______   Date: 12/16/2004

Stormwater Problem

		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1			6	8	20		34
	Item 2				6			6
	Item 3							0
		0	0	6	14	20	Subtotal	40

____ Residential Structure
____ Commercial Structure
Item 1 Street
____ Public Structure
Owner: ____
____ Drainage Structure
Type: ____
____ Improved Channel
____ Unimproved Channel
Item 2 Yard
____ Other
Describe: ____

Multiplier Number of Major Locations Affected x 1 = 40

Multiplier Frequency Rating (flooding only) x 1 = 40

Multiplier Degree of Risk x 2 = 80

80
Total Benefit Points

Comments:

Estimated Cost = $10,000
Divided by
Total Benefit Points = 80
Cost/Benefit Rating = **125**

P:2050\32518\priorityratingsheet

Table 8-2
GC-15 Grantwood Cove Lane

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Preliminary Cost Estimate
Grantwood Cove Lane

ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
GC-15	**Installation of Small Drainage Line**				
	4" Perforated Drain Tile	LF	200	$ 20	$ 4,000
	Inlet modification	Each	1	$ 200	$ 200
	Sump Pump Connection	Each	1	$ 200	$ 200
	Driveway Apron	SY	25	$ 40	$ 1,000
	Finish Grading & Sodding	SY	20	$ 11.00	$ 220
	Construction Subtotal=				$ 5,620
	Mobilization @ 4%	LS			$ 225
	Construction with Percent Allowances Subtotal=				**$ 5,845**
	Contingency @ 30%				$ 1,753
	Probable Cost Estimate=				**$ 7,598**
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 2,279
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 10,000**

8.2 Kirkwood Creek Watershed

This section presents the recommended improvements for the Kirkwood Creek watershed, including a brief description of the stormwater problem, alternative solutions, recommendation, project layout, priority ranking, cost estimate, and photographs for each problem area.

8.2.1 Project KC-1 9724-9700 Greenview Drive

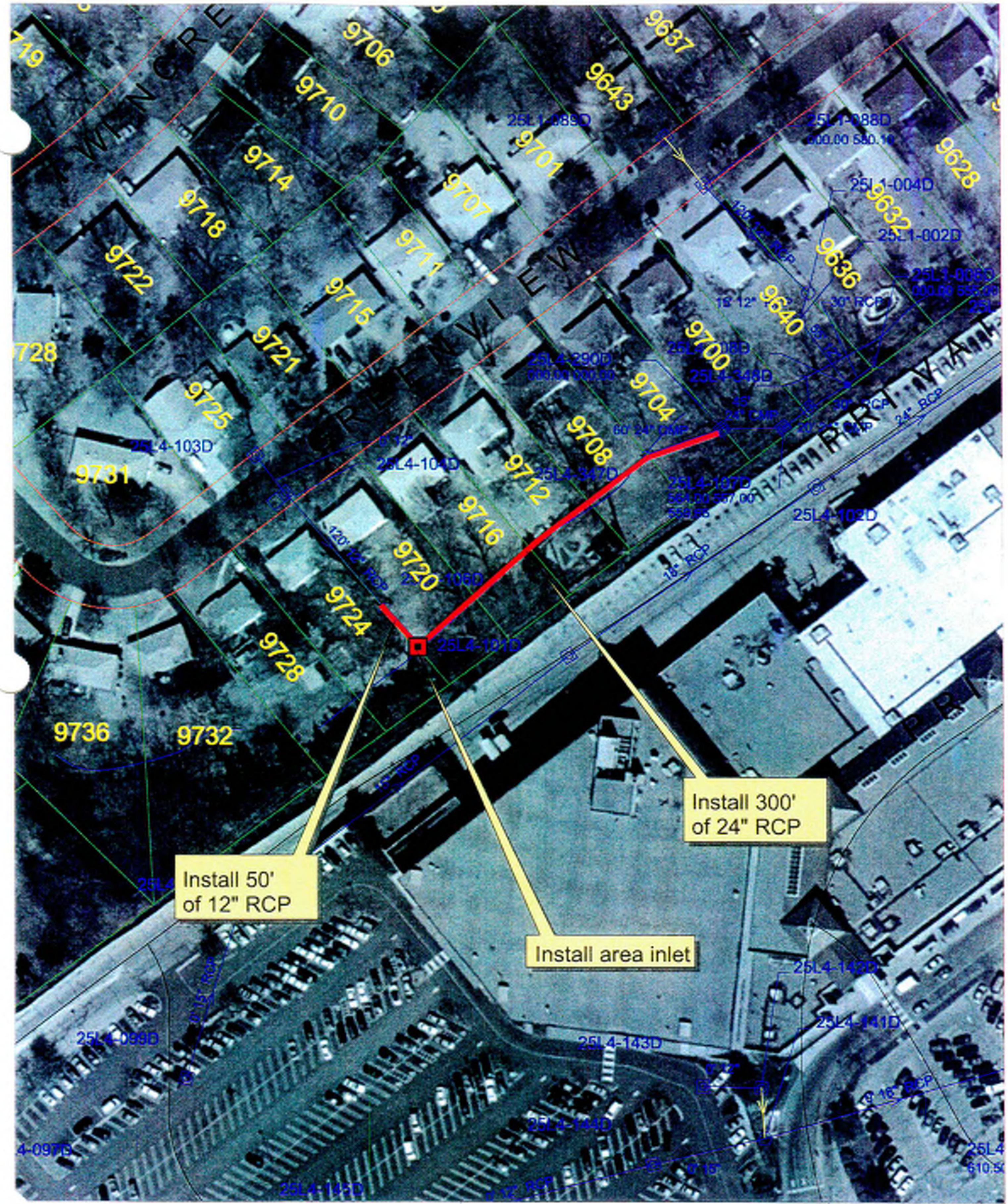
Erosion is occurring in the backyards of residences between 9704 and 9720 Greenview Drive. Concentrated surface runoff, which originates from upstream impervious areas of parking lots and Sappington Road, flows down a steep slope before emptying into the creek, which has caused gulleys in the backyards. The gulleys begin downstream from the 12-inch RCP outfall at 9720 Greenview Drive. Three alternative solutions were considered.

- **Alternative 1 - Extend Pipeline System.** The first solution is to replace the 24-inch CMP with a 24-inch RCP behind 9704 Greenview and extend the system 300 feet to 9720 Greenview to eliminate the gulley erosion in these backyards. In addition, a new area inlet should be installed in the backyards between 9720 and 9724. The 12-inch RCP that outfalls onto property 9720 Greenview, labeled 25L1-106D, should be extended 50 feet and the new area inlet connected to the proposed 24-inch RCP. The area inlet should be four sided with minimum sides of 36 inches to remove excess surface water, and a berm should be installed 10 feet below the area inlet to help collect runoff. The area inlet, labeled 25L1-290D, in the backyards between 9700 and 9704 Greenview, should also have a catch berm to prevent bypass. The estimated probable project cost is approximately $78,000.

- **Alternative 2 - Riprap Protection.** This alternative includes traditional rock materials to prevent further erosion. Rock sized for the relatively minor volume and velocity of flow common on this reach can be easily specified to halt the erosion occurring in this area. The solution involves installing 350 feet of riprap from the existing 12-inch pipe outlet to the opening of the existing 24-inch CMP. The estimated probable project cost is approximately $45,000.

- **Alternative 3 - Erosion Control Mat.** This alternative involves installing a biotechnical product such as a soil-filled rolled erosion control product covered with turf type sod and turf reinforced matrix similar to the Spellman Park project (KC-3). Typical installation includes grading the channel and installing a soil-filled TRM. Once the TRM is installed and anchored to the ground surface, pulverized topsoil would be spread over the TRM filling the majority of the open space. A turf-forming sod would then be installed over the soil-filled TRM. Most commercial sod is produced for full or part sun installation. For this reason, the sod should also be over-seeded with a shade-tolerant festuca species such as Dawson's Slender, Chewings, or Creeping Red. The estimated probable project cost is approximately $10,000.

Due to the considerable upstream drainage area and impervious area, the recommended solution is Alternative 1, extend pipeline system, which can easily be tied into the existing drainage system and will improve the aesthetics of the backyards. If channel incising or erosion begins to occur above the proposed system, then the area should be treated according to Alternative 3.



50 0 50 100 Feet

N S E W

CDM

Project: KC-1

9724-9700 Greenview Drive

Figure: 8-28

Table 8-37
Storm Sewer Priority Rating Sheet

ocation: KC-1 9724-9700 Greenview Drive   Inspection Date: 12/17/2001

Tributary: Kirkwood Creek

Problem Description: Erosion is occurring in the backyards of residences between 9704 and 9720 Greenview Drive.

Recommended Action: Replace the 24-inch RCP behind 9704 Greenview and extend the system 300 feet to 9720 Greenview to eliminate the gulley erosion in these backyards. New area inlets should be added to this problem area.

Preliminary Estimated Cost: $78,000   By: KL   Date: 12/17/2001

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1		12			30		42
Item 2							0
Item 3							0
	0	12	0	0	30	Subtotal	42

Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Item 1 Yard
Other
Describe:

Multiplier Number of Major Locations Affected x 1 | 42

Multiplier Frequency Rating (flooding only) x 1 | 42

Multiplier Degree of Risk x 1 | 42

42
Total Benefit Points

Comments:
Residents at 9724, 9720, 9716, 9712, 9708 and 9704 will benefit from the improvements.

Estimated Cost = $78,000
Divided by
Total Benefit Points = 42
Cost/Benefit Rating = **1,857**

Table 8-38
KC-1 9724-9700 Greenview Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-39
Preliminary Cost Estimate
9724-9700 Greenview Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
KC-1a	Extend Pipeline System				
	24" RCP	LF	300	$ 115	$ 34,500
	12" RCP	LF	50	$ -	$ -
	Area Inlet	EA	1	$ 1,850	$ 1,850
	Excavation - Grading for 2 berms	CY	10	$ 11	$ 110
	Seeding	SY	350	$ 1	$ 350
	Construction Subtotal=				$ 36,810
	Utility Relocation @ 20%	LS			$ 7,362
	Mobilization @ 4%	LS			$ 1,472
	Construction with Percent Allowances Subtotal=				$ 45,644
	Contingency @ 30%				$ 13,693
	Probable Cost Estimate=				$ 59,338
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 17,801
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 78,000**

Table 8-40
Preliminary Cost Estimate
9724-9700 Greenview Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
KC-1b	**Riprap Protection**				
	Excavation - Grading	CY	30	$ 11.00	$ 30
	Rock	SY	350	$ 60	$ 21,000
	Construction Subtotal=				$ 21,000
	Utility Relocation @ 20%	LS			$ 4,200
	Mobilization @ 4%	LS			$ 840
	Construction with Percent Allowances Subtotal=				$ 26,040
	Contingency @ 30%				$ 7,812
	Probable Cost Estimate=				$ 33,852
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 10,156

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 45,000**

Table 8-41
Preliminary Cost Estimate
9724-9700 Greenview Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
KC-1c	**Erosion Control Mat**				
	Excavation - Grading	CY	30	$ 11	$ 330
	Seeding	SY	190	$ 1	$ 190
	Soil Filled TRM with Sod	SY	350	$ 12	$ 4,200
	Construction Subtotal=				$ 4,720
	Utility Relocation @ 20%	LS			$ 944
	Mobilization @ 4%	LS			$ 189
	Construction with Percent Allowances Subtotal=				$ 5,853
	Contingency @ 30%				$ 1,756
	Probable Cost Estimate=				$ 7,609
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 2,283

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 10,000**

Figure 8-29. 9724 - 9700 Greenview Drive (KC-1)

8.2.2 Project KC-2 1000-1012 Banyon Drive

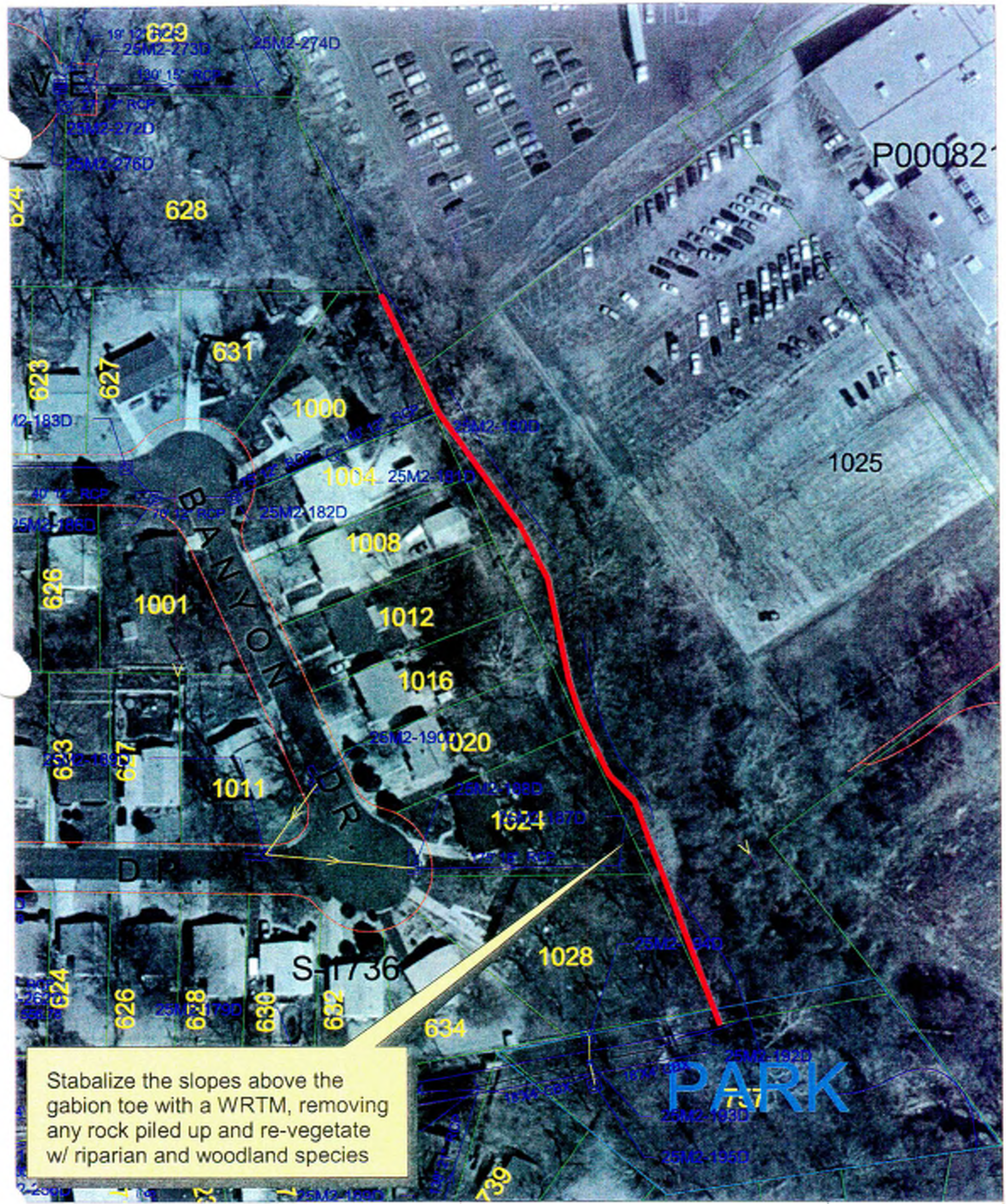
Erosion is occurring along Kirkwood Creek east of Banyon Drive between 1000 and 1028 Banyon Drive. The bank erosion is threatening fences and utilities along the rear yards of Banyon Drive. Two alternatives were evaluated:

- **Alternative 1 - Streambank Bio-stabilization.** In order to stabilize the toe of the channel, a buried rock gabion toe should be utilized. The use of traditional stone filled gabions for toe stabilization is extremely effective when built upon a solid base and used in conjunction with a wire TRM. The gabion toe could be constructed at or below the streambed grade and will act as an anchor, as well as reinforcement of the stream bank toe. If buried, only the uppermost portion of the gabion toe is visible during low flow conditions. The slopes above the gabion toe should be graded and sloped from the top of the gabion toe to the top of the bank, laying back the slopes where possible. The slopes should then be stabilized using a wire reinforced turf reinforced matrix (WTRM). WTRMs are reinforced with wire to withstand excessive forces of shear and scour, caused by negative water pressures or large pieces of floating debris. The estimated probable project cost is approximately $125,000.

- **Alternative 2 - Concrete Channel.** This solution involves constructing 645 feet of concrete channel. The left bank channel wall would have a 5:1 slope, while the right bank channel would have a 9:1 channel slope. The channel walls would be constructed to an approximate height of 4.6 feet and the channel bottom would have an approximate width of 7 feet. The estimated probable project cost is approximately $470,000.

  In order to implement any solution, the vegetation along the reach would have to be removed (i.e., cleared and grubbed) attempting to retain any large established trees. Any rock piled up in the area should be removed. The planting of trees will be necessary to restore the riparian corridor to mimic the original conditions on the channel. Plantings should include native, woodland species.

The recommended solution is Alternative 1, streambank biostabilization, which will maintain the aesthetics of the channel. Alternative 2, construction of a concrete lined channel, would cause high channel velocities that could pose a safety concern.



50 0 50 100 Feet

N W E S

CDM

Project: KC-2

1000-1012 Banyon Drive

Figure: 8-30

Table 8-42
Storm Sewer Priority Rating Sheet

Location: KC-2 1000-1012 Banyon Drive   Inspection Date: 12/17/2001

Tributary: Kirkwood Creek

Problem Description: Erosion is occurring along a tributary of Kirkwood Creek east of Banyon Drive between 1000 and 1028 Banyon Drive. Bank erosion is threatening a fence and utilities at 1012 Banyon Drive.

Recommended Action: A buried rock gabion toe should be utilized with a WTRM.

Preliminary Estimated Cost: $125,000   By: KL   Date: 12/17/2001

Stormwater Problem

Item 2 — Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Item 1 — Unimproved Channel
Yard
Other
Describe:

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1		12			30		42
Item 2	6						6
Item 3							0
	6	12	0	0	30	**Subtotal**	48

Multiplier Number of Major Locations Affected x 2 = 96

Multiplier Frequency Rating (flooding only) x 1 = 96

Multiplier Degree of Risk x 1 = 96

96
Total Benefit Points

Comments:
Residents at 1000, 1004, 1008, 1012, 1016, 1020, 1024 and 1028 Banyon Drive will be affected by the improvements.

Estimated Cost = $125,000
Divided by
Total Benefit Points = 96
Cost/Benefit Rating = **1,302**

Table 8-43
KC-2 1000-1012 Banyon Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-44
Preliminary Cost Estimate
1000-1012 Banyon Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
KC-2a	**Bank Stabilization**				
	18" Gabion Toe	LF	1280	$ 30	$ 38,400
	Excavation - Grading	CY	760	$ 12	$ 9,120
	Reforestation	ACRE	2	$ 2,500	$ 5,000
	Seeding	SY	290	$ 1	$ 363
	WTRM	SY	290	$ 23	$ 6,525
	Construction Subtotal=				$ 59,408
	Utility Relocation @ 20%	LS			$ 11,882
	Mobilization @ 4%	LS			$ 2,376
	Construction with Percent Allowances Subtotal=				$ 73,665
	Contingency @ 30%				$ 22,100
	Probable Cost Estimate=				$ 95,765
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 28,729
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 125,000**

Table 8-45
Preliminary Cost Estimate
1000-1012 Banyon Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price		Cost	
KC-2b	**Concrete Trapazoidal Channel**						
	Concrete Trapazoidal Channel w/ 3:1 slopes	SY	2150	$	100	$	215,000
	Reforestation	ACRE	1	$	2,500	$	2,500
	Seeding	SY	6450	$	1	$	6,450
	Construction Subtotal=					$	223,950
	Utility Relocation @ 20%	LS				$	44,790
	Mobilization @ 4%	LS				$	8,958
	Construction with Percent Allowances Subtotal=					$	277,698
	Contingency @ 30%					$	83,309
	Probable Cost Estimate=					$	361,007
	Design Engineering, Geotechnical, & Construction Management @ 30%					$	108,302
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)					**$**	**470,000**

Figure 8-31. 1000 - 1012 Banyon Drive (KC-2)

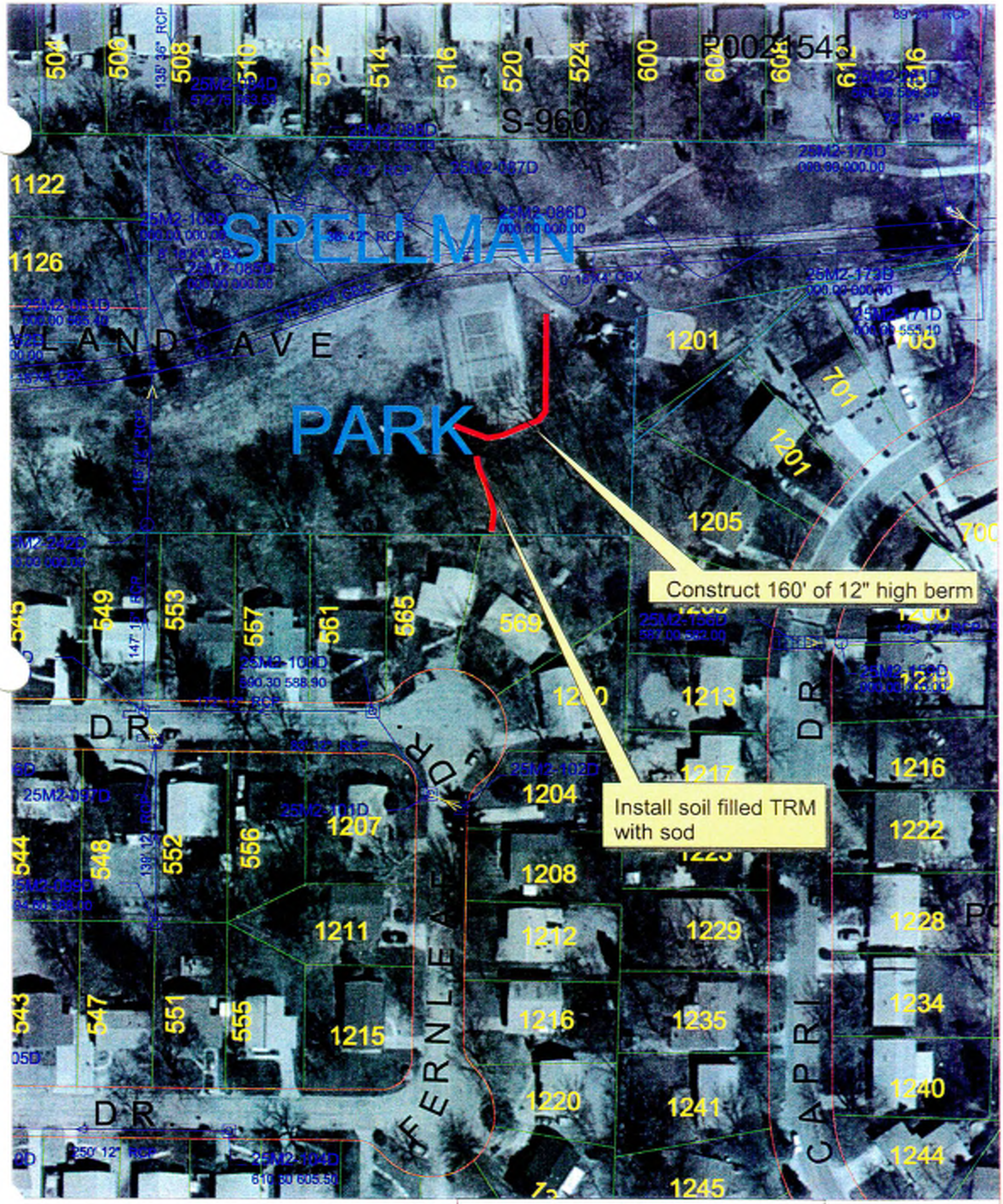
8.2.3 Project KC-3 Spellman Park

The parks department has reported that sedimentation occurs on the tennis courts in Spellman Park as a result of erosion occurring on the hill to the south. The hill is experiencing a shallow concentrated flow with high velocity due to the steep, 20-percent grade of the hill. The recommended solution involves two components:

- **Component 1 - Erosion control.** This involves a new swale and erosion control mats, such as a soil-filled rolled erosion control product (RECP) covered with a turf type sod. A Turf Reinforced Matrix (TRM) is one type of RECP recommended on this project. Another erosion control solution includes traditional rock materials to prevent further erosion, since the slope is heavily shaded. The TRM option would include 80 feet of soil-filled erosion control product. The entire area should be over seeded with a shade tolerant fescue species.

- **Component 2 - Drainage system.** A berm should be constructed at the base of the hill to collect the runoff and divert it away from the courts to the area inlets located east of the courts, and adjacent to the playground. The berm should be constructed to a maximum height of 12 inches. The berm would be approximately 160 feet long and would have a drainage swale with 2-percent grade on the south side that directs runoff to the northeast. The berm should begin on the south side of the tennis courts, then bend at the corner of the courts and extend north to at least the midpoint of the east side of the courts.

The estimated probable project cost is approximately $20,000.



50 0 50 100 Feet

CDM

Project: KC-3

Spellman Park

Figure: 8-32

Table 8-46
Storm Sewer Priority Rating Sheet

Location: KC-3 Spellman Park   Inspection Date: 12/17/2001

Tributary: Kirkwood Creek

Problem Description: Sedimentation has occurred on the tennis courts in Spellman Park as a result of erosion occurring on the hill to the south.

Recommended Action:

Preliminary Estimated Cost: $20,000   By: KL   Date: 12/17/2001

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1		14			10		24
Item 2				6			6
Item 3							0
	0	14	0	6	10	Subtotal	30

___ Residential Structure
___ Commercial Structure
___ Street
Item 1 Public Structure
Owner: Crestwood
___ Drainage Structure
Type: ___
___ Improved Channel
___ Unimproved Channel
Item 2 Yard
___ Other
Describe: ___

Multiplier Number of Major Locations Affected	x	1	30
Multiplier Frequency Rating (flooding only)	x	1	30
Multiplier Degree of Risk	x	2	60

60
Total Benefit Points

Comments:
The city will benefit from the improvement.

Estimated Cost = $20,000
Divided by
Total Benefit Points = 60
Cost/Benefit Rating = **333**

Table 8-47
KC-3 Spellman Park

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	**14**	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	**6**	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	**1.0**	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	**2.0**
1	**10**	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-48
Preliminary Cost Estimate
Spellman Park

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
KC-3	**Erosion Control**				
	Berm (Site Grading for Runoff Divertion, 12" High Berm)	CY	120	$ 14	$ 1,680
	Seeding	SY	1200	$ 1	$ 1,500
	Soil filled TRM with Sod	SY	220	$ 12	$ 2,640
	Vegetative Cover (Berm Only)	SY	180	$ 20	$ 3,600
	Construction Subtotal=				$ 9,420
	Utility Relocation @ 20%	LS			$ 1,884
	Mobilization @ 4%	LS			$ 377
	Construction with Percent Allowances Subtotal=				$ 11,681
	Contingency @ 30%				$ 3,504
	Probable Cost Estimate=				$ 15,185

Design Engineering, Geotechnical, & Construction Management @ 30% $ 4,556

Total Conceptual Cost Estimate= **$ 20,000**
(Rounded up to the nearest $1000)

Figure 8-33. Spellman Park (KC-3)

Figure 8-34. Spellman Park (KC-3)

Figure 8-35. Spellman Park (KC-3)

8.2.4 Project KC-4 546 and 538 Aspen Drive

Residents are experiencing flooding due to runoff from neighbors uphill and south of 546 and 542 Aspen Drive. The runoff bypasses an existing berm and collects in the backyards due to steep slopes. The existing east-west berm has settled and has flattened, which prevents the diversion of runoff to the west.

The recommended solution includes the reestablishment of 180 feet of berm along the south property line. The berm will have an associated swale on the south or uphill side with a designed grade of 2 percent grade to the west. The restoration of the berm will route the runoff to Spellman Avenue. The estimated probable project cost is $3,000.

50 0 50 100 Feet

CDM

Project: KC-4

546and 538 Aspen Drive

Figure: 8-36

Table 8-49
Storm Sewer Priority Rating Sheet

ocation. KC-4 546 and 538 Aspen Drive Inspection Date: 12/17/2001

Tribuary: Kirkwood Creek

Problem Description: Residents are experiencing flooding due to runoff from neighbors uphill and south of 548 and 542 Aspen Drive.

Recommended Action. Reestablish 180 feet of berm along the south property line.

Preliminary Estimated Cost: $3,000 By: KL Date: 12/17/2001

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1	10				20		30
Residential Structure	Item 2							0
Commercial Structure	Item 3							0
Street		10	0	0	0	20		
Public Structure							Subtotal	30

Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Yard
Item 1 Other
Describe: Swale/Berm

Multiplier			
Number of Major Locations Affected	x	1	30
Multiplier Frequency Rating (flooding only)	x	1	30
Multiplier Degree of Risk	x	1	30

30
Total Benefit Points

Comments:
Residents at 546 and 538 Aspen Drive will benefit from the improvements.

Estimated Cost = $3,000
Divided by
Total Benefit Points = 30
Cost/Benefit Rating = **100**

Table 8-50
KC-4 546 and 538 Aspen Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	**10**	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	**1.0**	Danger to Life	3.0
2-4	**20**	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	**1.0**

Table 8-51
Preliminary Cost Estimate
546 and 538 Aspen Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
KC-4	**Reestablish berm**				
	Excavation - east-west berm	CY	80	$ 12	$ 960
	Seeding	SY	120	$ 1	$ 120
	Construction Subtotal=				$ 1,080
	Utility Relocation @ 20%	LS			$ 216
	Mobilization @ 4%	LS			$ 43
	Construction with Percent Allowances Subtotal=				**$ 1,339**
	Contingency @ 30%				$ 402
	Probable Cost Estimate=				**$ 1,741**
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 522

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 3,000**

Figure 8-37. 546-538 Aspen Drive (KC-4)

8.3 Mulberry Creek Watershed

This section presents the recommended improvements for the Mulberry Creek watershed, including a brief description of the stormwater problem, alternative solutions, recommendation, project layout, priority ranking, cost estimate, and photographs for each problem area.

8.3.1 Project MC-1 9440-9448 Lodge Pole Lane

The structural armoring on the north bank of the channel between 9440 and 9448 Lodge Pole Drive is experiencing varying degrees of deterioration and erosion. This erosion threatens fences behind these homes. Areas of grouted riprap are being undermined at the toe of the sidewall slope.

- **Alternative 1 - Streambank Bio-stabilization.** A 150-foot 18-inch gabion toe should be installed to stabilize the channel sidewall on the north bank. The slope should be graded above the gabion and stabilized with a TRM. Native riparian and woodland species should be planted along the sides of the channel to enhance the riparian corridor, promote channel stabilization and minimize the effects of erosion. The estimated probable project cost is approximately $16,000.

- **Alternative 2 - Rehabilitate Grouted Riprap.** The areas where the grouted riprap is beginning to deteriorate should replaced and grouted to match the existing channel bank. The estimated probable project cost is $4,000.

The recommended solution, Alternative 2, involves replacing and rehabilitating the structural armoring of approximately 150-foot section of the channel's north bank to prevent further property damage.

50 0 50 100 Feet

N S E W

CDM

Project: MC-1

9440-9448 Lodge Pole Lane

Figure: 8-38

Table 8-52
Storm Sewer Priority Rating Sheet

ocation: MC-1 9440-9448 Lodge Pole Lane   Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: Structural armoring on the north bank of the channel between 9440 and 9448 Lodge Pole Drive is experiencing varying degrees of deterioration and erosion. The erosion threatens fences behind these homes.

Recommended Action: Gabion baskets should be installed along 150 feet of the north bank to stabilize the channel sidewalls to a height of 4 feet

Preliminary Estimated Cost: $4,000   By: KL   Date: 12/17/2001

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1			10		20		30
Residential Structure	Item 2							0
Commercial Structure	Item 3							0
Street		0	0	10	0	20		
Public Structure							Subtotal	30

Owner:

Drainage Structure

Type:

Item 1 Improved Channel

Unimproved Channel

Yard

Other

Describe:

Multiplier Number of Major Locations Affected	x	1	30
Multiplier Frequency Rating (flooding only)	x	1	30
Multiplier Degree of Risk	x	1	30

30
Total Benefit Points

Comments:
Residents at 9940, 9444, and 9448 Lodge Pole Drive will benefit from the improvements.

Estimated Cost =	$4,000
Divided by	
Total Benefit Points =	30
Cost/Benefit Rating =	**133**

Table 8-53
MC-1 9440-9448 Lodge Pole Lane

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	**10**	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	**1.0**	Danger to Life	3.0
2-4	**20**	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	**1.0**

Table 8-54
Preliminary Cost Estimate
9440-9448 Lodge Pole Lane

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-1a	**Biostabilization**				
	18" high gabion toe	LF	150	$ 30	$ 4,500
	Excavation - grouted rip rap	CY	40	$ 12	$ 480
	Reforestation	ACRE	0.2	$ 2,500	$ 500
	Removal - grouted rip rap	CY	40	$ 10	$ 400
	Seeding - two sides of the channel	SY	300	$ 1	$ 375
	TRM (turf reinforced matrix)	SY	150	$ 7	$ 1,050
	Construction Subtotal=				$ 7,305
	Utility Relocation @ 20%	LS			$ 1,461
	Mobilization @ 4%	LS			$ 292
	Construction with Percent Allowances Subtotal=				$ 9,058
	Contingency @ 30%				$ 2,717

Probable Cost Estimate= $ 11,776

Design Engineering, Geotechnical, & Construction Management @ 30% $ 3,533

Total Conceptual Cost Estimate= **$ 16,000**
(Rounded up to the nearest $1000)

Table 8-55
Preliminary Cost Estimate
9440-9448 Lodge Pole Lane

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-1b	**Rehabilitate Grouted Riprap**				
	Excavation - grouted rip rap	CY	10	$ 12	$ 120
	Grouted rip rap	SY	20	$ 75	$ 1,500
	Removal - grouted rip rap	CY	10	$ 10	$ 100
	Seeding - one side of channel	SY	80	$ 1	$ 80
	Construction Subtotal=				$ 1,800
	Utility Relocation @ 20%	LS			$ 360
	Mobilization @ 4%	LS			$ 72
	Construction with Percent Allowances Subtotal=				$ 2,232
	Contingency @ 30%				$ 670
	Probable Cost Estimate=				$ 2,902

Design Engineering, Geotechnical, & Construction Management @ 30% — $ 870

Total Conceptual Cost Estimate= **$ 4,000**
(Rounded up to the nearest $1000)

Figure 8-39. 9440-9448 Lodge Pole Lane (MC-1)

8.3.2 Project MC-2 9319 Lawndale Drive

Residents at 9319 Lawndale Drive and 9301 Cherrybrook Lane have experienced building and street flooding, and yard erosion. The flooding is being caused by two undersized curb inlets, labeled 26L1-198D and 26L1-197D, which straddle Lawndale Drive between the two residences identified above. Another potential contributor to the problem could be debris clogging the drainage pipe between the 42-inch outfall and area inlet 26L1-185D. Both curb inlets are located at the low point of the vertical profile of Lawndale Drive. Stormwater bypasses other upstream curb inlets, which are located east and west along Lawndale Drive. This is caused by the steep grades, which reduce the capacity of the curb inlets.

The recommended solution includes installing two additional curb inlets at the sump location, one on each side of the street, to handle the stormwater bypass from the upstream inlets. In addition, the 12-inch RCP that connects the existing curb inlets, will need to be replaced with 35-feet of 24-inch RCP. Also, minor grading will be required at 9301 Cherrybrook to establish a 2-percent grade toward the street and area inlet 26L1-185D. The estimated probable project cost is $26,000.

50 0 50 100 Feet

N W E S

CDM

Project: MC-2

9319 Lawndale Drive

Figure: 8-40

Table 6-56
Storm Sewer Priority Rating Sheet

xation: MC-2 9319 Lawndale Drive   Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: Residents at 9319 Lawndale Drive and 9301 Cherrybrook Lane have experienced building and street flooding, and yard erosion. The flooding is due to two undersized curb inlets.

Recommended Action: Install two additional curb inlets at the sump location, on each side of the street. Replace 12-inch RCP with 35-feet of 24-inch RCP.

Preliminary Estimated Cost: $26,000   By: KL   Date: 12/17/2001

Stormwater Problem

Item 1 — Residential Structure
Commercial Structure
Item 2 — Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Item 3 — Yard
Other
Describe:

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1	16				20		36
Item 2	8						8
Item 3		6					6
	24	6	0	0	20	Subtotal	50

Multiplier		Factor	Result
Number of Major Locations Affected	x	1	50
Frequency Rating (flooding only)	x	1	50
Degree of Risk	x	2	100

100
Total Benefit Points

Comments:
Residents at 9313 Lawndale Drive and 9301 Cherrybrook Drive will directly benefit from improvements.

Estimated Cost = $26,000
Divided by
Total Benefit Points = 100
Cost/Benefit Rating = **260**

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Table 8-57
MC-2 9319 Lawndale Drive

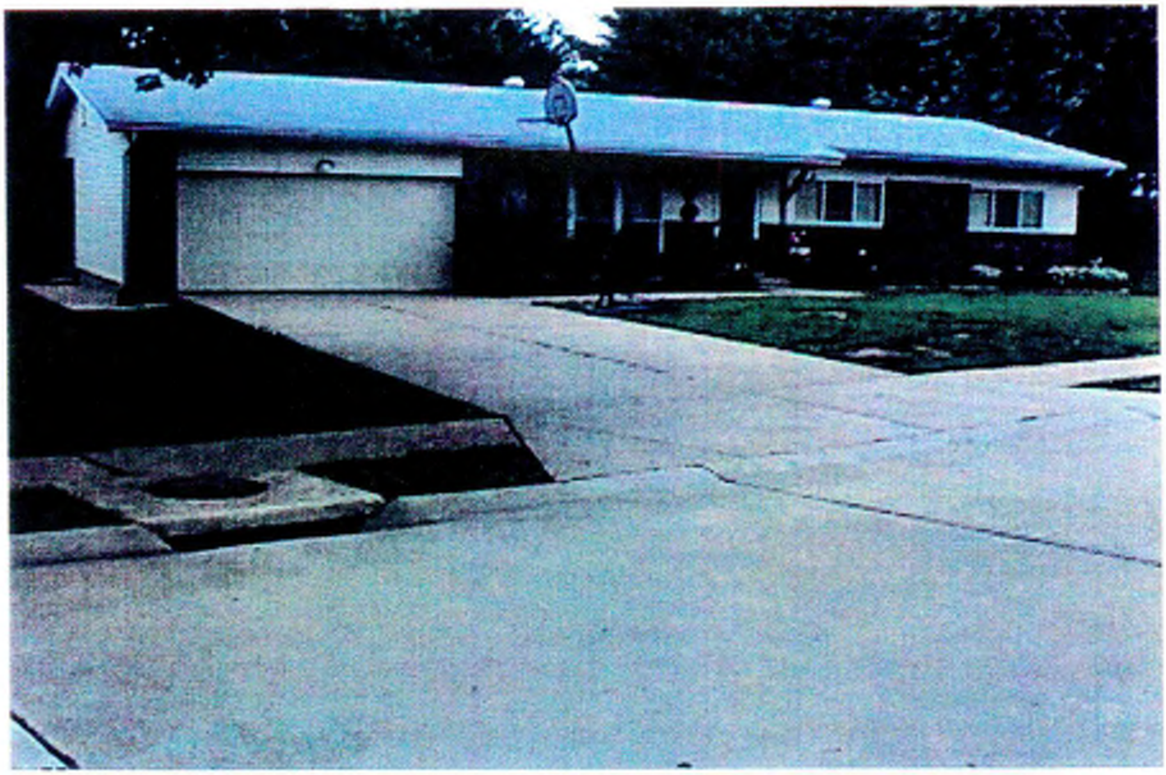
Evaluation Category	Problem Type	Benefit Points: Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-58
Preliminary Cost Estimate
9319 Lawndale Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-2	**Curb Inlets in Sump for Runoff Bypass Collection**				
	24" RCP	LF	35	$ 170	$ 5,950
	Curb Inlets	EA	2	$ 2,100	$ 4,200
	Excavation - Grading 2% toward street	CY	190	$ 11	$ 2,090
	Seeding	SY	20	$ 1	$ 20
	Construction Subtotal=				$ 12,260
	Utility Relocation @ 20%	LS			$ 2,452
	Mobilization @ 4%	LS			$ 490
	Construction with Percent Allowances Subtotal=				$ 15,202
	Contingency @ 30%				$ 4,561
	Probable Cost Estimate=				$ 19,763
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 5,929
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 26,000**

Figure 8-41. 9319 Lawndale Drive (MC-2)



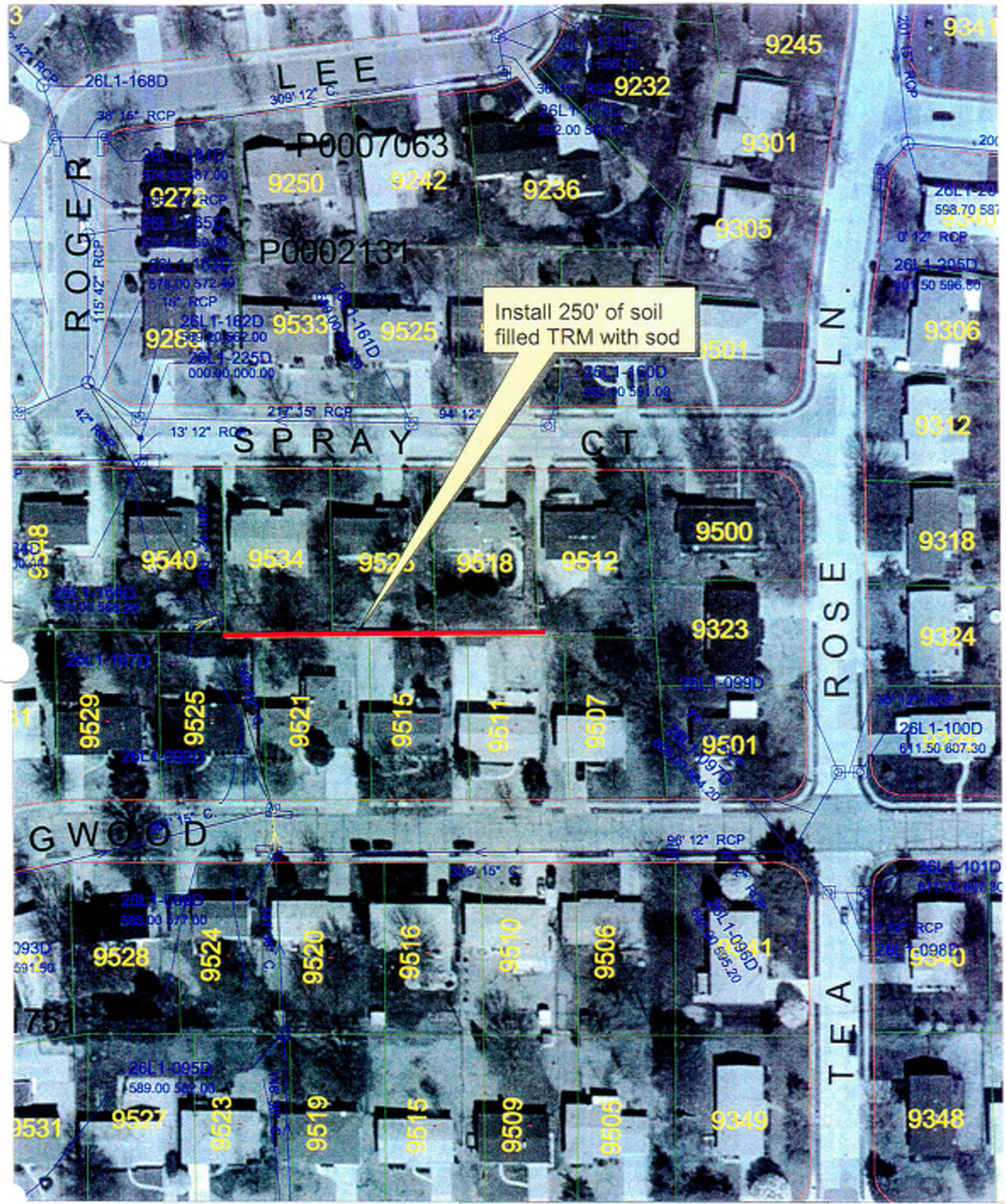
8.3.3 Project MC-3 9518-9534 Pine Spray Court

Residents are reporting erosion in their backyards between 9518 and 9534 Pine Spray Court. Erosion has resulted from shallow concentrated flow that becomes a drainage channel as it discharges into area inlet 26L1-166D. Without repair and stabilization, the channel will continue to erode, widen, down cut, and migrate upstream in the backyards of 9518, 9526, and 9534 Pine Spray Court. Two alternative solutions were evaluated:

- **Alternative 1 - Erosion control mat.** This alternative involves 250 feet of new swale with erosion control mats, such as a soil-filled rolled erosion control product (RECP) covered with a turf type sod. A Turf Reinforced Matrix (TRM) is one type of RECP, which is recommended on this project and which will require backyard grading for installation. A combination of sod and a shade tolerant festuca species should be planted to stabilize the soil. The estimated probable project cost is approximately $11,000.

- **Alternative 2 - Enclosed System.** This alternative involves installing a backyard drainage system consisting of approximately 200 feet of 18-inch RCP with one area inlet. The system would tie into the existing area inlet. The estimated probable project cost is approximately $53,000.

The recommended solution is Alternative 1, erosion control mat, which will provide an aesthetically pleasing improvement and will minimize the disruption of existing trees, fences, and utilities in these backyards.



50 0 50 100 Feet

N
W E
S

CDM

Project: MC-3

9518-9534 Pine Spray Court

Figure: 8-42

Table 8-59
Storm Sewer Priority Rating Sheet

ocation: MC-3 9518-9534 Pine Spray Court Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: Residents are reporting erosion in their backyards between 9518 and 9534 Pine Spray Court.

Recommended Action: Install approximately 260 feet of new swale with erosion control mats

Preliminary Estimated Cost: $11,000 By: KL Date: 12/17/2001

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1		16			20		36
Item 2							0
Item 3							0
	0	16	0	0	20	Subtotal	36

Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Item 1 Yard
Other
Describe:

Multiplier
Number of Major Locations Affected x 1 36

Multiplier Frequency Rating (flooding only) x 1 36

Multiplier Degree of Risk x 1 36

36
Total Benefit Points

Comments:
Residents at 9512, 9526, and 9518 Pine Spray Court will directly benefit from the improvements.

Estimated Cost = $11,000
Divided by
Total Benefit Points = 36
Cost/Benefit Rating = **306**

Table 8-60
MC-3 9518-9534 Pine Spray Court

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		**16**	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	**1.0**	Danger to Life	3.0
2-4	**20**	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	**1.0**

Table 8-61
Preliminary Cost Estimate
9518-9534 Pine Spray Court

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-3a	**Erosion Control Mat**				
	Excavation - Grading for TRM	CY	100	$ 11	$ 1,100
	Seeding	SY	290	$ 1	$ 363
	Soil Filled TRM with Sod	SY	290	$ 12	$ 3,480
	Construction Subtotal=				$ 4,943
	Utility Relocation @ 20%	LS			$ 989
	Mobilization @ 4%	LS			$ 198
	Construction with Percent Allowances Subtotal=				$ 6,129
	Contingency @ 30%				$ 1,839
	Probable Cost Estimate=				$ 7,967
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 2,390

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 11,000**

Table 8-62
Preliminary Cost Estimate
9518-9534 Pine Spray Court

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-3b	**Enclosed System**				
	18" RCP	LF	200	$ 115	$ 23,000
	Area Inlet	EA	1	$ 1,850	$ 1,850
	Seeding	SY	110	$ 1	$ 110
	Construction Subtotal=				$ 24,960
	Utility Relocation @ 20%	LS			$ 4,992
	Mobilization @ 4%	LS			$ 998
	Construction with Percent Allowances Subtotal=				$ 30,950
	Contingency @ 30%				$ 9,285
	Probable Cost Estimate=				**$ 40,236**
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 12,071

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 53,000**

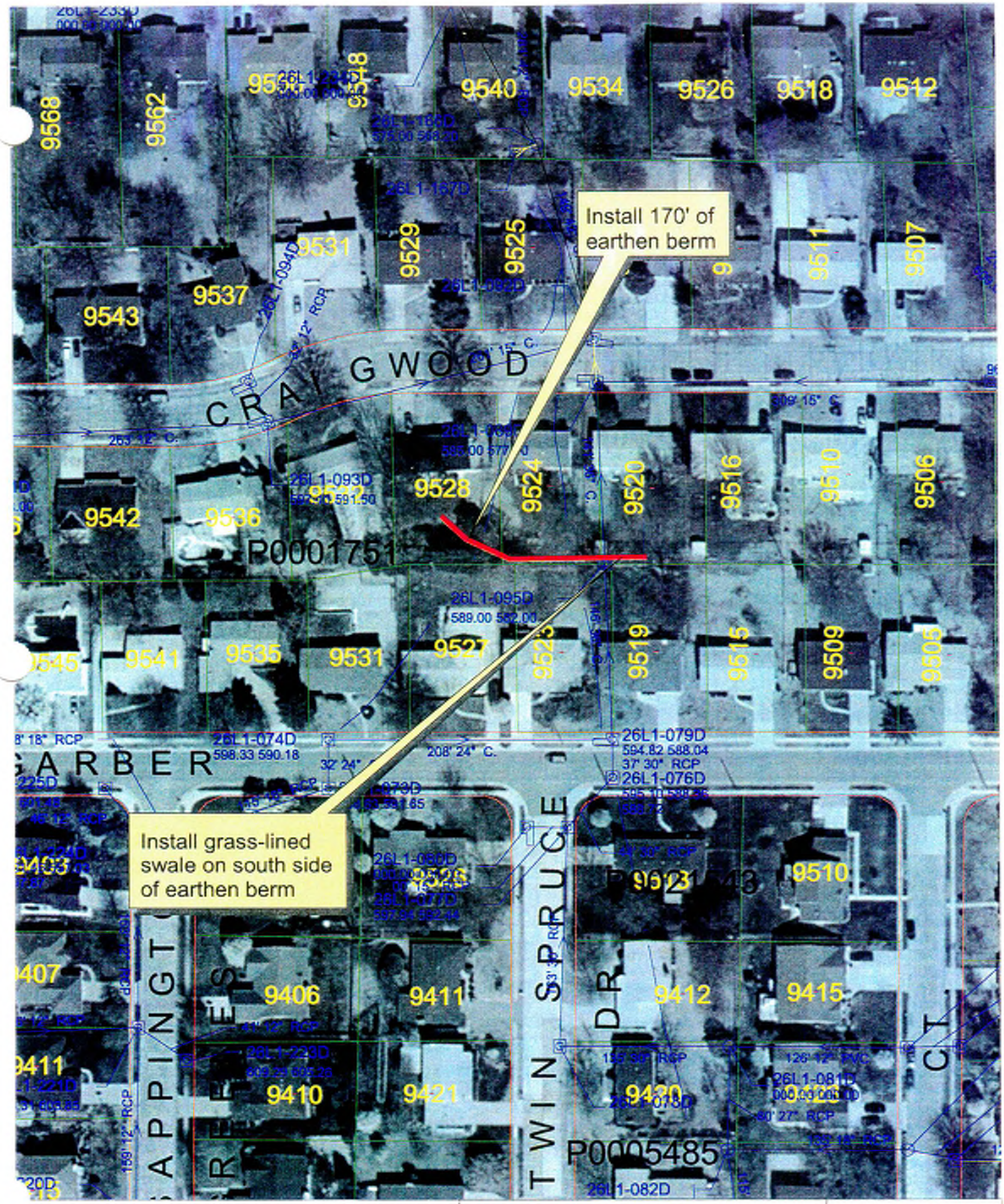
Figure 8-43. 9518 - 9534 Pine Spray Court (MC-3)

8.3.4 Project MC-4 9528 Craigwood Terrace

Residents at 9528 Craigwood and 9523 Garber have reported building and yard flooding on their property. Poor grading in the backyards prevents stormwater runoff from reaching the existing area inlet, labeled 26L1-095D. Two alternative solutions were evaluated:

- **Alternative 1 – Install Grass Swale.** This alternative involves re-grading the ground behind 9528 and 9524 Craigwood toward area inlet 26L1-095D. The improvement project consists of approximately 170 feet of earthen berm, 1-foot high, with associated grass-lined swale on the south side of the berm to properly drain the runoff to the area inlet. In addition, the project will involve lowering the flow line of the throat of the area inlet based on establishing a 2-percent grade for the swale that drains from the west. The estimated probable project cost is approximately $15,000.
- **Alternative 2 – Install Enclosed Pipeline.** This alternative involves installing approximately 170-feet of 15-inch RCP along the backyard property lines of 9528 and 9524 Craigwood toward area inlet 26L1-095D. The estimated probable project cost is approximately $46,000.

The recommended solution is Alternative 1, grass swale, which is more cost-effective than the enclosed system and will require less maintenance.



50 0 50 100 Feet

N W E S

CDM

Project: MC-4

9528 Craigwood Terrace

Figure: 8-44

Table 8-63
Storm Sewer Priority Rating Sheet

..ation: MC-4 9528 Craigwood Terrace

Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: Residents at 928 Craigwood and 9523 Garber have reported building flooding and yard flooding on their property.

Recommended Action: Regrade the ground behind 9528 and 9524 Craigwood toward area inlet 26L1-095D. Install 170 feet of earthen berm, 1-foot high, with associated grass-lined swale on the south side of the berm.

Preliminary Estimated Cost: $15,000 By: KL Date: 12/17/2001

Stormwater Problem			Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
		Item 1	20				20		40
Item 1	Residential Structure	Item 2				10			10
	Commercial Structure	Item 3							0
	Street		20	0	0	10	20		
	Public Structure							Subtotal	50

Owner: ______

Drainage Structure

Type: ______

Improved Channel

Unimproved Channel

Item 2 Yard

Other

Describe: ______

Multiplier				
Number of Major Locations Affected	x	1	50
Multiplier: Frequency Rating (flooding only)	x	1	50
Multiplier: Degree of Risk	x	2	100

100
Total Benefit Points

Comments:
Residents at 9528 and 9523 Craigwood Terrace will benefit directly from the improvements.

Estimated Cost = $15,000
Divided by
Total Benefit Points = 100
Cost/Benefit Rating = **150**

P:\20509\32518\Storm Sewer Priority Rating Sheet\cv1.xls

Table 8-64
MC-4 9528 Craigwood Terrace

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-65
Preliminary Cost Estimate
9528 Craigwood Terrace

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-4a	**Install Grass Swale**				
	Excavation (Grading of Swale)	CY	30	$ 12	$ 360
	Modify Area Inlet	EA	1	$ 500	$ 500
	Seeding	SY	280	$ 1	$ 280
	Vegetative Cover	SY	280	$ 20	$ 5,600
	Construction Subtotal=				$ 6,740
	Utility Relocation @ 20%	LS			$ 1,348
	Mobilization @ 4%	LS			$ 270
	Construction with Percent Allowances Subtotal=				$ 8,358
	Contingency @ 30%				$ 2,507
	Probable Cost Estimate=				**$ 10,865**

Design Engineering, Geotechnical, & Construction Management @ 30% $ 3,259

Total Conceptual Cost Estimate= **$ 15,000**
(Rounded up to the nearest $1000)

Table 8-66
Preliminary Cost Estimate
9528 Craigwood Terrace

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-4b	**Install Enclosed Pipeline**				
	15" RCP	LF	170	$ 115	$ 19,550
	Area inlet	EA	1	$ 1,850	$ 1,850
	Seeding	SY	90	$ 1	$ 90
	Construction Subtotal=				$ 21,490
	Utility Relocation @ 20%	LS			$ 4,298
	Mobilization @ 4%	LS			$ 860
	Construction with Percent Allowances Subtotal=				$ 26,648
	Contingency @ 30%				$ 7,994
	Probable Cost Estimate=				$ 34,642
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 10,393

Total Conceptual Cost Estimate= **$ 46,000**
(Rounded up to the nearest $1000)

Figure 8-45. 9528 Craigwood Terrace (MC-4)

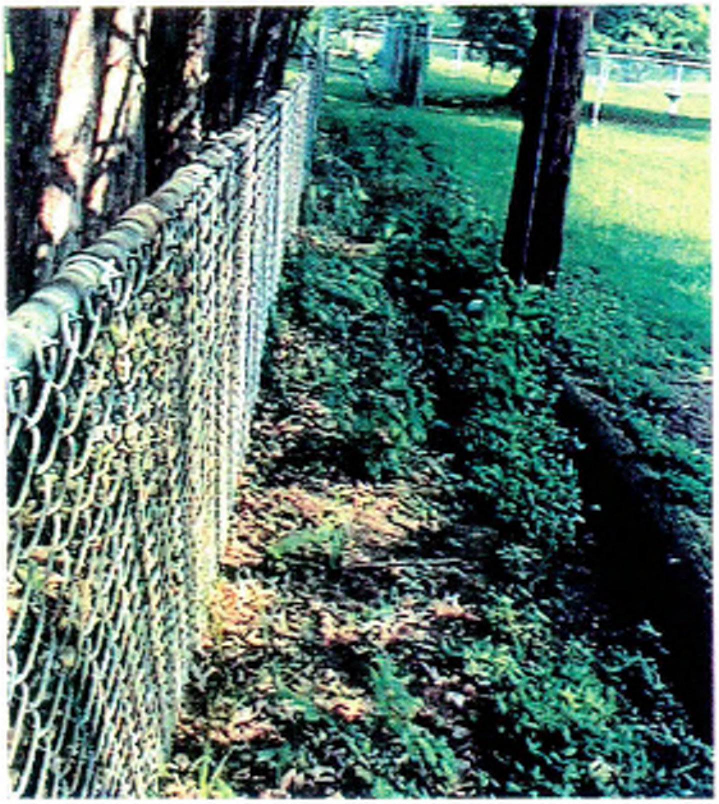
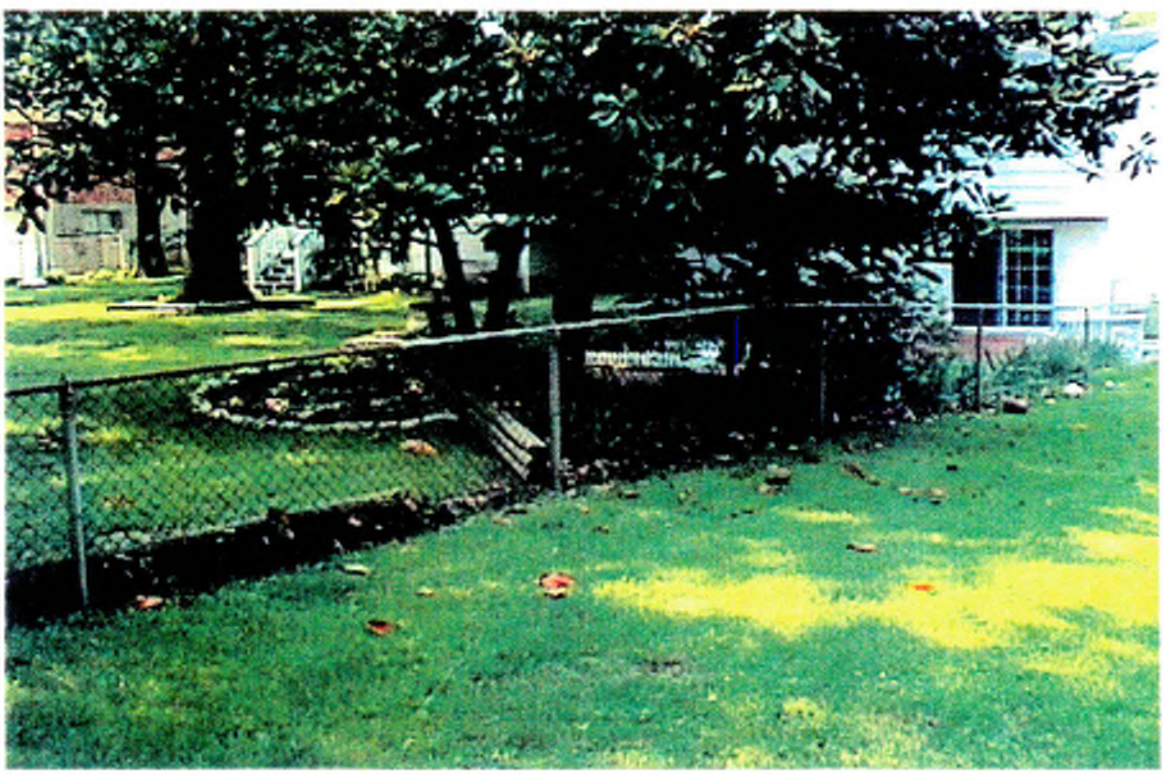


Figure 8-46. 9528 Craigwood Terrace (MC-4)



8.3.5 Project MC-5 9600 Block Yorkshire Estates Drive

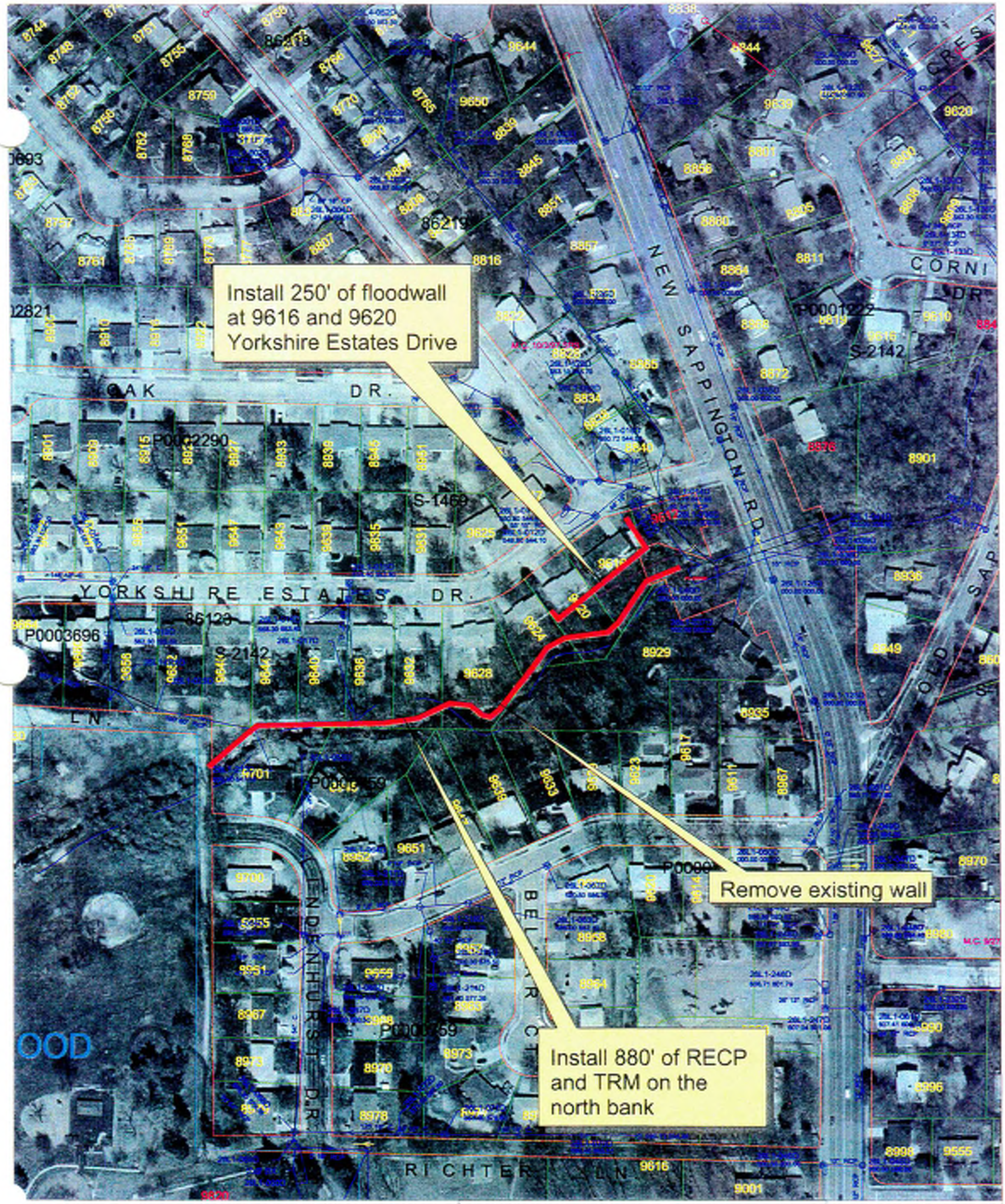
Flooding of structures is occurring along the north bank at 9616 and 9620 Yorkshire Estates Drive, and erosion is occurring between 9648 and 9616 Yorkshire Estates Drive on the north bank. Two alternative solutions were evaluated:

- **Alternative 1 - Flood proofing and biostabilization.** Install 250 feet of 4-foot high floodwall, for the residents at 9616 and 9620 Yorkshire Estates Drive. The protection should consider the elevation at which storm water overtops New Sappington Road. The culvert, labeled 26L1-040D, which lies beneath the road, is a double 6 x 11.5-foot RCB. The culvert properly handles the flooding for the 15-year event. This is according to flows presented in the MSD Gravois Creek Watershed Study (February 1997) and existing elevation data based on aerial photos, which provide 4-foot contour intervals.

  To alleviate the erosion, 880 feet of bank stabilization should be installed on the north bank of Mulberry Creek, which includes removing the failing structural wall systems, and replacing it with a geogrid-reinforced fill slope RECP. The base of the slopes in the area consists of natural rock, which provides superior toe stabilization of the banks. Erosion is occurring in other areas where rock is not present. These areas should be sloped back and stabilized with vegetation. The stream banks could be stabilized through the use of a Turf-Reinforcing Matrix (TRM) and a Wire Turf Reinforcing Matrix (WTRM). Since vegetation is not viable stabilization alternative near the low water line, structural assistance is often necessary to insure the toe remains stabile. Applicable technologies include organic logs or stone. Re-vegetation should be done with native, woodland and riparian species. The estimated probable project cost is approximately $536,000.

- **Alternative 2 - Flood proofing and gabion wall.** Flood proofing should be installed as stated in Alternative 1. A rock gabion wall, extending 880 feet in length, should be installed on the north bank of the channel. The gabion wall should be constructed to a height of 10 feet to contain flows from the 100-year storm. The estimated probable project cost is approximately $397,000.

The recommended solution is Alternative 1, which will establish the vegetation on the channel bank, as well as provide a smoother transition between the ground surface and the channel bottom. The 8-foot vertical gabion wall of Alternative 2 would present a safety concern for residents.



100 0 100 200 Feet

CDM

Project: MC-5

9600 Blk. Yorkshire Estates Dr.

Figure: 8-47

Table 8-67
Storm Sewer Priority Rating Sheet

cation: MC-5 9600 Block Yorkshire Estates Drive — Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: Flooding of structures is occurring along the north bank at 9616 and 9620 Yorkshire Estates Drive, and erosion is occurring between 9648 and 9616 Yorkshire Estates Drive on the north bank.

Recommended Action: Install 250 feet of 4-foot high floodwall, for the residents at 9616 and 9620 Yorkshire Estates Drive. Bank stabilization should be applied to 880 feet of the North bank of Mulberry Creek.

Preliminary Estimated Cost: $536,000 By: KL Date: 12/17/2001

Stormwater Problem

Item 1 Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Item 2 Improved Channel
Unimproved Channel
Yard
Other
Describe:

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1	16				30		46
Item 2		14					14
Item 3							0
	16	14	0	0	30	Subtotal	60

Multiplier Number of Major Locations Affected	x	1	60
Multiplier Frequency Rating (flooding only)	x	1	60
Multiplier Degree of Risk	x	2	120

120
Total Benefit Points

Comments:
Residents at 9616, 9620, 9624, 9628, 9632, 9636, 9640, 9644 and 9648 will benefit directly from this improvement.

Estimated Cost =	$536,000
Divided by	
Total Benefit Points =	120
Cost/Benefit Rating =	**4,467**

Table 8-68
MC-5 9528 Craigwood Terrace

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-69
Preliminary Cost Estimate
9600 Block Yorkshire Estates Drive

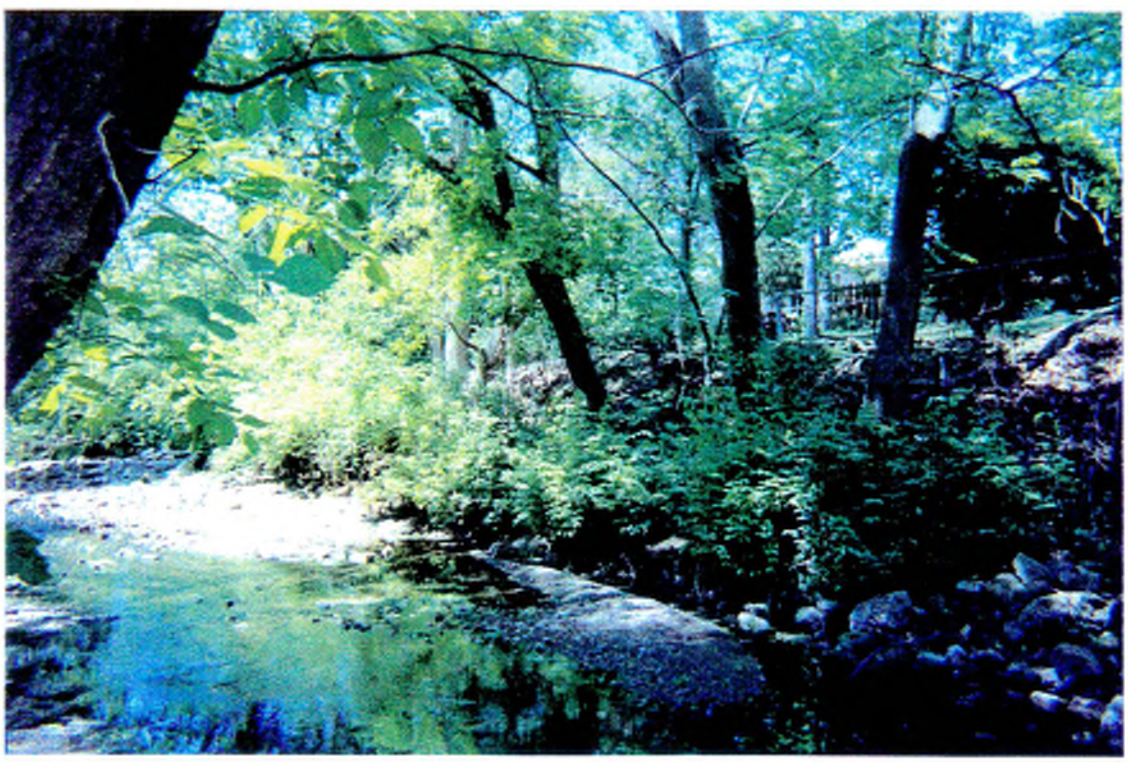
Site ID #	Item Description	Unit	Estimated Quantity	Unit Price		Cost	
MC-5a	**Floodproofing and bank stabilization**						
	Excavation - Existing Structural Wall System	CY	260	$	12	$	3,120
	Excavation - Grading	CY	160	$	12	$	1,920
	Floodwall	CY	30	$	600	$	18,000
	Geogrid reinforced fill slope RECP	FSF	8800	$	25	$	220,000
	Material to be hauled off site - Existing Structural Wall System	CY	260	$	10	$	2,600
	Reforestation	ACRE	1.3	$	2,500	$	3,250
	Seeding	SY	630	$	1	$	630
	TRM	SY	880	$	7	$	6,160
	Construction Subtotal=					$	255,680
	Utility Relocation @ 20%	LS				$	51,136
	Mobilization @ 4%	LS				$	10,227
	Construction with Percent Allowances Subtotal=					$	317,043
	Contingency @ 30%					$	95,113
	Probable Cost Estimate=					$	412,156
	Design Engineering, Geotechnical, & Construction Management @ 30%					$	123,647
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)					**$**	**536,000**

Table 8-70
Preliminary Cost Estimate
9600 Block Yorkshire Estates Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price		Cost	
MC-5b	**Floodproofing and gabion wall**						
	8' Gabion Wall	FSF	7040	$	20	$	140,800
	Excavation - Existing Structural Wall System	CY	260	$	12	$	3,120
	Excavation - Grading	CY	160	$	12	$	1,920
	Floodwall	CY	30	$	500	$	15,000
	Handrails	LF	880	$	25	$	22,000
	Material to be hauled off site - Existing Structural Wall System	CY	260	$	10	$	2,600
	Reforestation	ACRE	1.3	$	2,500	$	3,250
	Seeding	SY	630	$	1	$	630
	Construction Subtotal=					$	189,320
	Utility Relocation @ 20%	LS				$	37,864
	Mobilization @ 4%	LS				$	7,573
	Construction with Percent Allowances Subtotal=					$	234,757
	Contingency @ 30%					$	70,427
	Probable Cost Estimate=					$	305,184
	Design Engineering, Geotechnical, & Construction Management @ 30%					$	91,555
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)					**$**	**397,000**

Figure 8-48. 9600 Block Yorkshire Estates Drive (MC-5)

Figure 8-49. 9600 Block Yorkshire Estates Drive (MC-5)



8.3.6 Project MC-6 9781-9783 Twin Vista Drive

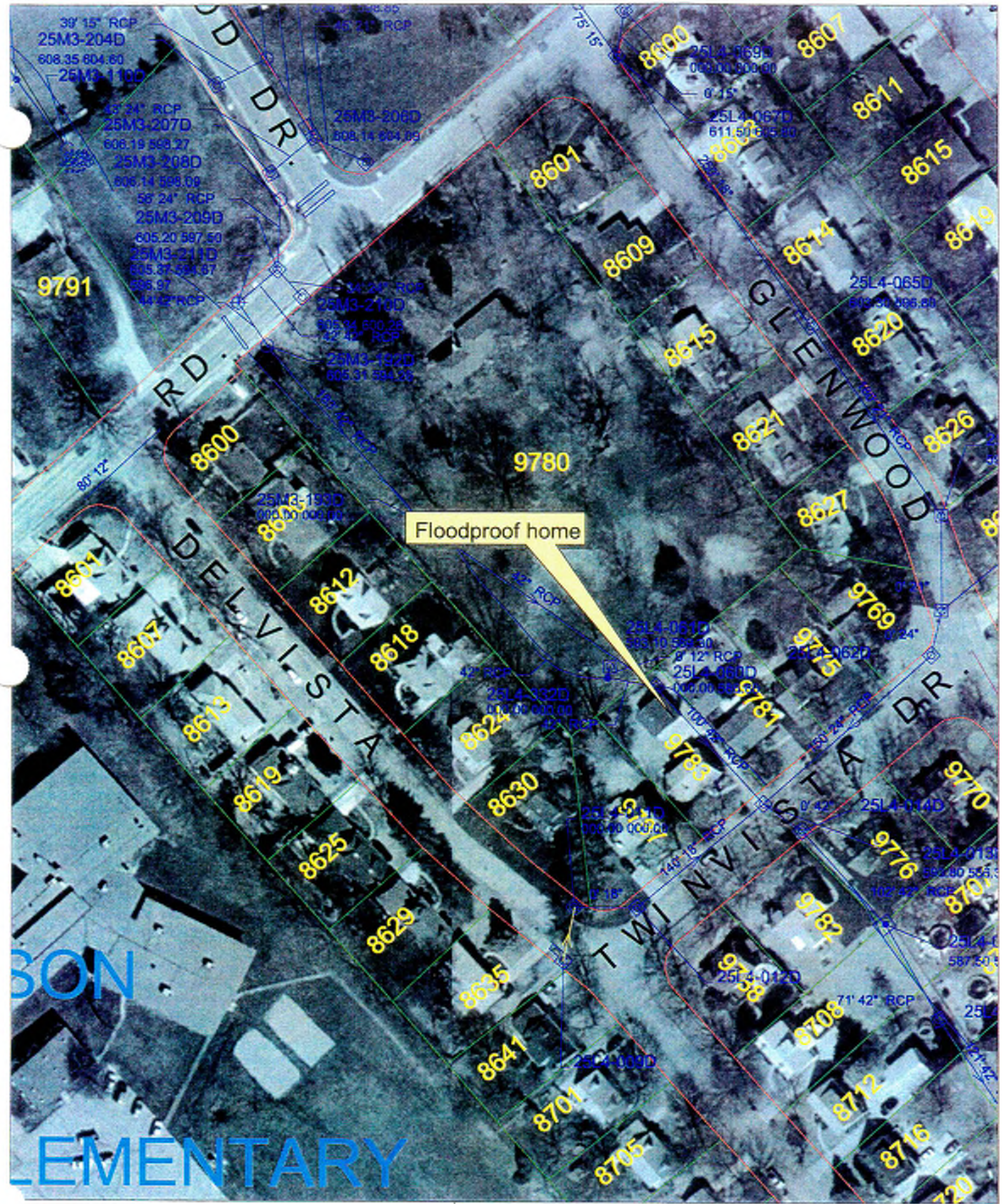
Building flooding occurs between 9781 and 9783 Twin Vista Drive, caused by two area inlets, labeled 25L4-060D and 25L4-061D, that surcharge. No overflow channel exists to drain the surcharge runoff downstream. In addition, the existing 42-inch line between the two residents is undersized. Three alternative solutions were evaluated:

- **Alternative 1 - Detention basin.** A detention basin could be installed on the southeast side of property 9780 East Watson Road to reduce the stormwater flows to mitigate the flooding. Re-grading around the existing area inlets and installing a 3.5-foot berm would construct the detention basin. The western area inlet, 25L4-061D, would need to be removed and replaced with an appropriately sized detention basin outlet to match the capacity of the existing 42-inch RCP. The area required for the detention basin is approximately 160- by 210-feet, which would extend northwest to area inlet 25M3-193D, and northeast to the property line of 9781 Twin Vista Drive. The estimated probable project cost is approximately $65,000.

- **Alternative 2 - Floodproof Home.** This alternative includes floodproofing the adjacent garage and home by eliminating any low flow openings and floodproofing the foundations. The cost is $42,000.

- **Alternative 3 - Pipe replacement.** To mitigate the surcharging at the area inlets, the 42-inch drainage pipe will need to be replaced with 130 feet of 54-inch pipe to handle the flow for the 15-year design storm, to transport the stormwater underground to the curb inlets, labeled 25L4-013D, on Twin Vista Drive. However, several hundred feet of pipeline southeast of Twin Vista Drive is also undersized, which would need to be replaced. This alternative was determined to be not feasible due to the high costs associated with replacing pipeline located in the backyards of several residents. Due to the magnitude of the potential project, this alternative was determined not to be feasible.

The recommended solution is Alternative 2, floodproof home, which is the most cost-effective solution.



50 0 50 100 Feet

N
W E
S

CDM

Project: MC-6

9781-9783 Twin Vista Drive

Figure: 8-50

Table 8-71
Storm Sewer Priority Rating Sheet

ocation: MC-6 9781-9783 Twin Vista Drive   Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: Building flooding occurs between 9781 and 9783 Twin Vista Drive, caused by two area inlets, labeled 25L4-060D and 25L4-061D, that surcharge. In addition, the 42-inch between the two residents is undersized.

Recommended Action: Construct a detention basin on the southeast side of property 9780 East Watson Road.

Preliminary Estimated Cost: $42,000   By: KL   Date: 12/17/2001

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1	16				20		36
Item 1 Residential Structure	Item 2							0
Commercial Structure	Item 3							0
Street		16	0	0	0	20		
Public Structure							Subtotal	36
Owner:		**Multiplier** Number of Major Locations Affected			x		1	36
Drainage Structure								
Type:								
Improved Channel								
Unimproved Channel		**Multiplier** Frequency Rating (flooding only)			x		0.6	21.6
Yard								
Other								
Describe:		**Multiplier** Degree of Risk			x		2	43.2

43.2
Total Benefit Points

Comments:
Residents at 9781 and 9783 Twin Vista Drive will benefit from the improvements.

Estimated Cost =	$42,000
Divided by	
Total Benefit Points =	43
Cost/Benefit Rating =	**972**

Table 8-72
MC-6 9781-9783 Twin Vista Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-73
Preliminary Cost Estimate
9781-9783 Twin Vista Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-6a	**Detention Basin**				
	Construct Detention Basin	AC-FT	3.4	$ 7,000	$ 23,800
	Outlet Structure - 42" RCP	LF	20	$ 250	$ 5,000
	Outlet Structure - Inlet	EA	1	$ 1,850	$ 1,850
	Construction Subtotal=				$ 30,650
	Utility Relocation @ 20%	LS			$ 6,130
	Mobilization @ 4%	LS			$ 1,226
	Construction with Percent Allowances Subtotal=				**$ 38,006**
	Contingency @ 30%				$ 11,402
	Probable Cost Estimate=				**$ 49,408**
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 14,822

Total Conceptual Cost Estimate= **$ 65,000**
(Rounded up to the nearest $1000)

Table 8-74
Preliminary Cost Estimate
9781-9783 Twin Vista Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-6b	**Flood proof residence**				
	Flood proofing	EA	1	$ 20,000	$ 20,000
	Construction Subtotal=				$ 20,000
	Utility Relocation @ 20%	LS			$ 4,000
	Mobilization @ 4%	LS			$ 800
	Construction with Percent Allowances Subtotal=				$ 24,800
	Contingency @ 30%				$ 7,440
	Probable Cost Estimate=				$ 32,240
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 9,672
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 42,000**

Figure 8-51. 9871 - 9873 Twin Vista Drive (MC-6)

8.3.7 Project MC-7 8900 Block Lindenhurst Drive

Residents between 8966 and 8978 Lindenhurst Drive have building flooding and erosion in their backyards. In an effort to mitigate the problem, the resident at 9656 Lindenhurst has placed sandbags at the basement window on the east side of the home and constructed a narrow channel to divert the runoff away from the building, while the resident at 8968 Lindenhurst has reported standing water in their backyard. Finally, the resident at 8963 Belmar Court has a poorly constructed retaining wall, which is causing erosion in the backyard. The recommended solution involves four components:

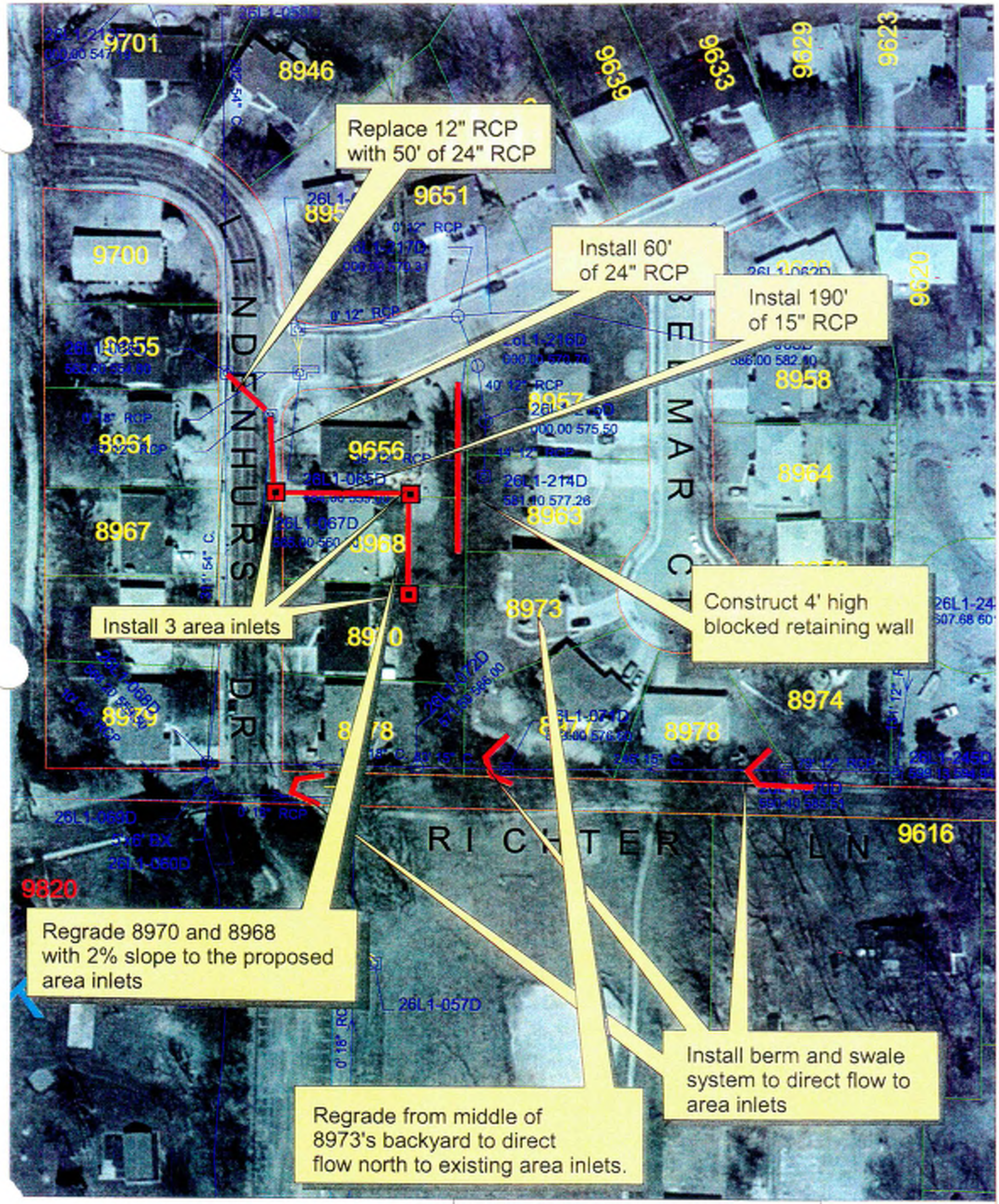
- **Component 1 - Drainage system.** Install a backyard drainage system that ties into the curb inlet, 26L1-007D, on Lindenhurst Drive. The proposed drainage system would include installing a backyard drainage system that includes three area inlets, 175 feet of 15-inch RCP to connect the area inlets, and approximately 60 feet of 24-inch RCP to connect the inlets to the existing system. The 12-inch pipeline downstream of the existing curb inlet would also need to be replaced with 50 feet of 24-inch pipeline.

- **Component 2 - Grading.** A series of existing area inlets, 26L1-070D and 26L1-071D, and one CMP end section, which is not labeled, are located south of 8978 Lindenhurst Drive and drain to junction box 26L1-068D. Provide grading around the inlets to more efficiently collect the runoff to eliminate excessive bypass.

- **Component 3 - Retaining wall.** The installation of two 100-foot lengths of 4-foot high, blocked retaining wall, stepped on the slope behind 8963 Belmar Court, would alleviate erosion problems. The key is to provide the proper foundation drainage for the retaining walls.

- **Component 4 -** Provide backyard drainage swales behind the residences of Belmar Court to divert the stormwater north and south to existing inlet structures.

The estimated probable project cost is approximately $150,000.



CDM

Project: MC-7	Figure: 8-52
8900 Block Lindenhurst Drive	

Table 8-75
Storm Sewer Priority Rating Sheet

Location: MC-7 8900 Block Lindenhurst Drive   Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: Residents between 8966 and 8978 Lindenhurst Drive have building flooding and erosion in their backyards. The resident at 8968 Lindenhurst has reported standing water in their backyard. The resident at 8963 Belmar Court has a poorly constructed retaining wall.

Recommended Action: Install a backyard drainage system with two area inlets that ties into the curb inlet 76L1-007D, on Lindenhurst Drive. Provide grading around area inlets to eliminate excessive bypass from runoff

Preliminary Estimated Cost: $150,000   By: KL   Date: 12/17/2001

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1	16				30		46
Item 1 Residential Structure	Item 2		12		10			22
Commercial Structure	Item 3		8					8
Street		16	20	0	10	30		
Public Structure							Subtotal	76
Owner:								
Drainage Structure		Multiplier: Number of Major Locations Affected			x		2	152
Type:								
Improved Channel								
Unimproved Channel		Multiplier: Frequency Rating (flooding only)			x		1	152
Item 2 Yard								
Other								
Describe:		Multiplier: Degree of Risk			x		2	304

304
Total Benefit Points

Comments:
Residents at 9656, 8968,8970 and 8978 will benefit from improvements; Residents at 8957 and 8963 will benefit from improvements.
The collapsing retaining wall poses risk to limb

Estimated Cost = $150,000
Divided by
Total Benefit Points = 304
Cost/Benefit Rating = **493**

Table 8-76
MC-7 8900 Block Lindenhurst Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-77
Preliminary Cost Estimate
8900 Block Lindenhurst Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price		Cost	
MC-7	**Improved Drainage System**						
	15" RCP	LF	190	$	115	$	21,850
	24" RCP	LF	60	$	115	$	6,900
	24" RCP (Thru Pavement)	LF	50	$	170	$	8,500
	4' High Concrete Walls (or Block)	CY	20	$	500	$	10,000
	Area Inlets	EA	3	$	1,850	$	5,550
	Grading at Existing Area Inlets	CY	30	$	14	$	420
	Grading in Backyards of Belmar Court	CY	90	$	10	$	900
	Grading in Backyards of Lindenhurst Drive	CY	40	$	10	$	400
	Revegetation for All Grading	SY	840	$	20	$	16,800
	Seeding for RCP	SY	120	$	1	$	120
	Construction Subtotal=					$	71,440
	Utility Relocation @ 20%	LS				$	14,288
	Mobilization @ 4%	LS				$	2,858

Construction with Percent Allowances Subtotal=	$	88,586
Contingency @ 30%	$	26,576
Probable Cost Estimate=	$	115,161
Design Engineering, Geotechnical, & Construction Management @ 30%	$	34,548
Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$**	**150,000**

Figure 8-53. 8900 Block Lindenhurst Drive (MC-7)

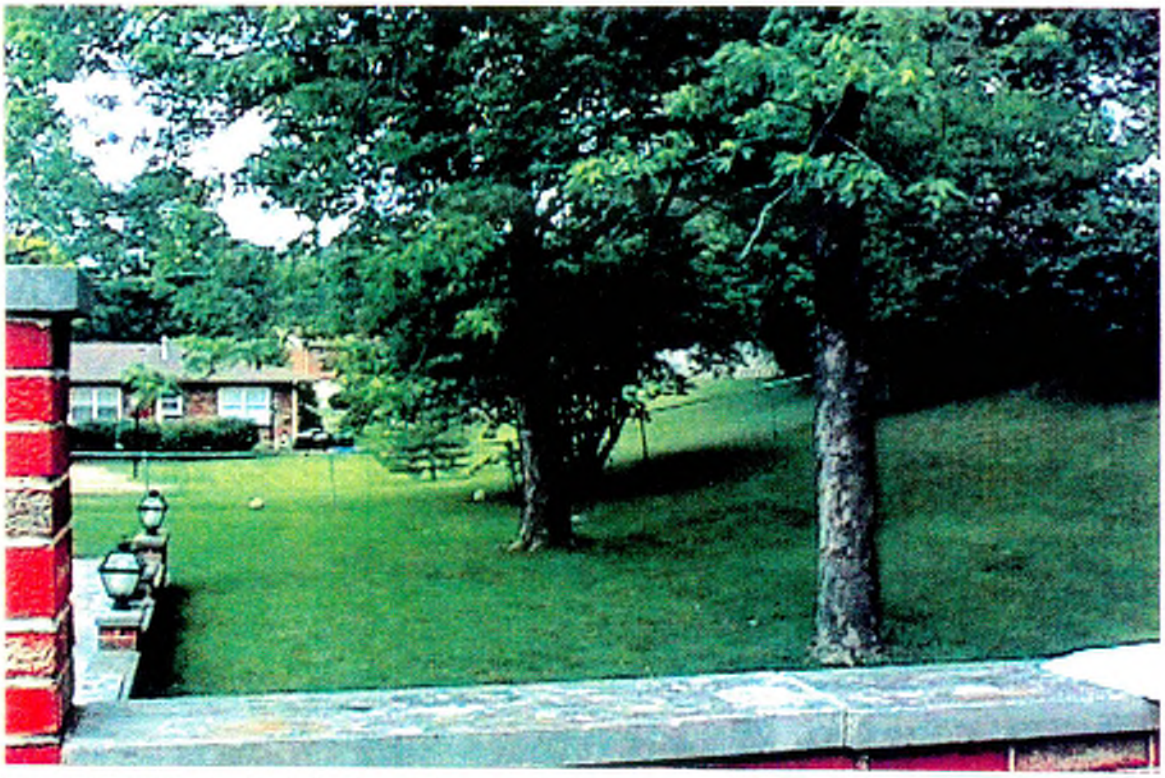
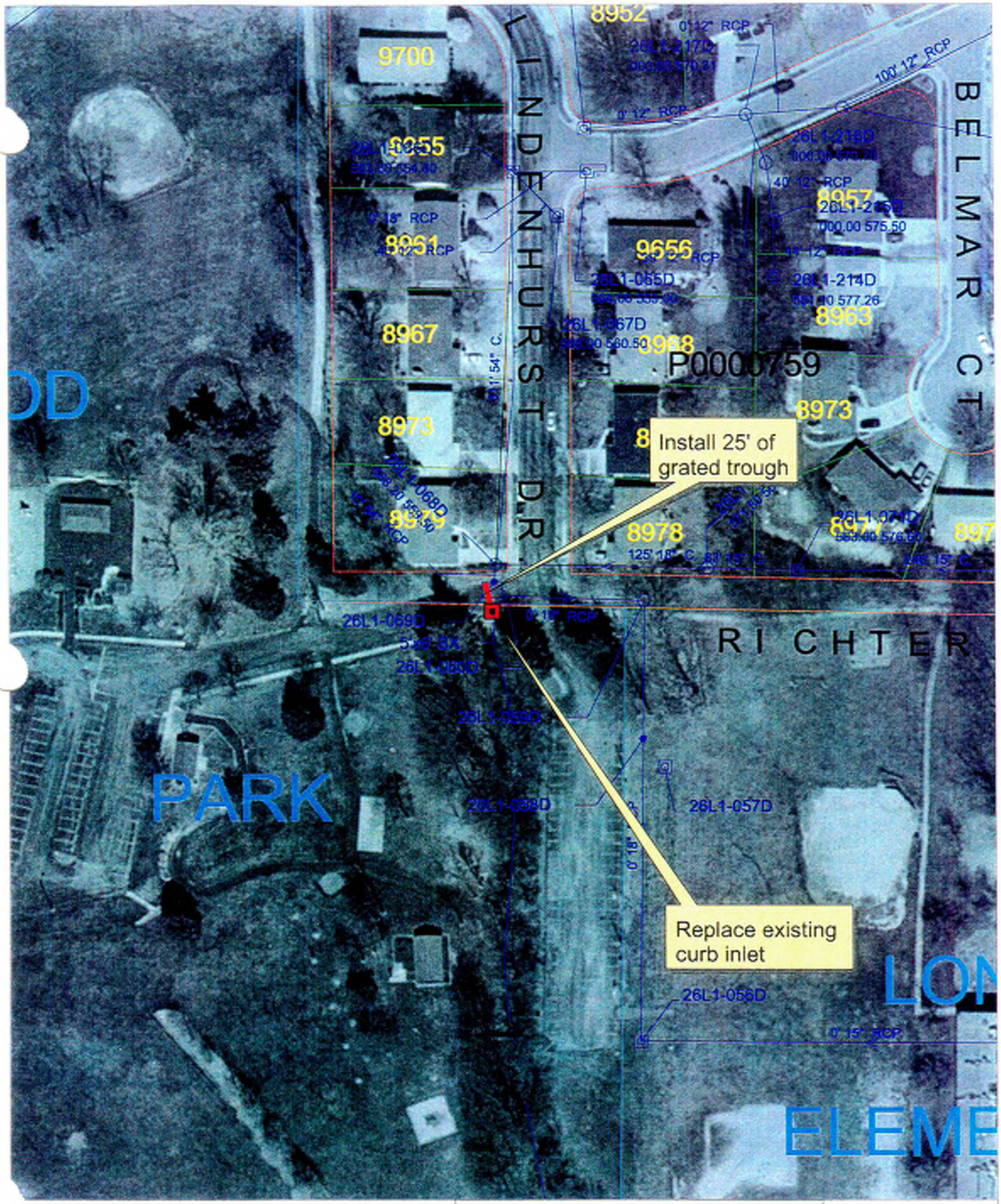


Figure 8-54. 8900 Block Lindenhurst Drive (MC-7)

8.3.8 Project MC-8 Crestwood Park Entrance

A 54-inch RCP extends beneath the east entrance to Crestwood Park. An existing curb inlet that drains to the culvert is in poor structural condition and is causing erosion at the entrance of the culvert. The recommended solution involves replacing the existing curb inlet and installing a grate system, or trench drain, that extends across the park entrance. The estimated probable project cost is approximately $12,000.



50 0 50 100 Feet

CDM

Project: MC-8

Crestwood Park Entrance

Figure: 8-55

Table 8-78
Storm Sewer Priority Rating Sheet

cation: MC-8 Crestwood Park Entrance   Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: An existing curb inlet that drains into a 54-inch RCP is in poor structural condition and is causing erosion at the entrance of the culvert.

Recommended Action: Replace the existing curb inlet and install a grate system, or trench drain, that extends across the park entrance.

Preliminary Estimated Cost: $12,000   By: KL   Date: 12/17/2001

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1			12		10		22
Item 2							0
Item 3							0
	0	0	12	0	10	Subtotal	22

Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Item 1 Drainage Structure
Type: Curb Inlet
Improved Channel
Unimproved Channel
Yard
Other
Describe:

Multiplier Number of Major Locations Affected	x	1	22
Multiplier Frequency Rating (flooding only)	x	1	22
Multiplier Degree of Risk	x	1	22

22
Total Benefit Points

Comments:
The city will benefit from this improvement.

Estimated Cost =	$12,000
Divided by	
Total Benefit Points =	22
Cost/Benefit Rating =	**545**

Table 8-79
MC-8 Crestwood Park Entrance

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-80
Preliminary Cost Estimate
Crestwood Park Entrance

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-8	**Park Entrance Drainage System Rehabilitation**				
	Curb Inlet	EA	1	$ 2,100	$ 2,100
	Seeding	SY	10	$ 1	$ 10
	Trench Drain	EA	1	$ 3,400	$ 3,400
	Construction Subtotal=				$ 5,510
	Utility Relocation @ 20%	LS			$ 1,102
	Mobilization @ 4%	LS			$ 220
	Construction with Percent Allowances Subtotal=				$ 6,832
	Contingency @ 30%				$ 2,050
	Probable Cost Estimate=				$ 8,882
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 2,665

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 12,000**

Figure 8-56. Crestwood Park Entrance (MC-8)

8.3.9 Project MC-9 8940 Craighurst Terrace

The parks department has reported that maintenance equipment is unable to easily access the west end of Crestwood Park due to the dense vegetation and limited access across the tributary channel. Two alternatives were evaluated:

- **Alternative 1 – Install enclosed system.** This alternative includes replacing the natural channel with 225 feet of enclosed, 30-inch RCP. This will increase the visibility and use of the west side of the park. The estimated probable project cost is approximately $56,000.

- **Alternative 2 – Channel maintenance.** This alternative includes removing the unnecessary debris and vegetation along the channel to provide a more aesthetically pleasing natural stream, and to provide stream restoration immediately downstream of the outlet pipe adjacent to property 8940 Craighurst Terrace, using 25 feet of biogabions on both sides of the channel. Also, to provide better access for maintenance equipment to cross the channel, a 20-foot section of 30-inch RCP should be installed to replace the existing creek access. The estimated probable project cost is $21,000.

The recommended solution is Alternative 2, channel maintenance, which is more cost-effective and will preserve the aesthetic appearance of the natural creek.

CDM

Project: MC-9

8940 Craighurst Terrace

Figure: 8-57

Table 8-81
Storm Sewer Priority Rating Sheet

cation: MC-9 8940 Craighurst Terrace   Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: The parks department has reported that maintenance equipment is unable to easily access the west end of Crestwood Park due to dense vegetation and limited access across the tributary channel.

Recommended Action: Remove unnecessary debris and vegetation along the channel to provide a more aesthetically pleasing natural system, and to provide stream restoration immediately downstream of the outlet pipe adjacent to property 8940 Craighurst Terrace

Preliminary Estimated Cost: $21,000   By: KL   Date: 12/17/2001

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1		8			10		18
Item 2			12				12
Item 3							0
	0	8	12	0	10	**Subtotal**	30

Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Item 2 Drainage Structure
Type: RCP
Improved Channel
Item 1 Unimproved Channel
Yard
Other
Describe:

Multiplier
Number of Major Locations Affected x 1 30

Multiplier Frequency Rating (flooding only) x 1 30

Multiplier Degree of Risk x 1 30

30
Total Benefit Points

Comments:
The city will benefit from this improvement.

Estimated Cost = $21,000
Divided by
Total Benefit Points = 30
Cost/Benefit Rating = **700**

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Table 8-82
MC-9 8940 Craighurst Terrace

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-83
Preliminary Cost Estimate
8940 Craighurst Terrace

Site ID #	*Item Description*	*Unit*	*Estimated Quantity*	*Unit Price*	*Cost*
MC-9a	**Install Enclosed System**				
	30" RCP	LF	225	$ 115	$ 25,875
	Excavation - Grading adjacent to old channel	CY	40	$ 11	$ 440
	Seeding	SY	130	$ 1	$ 130
	Construction Subtotal=				$ 26,445
	Utility Relocation @ 20%	LS			$ 5,289
	Mobilization @ 4%	LS			$ 1,058
	Construction with Percent Allowances Subtotal=				**$ 32,792**
	Contingency @ 30%				$ 9,838
	Probable Cost Estimate=				**$ 42,629**
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 12,789

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 56,000**

Table 8-84
Preliminary Cost Estimate
8940 Craighurst Terrace

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-9b	**Channel Maintenance of Tributary from 8940 Craighurst Terrace**				
	30" RCP	LF	20	$ 115	$ 2,300
	Biogabions	FSF	150	$ 28	$ 4,200
	Major Channel Maintenance	LF	225	$ 14	$ 3,150
	Seeding for RCP	SY	100	$ 1	$ 100
	Construction Subtotal=				$ 9,750
	Utility Relocation @ 20%	LS			$ 1,950
	Mobilization @ 4%	LS			$ 390
	Construction with Percent Allowances Subtotal=				$ 12,090
	Contingency @ 30%				$ 3,627
	Probable Cost Estimate=				$ 15,717
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 4,715
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 21,000**

Figure 8-58. 8940 Craighurst Terrace (MC-9)

8.3.10 Project MC-10 9000 Block Maple Grove/Sky Crest

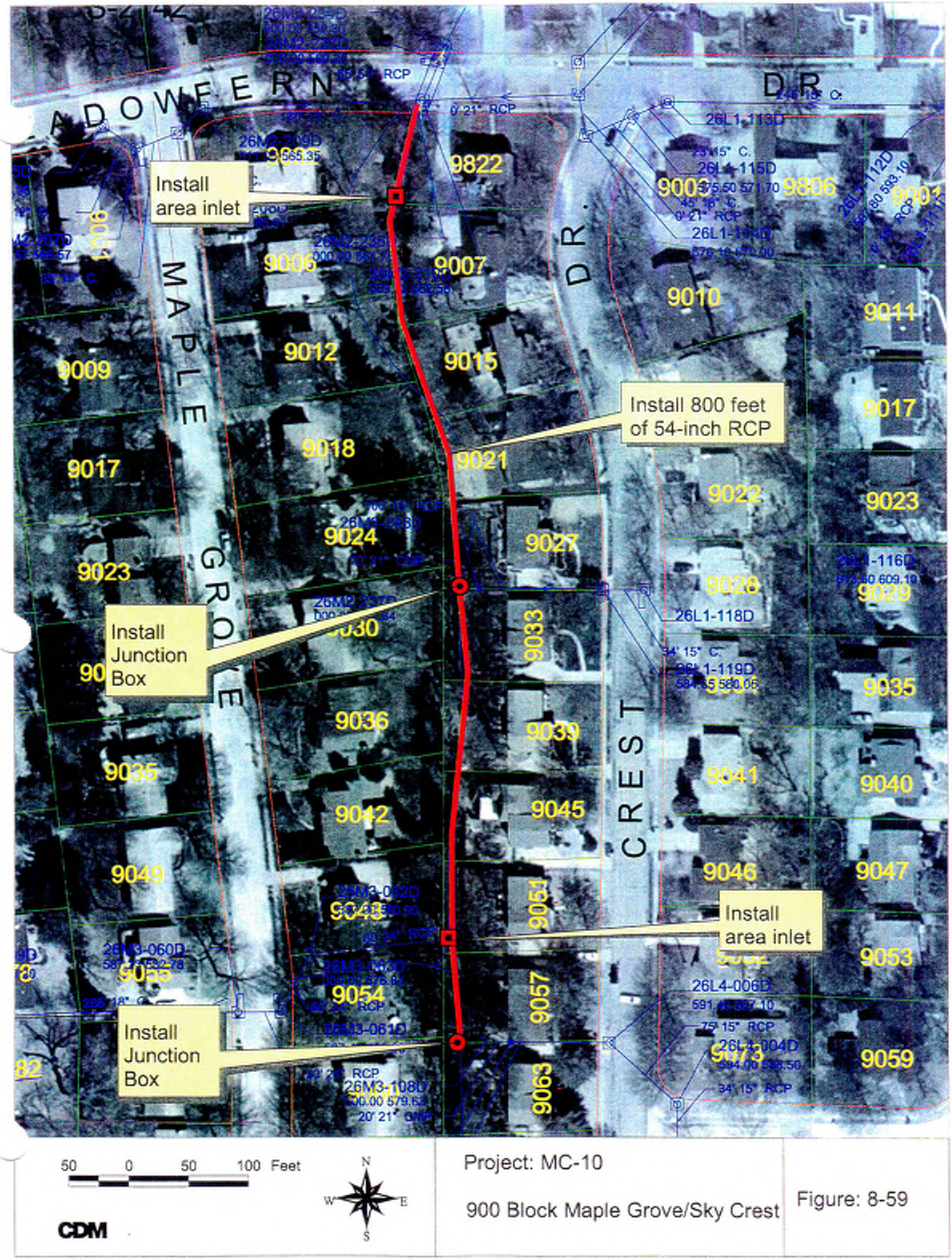
The natural channel between Sky Crest Drive and Maple Grove Drive, for the block lying upstream of Meadowfern Drive, is eroding. This channel alignment is not naturally occurring, and the existing slope of 2.6-percent is high enough to cause erosive velocities of 15 to 20 fps. Erosion and down cutting are evident throughout the reach. Three alternative solutions were evaluated:

- **Alternative 1 - Enclosed pipeline system.** This alternative includes installing approximately 800 feet of 54-inch RCP, with two junction boxes, and two area inlets. The junction boxes would join the existing 21-inch CMPs located near 9057 and 9027 Sky Crest to the proposed 54-inch RCP. An area inlet would be connected to the 24-inch RCP located near 9048 Maple Grove and collect local runoff, while a second proposed area inlet would join the end of the 54-inch RCP to the existing 54-inch RCP under Meadowfern Drive to collect local runoff. The estimated probable project cost is approximately $443,000.

- **Alternative 2 - Concrete open channel.** This alternative includes installing approximately 1,130 feet of concrete trapezoidal channel with a 54-inch bottom width and 3:1 side slopes. The width of the channel bottom would match the size of the existing 54-inch diameter pipe at Meadowfern Drive. The velocity of the stormwater would be approximately 18 fps for the 15-year design storm, which could pose a possible safety concern. The estimated probable project cost is $818,000.

- **Alternative 3 - Streambank Bio-stabilization.** This alternative includes installing approximately 1,200 feet of bioengineered channel with the same dimensions of the concrete channel. A soil filled Turf Reinforced Matrix (TRM) with sod should be installed to stabilize the channel. The velocities of the stormwater for the bio-technical channel would be approximately 9 fps under the 15year design storm. The channel would have a depth of approximately 3 feet, and top width of 22 feet to meet the design criteria. The residents have existing retaining walls, trees, and pools that could be incorporated into the design. The estimated probable project cost is approximately $155,000.

The recommended solution is Alternative 1, enclosed pipeline, due to limited space along the backyards. The biotechnical solution would require a significant amount of disturbance to create a natural, stable channel.



Project: MC-10

900 Block Maple Grove/Sky Crest

Figure: 8-59

Table 8-85
Storm Sewer Priority Rating Sheet

cation: MC-10 9000 Block Maple Grove/Sky Crest Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: The natural channel between Sky Crest Drive and Maple Grove Drive, for the block lying upstream of Meadowfern Drive, is eroding.

Recommended Action: Install approximately 880 feet of 54-inch RCP, with two junction boxes, and two area inlets.

Preliminary Estimated Cost: $443,000 By: KL Date: 12/17/2001

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1		8			50		58
Residential Structure	Item 2							0
Commercial Structure	Item 3							0
Street		0	8	0	0	50	Subtotal	58
Public Structure								

Owner:

Drainage Structure

Type:

Improved Channel

Item 1 Unimproved Channel

Yard

Other

Describe:

Multiplier Number of Major Locations Affected	x	2	116
Multiplier Frequency Rating (flooding only)	x	1	116
Multiplier Degree of Risk	x	1	116

116
Total Benefit Points

Comments:
Residents at 9057, 9051, 9045, 9039, 9033, 9027, 9021, 9015, 9007 Sky Crest Drive and 9006, 9012, 9018, 9024, 9030, 9036, 9042, 9048, 9054, 9060 Maple Grove will benefit from improvements. Residents at 9822 and 9832 Meadowfern Drive will benefit from improvements.

Estimated Cost = $443,000
Divided by
Total Benefit Points = 116
Cost/Benefit Rating = **3,819**

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Table 8-86
MC-10 900 Block Maple Grove/Sky Crest

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	**8**	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	**50**				
11-20	40				
5-10	30	>1/yr	**1.0**	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	**1.0**

Table 8-87
Preliminary Cost Estimate
9000 Block Maple Grove/Sky Crest

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-10a	Enclosed Pipeline System				
	54" RCP	LF	800	$ 250	$ 200,000
	Area Inlets	EA	2	$ 1,850	$ 3,700
	Excavation - Grading adjacent to channel	CY	150	$ 11	$ 1,650
	Junction Box	EA	2	$ 2,600	$ 5,200
	Seeding	SY	440	$ 1	$ 440
	Construction Subtotal=				$ 210,990
	Utility Relocation @ 20%	LS			$ 42,198
	Mobilization @ 4%	LS			$ 8,440
	Construction with Percent Allowances Subtotal=				$ 261,628
	Contingency @ 30%				$ 78,488
	Probable Cost Estimate=				$ 340,116
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 102,035
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 443,000**

Table 6-88
Preliminary Cost Estimate
9000 Block Maple Grove/Sky Crest

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-10b	**Concrete Open Channel**				
	Concrete Open Channel	SY	3390	$ 100	$ 339,000
	Excavation	CY	4530	$ 11	$ 49,830
	Seeding	SY	1260	$ 1	$ 1,260
	Construction Subtotal=				$ 390,090
	Utility Relocation @ 20%	LS			$ 78,018
	Mobilization @ 4%	LS			$ 15,604
	Construction with Percent Allowances Subtotal=				$ 483,712
	Contingency @ 30%				$ 145,113
	Probable Cost Estimate=				$ 628,825
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 188,648

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 818,000**

Table 8-89
Preliminary Cost Estimate
9000 Block Maple Grove/Sky Crest

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-10c	Bio-Technical Channel				
	Excavation - Channel grading	CY	1600	$ 12	$ 19,200
	Reforestation	ACRE	1.25	$ 2,500	$ 3,125
	Seeding	SY	1730	$ 1	$ 1,730
	Soil Filled TRM with sod	SY	4130	$ 12	$ 49,560
	Construction Subtotal=				$ 73,615
	Utility Relocation @ 20%	LS			$ 14,723
	Mobilization @ 4%	LS			$ 2,945
	Construction with Percent Allowances Subtotal=				$ 91,283
	Contingency @ 30%				$ 27,385
	Probable Cost Estimate=				$ 118,667

Design Engineering, Geotechnical, & Construction Management @ 30% $ 35,600

Total Conceptual Cost Estimate= **$ 155,000**
(Rounded up to the nearest $1000)

Figure 8-60. 900 Block Maple Grove/Sky Crest (MC-10)

Figure 8-61. 900 Block Maple Grove/Sky Crest (MC-10)

8.3.11 Project MC-11 Lowill Lane to Crest Oak Lane

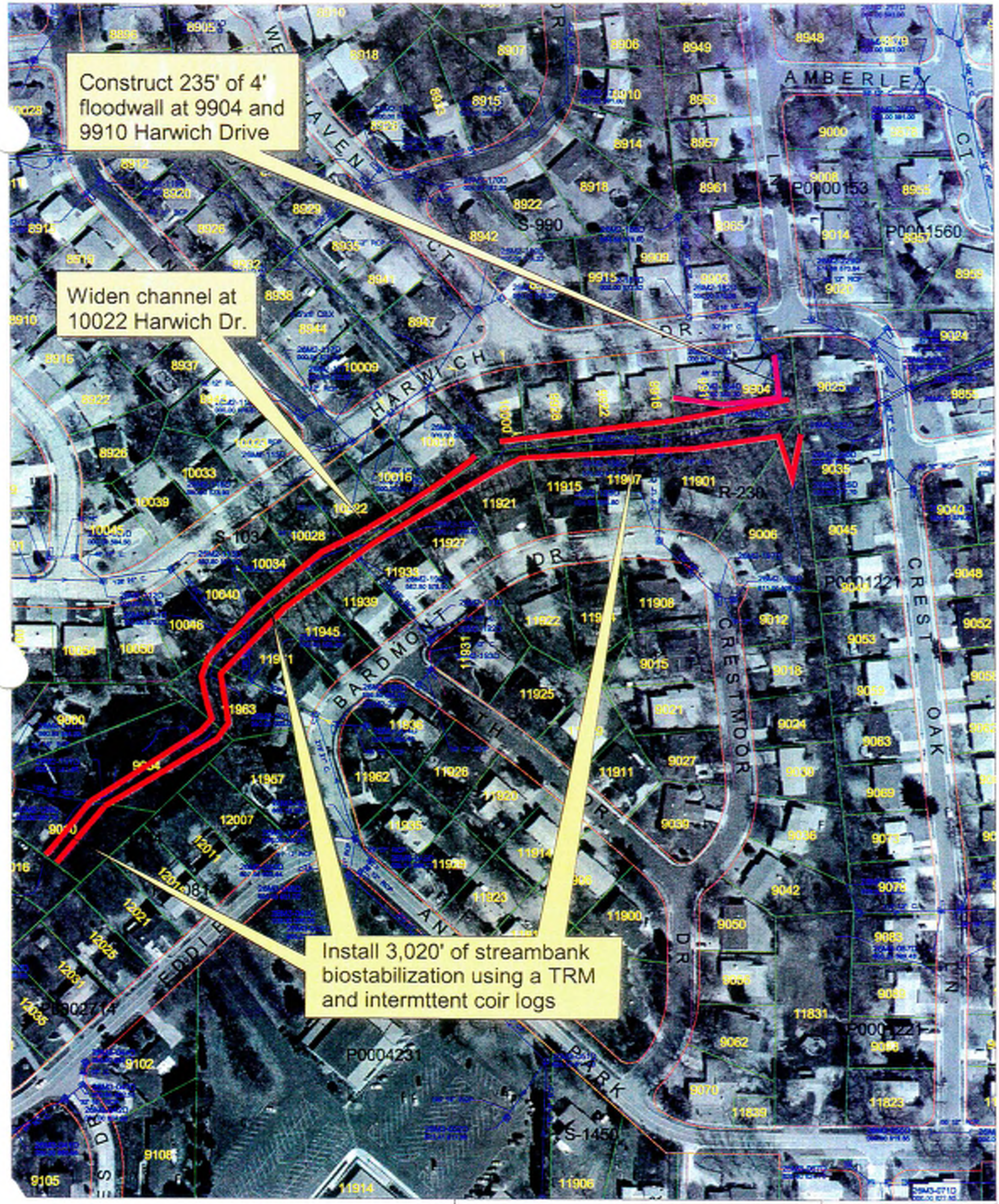
Residents have reported stream bank erosion in the backyards of homes behind 9010 Lowill Lane and along a reach between 9004 Lowill Lane and 9904 Harwich Drive for both sides of Mulberry Creek. In addition, residents at 9904 and 9910 Harwich Drive and 10028 Harwich Drive are having flooding problems. The stream is characterized by bank erosion and apparent channel down cutting. The entire reach has been encroached upon by residential development. The channel requires a larger cross-section and longer flow path in order to be naturally stable. When space is available, this reach of channel can be made stable with basic cross-section and alignment alterations. If alterations are not made, stream transition will continue until they are achieved naturally.

The first component of the recommended solution involves flood proofing the residences at 9904 and 9910 Harwich Drive with a 4-foot high floodwall to alleviate the flooding caused by an undersized 10x10-foot RCB (26M2-232D). In addition to flood proofing, there are two alternatives for correcting the channel related problems. The cost of flood proofing was calculated in the cost estimate of each alternative.

- **Alternative 1 - Bio-technical bank stabilization.** Install 2,620 feet of bioengineered bank stabilization along both banks of Mulberry Creek. In order to implement any solution, the vegetation along the reach would have to be removed (i.e., cleared and grubbed) attempting to retain any large established trees. The existing channel banks would be graded and sloped back. The channel alignment should include additional meandering with areas of deep pools and riffles as is currently present. Banks would be stabilized with TRMs. In addition, the channel 100 feet downstream of 10028 Harwich Drive could be widened in accordance with the bioengineering recommendations to eliminate flood problems at 10028 Harwich Drive. Trees should be planted to enhance the riparian corridor. The estimated probable project cost is approximately $229,000.

- **Alternative 2 - Concrete Trapezoidal Channel.** Install 2,620 feet of 3:1 sloped concrete trapezoidal channel along Mulberry Creek. The channel should be constructed with a center height of 5.5 feet above the channel bottom and a width of 8 feet. The estimated probable project cost is approximately $2,161,000.

The recommended solution involves flood proofing at 9904 and 9910 Harwich Drive, and Alternative 1. The biostabilization improvements will provide an aesthetically pleasing channel and lower erosive velocities.



Project: MC-11

Lowill Lane to Crest Oak Lane

Figure: 8-62

Table 8-90
Storm Sewer Priority Rating Sheet

ocation: MC-11 Lowill Lane to Crest Oak Lane   Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: Residents have reported stream bank erosion in the backyards at 9010 Lowill Lane and along a reach between 9004 Lowill Lane and 9904 Harwich Drive for both sides of Mulberry Creek. Residents at 9904 and 9910 Harwich Drive and 10028 Harwich Drive are having flooding problems.

Recommended Action: Flood proofing should be implemented at 9904 and 9910 Harwich Drive. A total of 2,620 feet of bioengineered bank stabilization along both banks of Mulberry Creek.

Preliminary Estimated Cost: $229,000   By: KL   Date: 12/17/2001

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1	16				50		66
Item 1 Residential Structure	Item 2		12					12
Commercial Structure	Item 3							0
Street		16	12	0	0	50	Subtotal	78
Public Structure								

Residential Structure: Item 1
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel: Item 2
Yard
Other
Describe:

Multiplier				
Multiplier	Number of Major Locations Affected	x	1	78
Multiplier	Frequency Rating (flooding only)	x	1	78
Multiplier	Degree of Risk	x	2	156

156
Total Benefit Points

Comments:
Residents from 9904 to 10046 Harwich Drive will benefit from improvements. (13) Residents from 9000 will benefit from the improvements.
Residents from 11901 to 11957 Bardmont Drive will benefit from improvements. (11)

Estimated Cost =	$229,000
Divided by	
Total Benefit Points =	156
Cost/Benefit Rating =	**1,468**

Table 8-91
MC-11 Lowill Lane to Crest Oak Lane

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-92
Preliminary Cost Estimate
Lowill Lane to Crest Oak Lane

...e ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-11a	**Bio-technical bank stabilization**				
	Excavation - Channel widening	CY	530	$ 12	$ 6,360
	Excavation - Grading	CY	100	$ 12	$ 1,200
	Floodwall - 4 ft high	CY	30	$ 500	$ 15,000
	Material to be hauled off site - Channel widening	CY	530	$ 10	$ 5,300
	Reforestation	ACRE	2.5	$ 2,500	$ 6,250
	Seeding	SY	1810	$ 1	$ 1,810
	TRM	SY	3940	$ 7	$ 27,580
	Coir Logs	LF	3020	$ 15	$ 45,300
	Construction Subtotal=				$ 108,800
	Utility Relocation @ 20%	LS			$ 21,760
	Mobilization @ 4%	LS			$ 4,352
	Construction with Percent Allowances Subtotal=				**$ 134,912**

Contingency @ 30%	$	40,474
Probable Cost Estimate=	$	175,386
Design Engineering, Geotechnical, & Construction Management @ 30%	$	52,616
Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$**	**229,000**

Figure 8-63. Lowill Lane to Crest Oak Lane (MC-11)

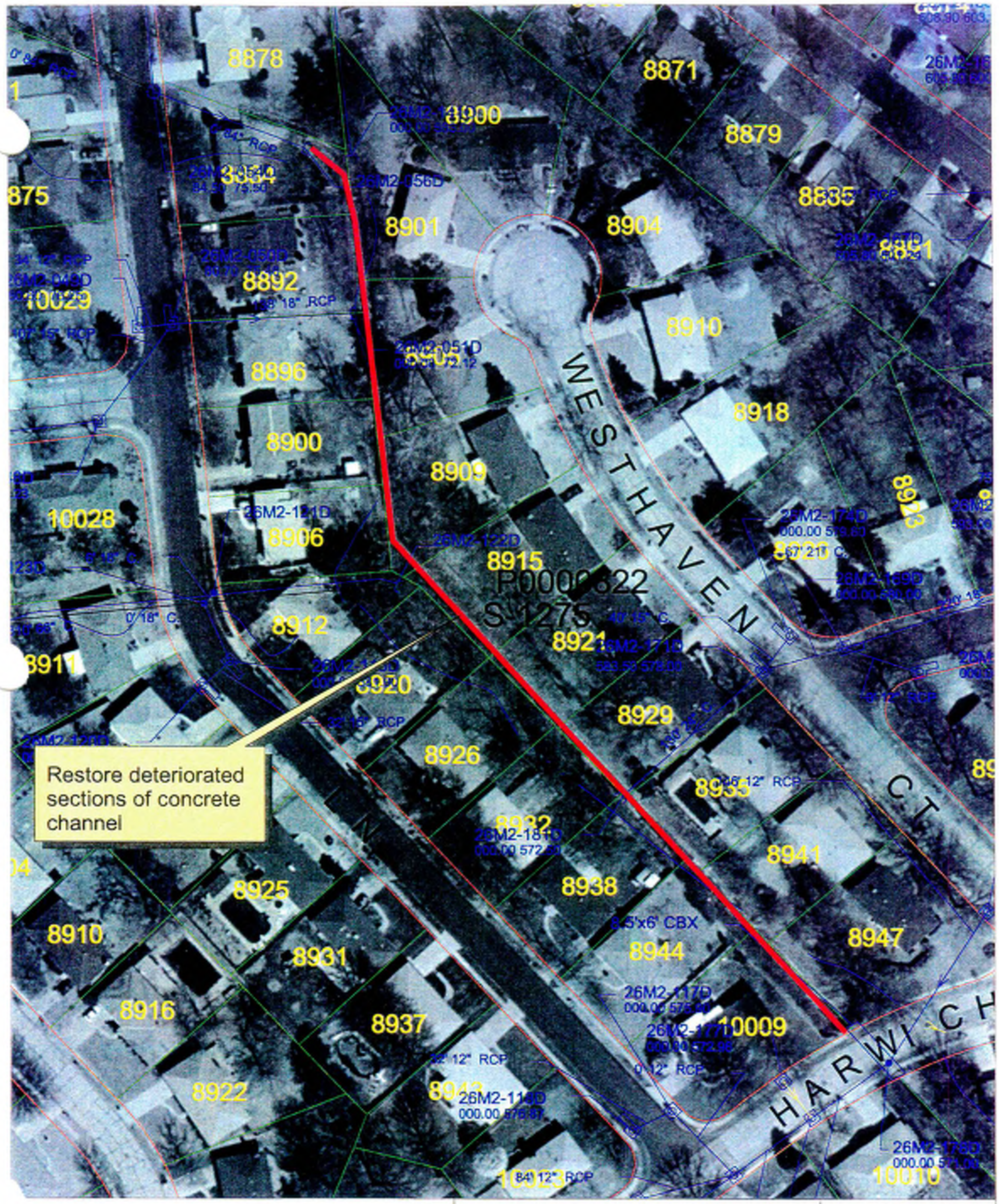
Figure 8-64. Lowill Lane to Crest Oak Lane (MC-11)

8.3.12 Project MC-12 8900 Block Rudson Lane

The existing concrete channel is deteriorating behind residences 8895 through 8944 Rudson Lane. The 15-year event causes severe velocities over 20 fps based on the existing configuration of the channel, which includes an 8-foot bottom width, 3:1 side slopes, and 1.9-percent channel slope. Two alternative solution were evaluated:

- **Alternative 1 – Channel restoration.** This alternative involves restoring 855 feet of concrete channel at four major joints between various sections and at the mouth of the channel behind 8878 Rudson Lane. The restoration measures include concrete patchwork and foundation restoration. The estimated probable project cost is approximately $13,000.
- **Alternative 2 – Channel replacement.** This alternative involves replacing the concrete channel, with a new 855-foot concrete trapezoidal channel with an 8-foot bottom width, 3:1 side slopes, and 1.9 percent channel slope. In addition, a protective safety railing should be installed on both sides of the channel. The estimated probable project cost is approximately $841,000.

The recommended solution is Alternative 1.



50 0 50 100 Feet

CDM

Project: MC-12

8900 Block Rudson Lane

Figure: 8-65

Table 8-94
Storm Sewer Priority Rating Sheet

cation: MC-12 8900 Block Rudson Lane | Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: Existing concrete channel is deteriorating behind residences 8895 through 8944 Rudson Lane. Whitehaven court. Improvements will benefit resident at 10009 Harwich Drive.

Recommended Action: Replace the concrete channel with a new 855-foot concrete trapezoidal channel.

Preliminary Estimated Cost: $13,000 | By: KL | Date: 12/17/2001

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1			10		30		40
Residential Structure	Item 2							0
Commercial Structure	Item 3							0
Street		0	0	10	0	30		
Public Structure							Subtotal	40

Owner:

Drainage Structure

Type:

Item 1 Improved Channel

Unimproved Channel

Yard

Other

Describe:

Multiplier Number of Major Locations Affected	x	1	40
Multiplier Frequency Rating (flooding only)	x	1	40
Multiplier Degree of Risk	x	1	40

40
Total Benefit Points

Comments:
Improvements will benefit residents from 8944 to 8884 Rudson Lane (11). Improvements will benefit residents from 8947 to 8901 Westhaven court. (9) Improvements will benefit resident at 10009 Harwich Drive.

Estimated Cost =	$13,000
Divided by	
Total Benefit Points =	40
Cost/Benefit Rating =	**325**

Table 8-95
MC-12 8900 Block Rudson Lane

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	**10**	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	**30**	>1/yr	**1.0**	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	**1.0**

Table 8-96
Preliminary Cost Estimate
8900 Block Rudson Lane

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price		Cost	
MC-12a	**Channel Restoration**						
	Repair Concrete Open Channel	SY	60	$	100	$	6,000
	Seeding	SY	10	$	1	$	10
	Construction Subtotal=					$	6,000
	Utility Relocation @ 20%	LS				$	1,200
	Mobilization @ 4%	LS				$	240
	Construction with Percent Allowances Subtotal=					$	7,440
	Contingency @ 30%					$	2,232
	Probable Cost Estimate=					$	9,672
	Design Engineering, Geotechnical, & Construction Management @ 30%					$	2,902

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$**	**13,000**

Table 8-97
Preliminary Cost Estimate
8900 Block Rudson Lane

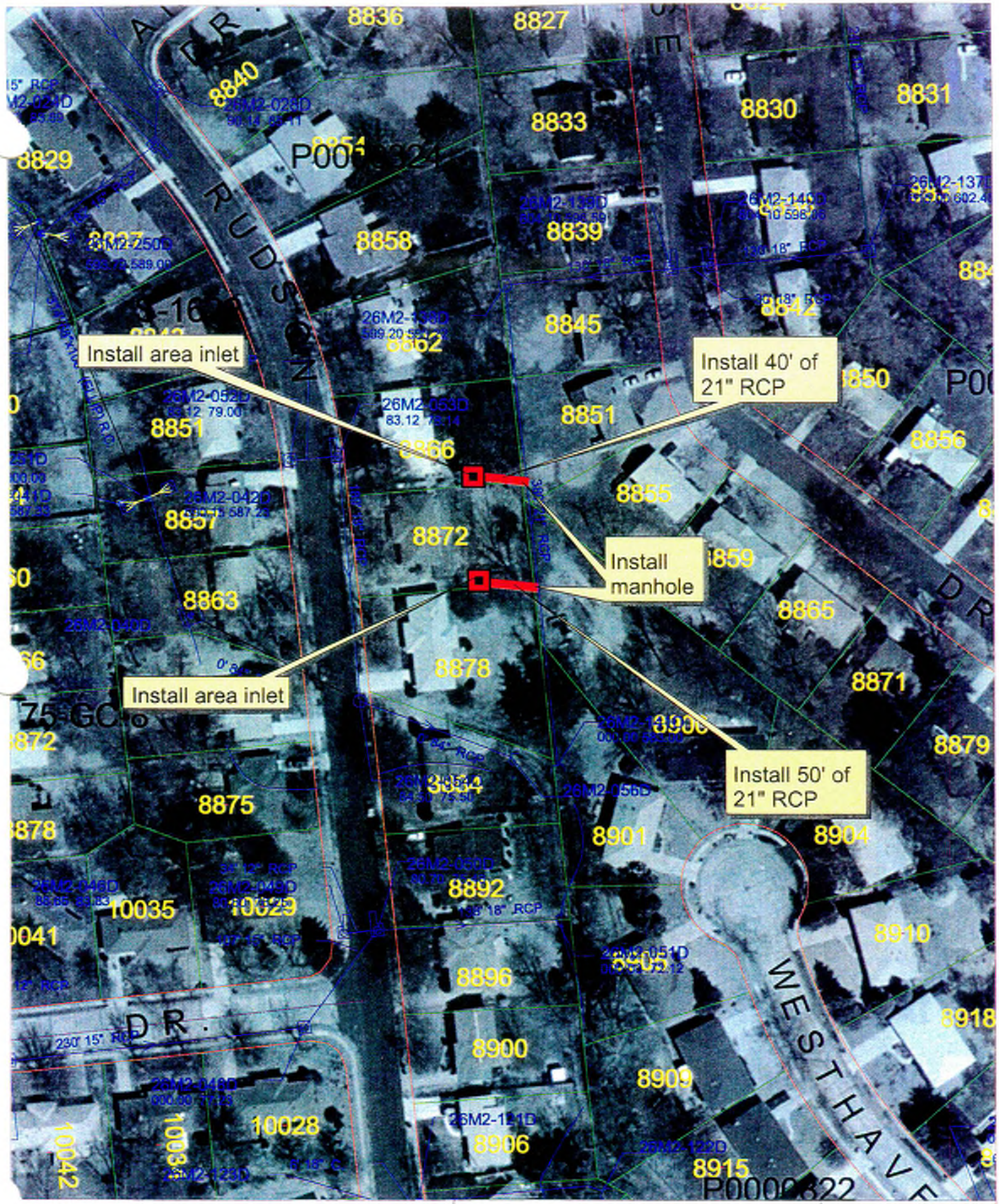
Site ID #	Item Description	Unit	Estimated Quantity	Unit Price		Cost	
MC-12b	**Channel Replacement**						
	Concrete Open Channel	SY	3330	$	100	$	333,000
	Excavation of Existing Channel	CY	1110	$	12	$	13,320
	Hand Rail (Limited Access)	LF	1710	$	25	$	42,750
	Offsite Removal of Existing Channel	CY	1110	$	10	$	11,100
	Seeding	SY	950	$	1	$	950
	Construction Subtotal=					$	401,120
	Utility Relocation @ 20%	LS				$	80,224
	Mobilization @ 4%	LS				$	16,045
	Construction with Percent Allowances Subtotal=					$	497,389
	Contingency @ 30%					$	149,217
	Probable Cost Estimate=					$	646,605
	Design Engineering, Geotechnical, & Construction Management @ 30%					$	193,982
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)					**$**	**841,000**

Figure 8-66. 8900 Rudson Lane (MC-12)

8.3.13 Project MC-13 8854-8866 Rudson Lane

A localized drainage problem exists in the backyards of residents located between 8854 and 8866 Rudson Lane. Ponding, typically 6 inches deep, occurs in the rear yards of 8862 and 8860 Rudson Lane due to poor grading.

The recommended solution involves installing a series of two four-sided area inlets behind 8866 and 8872 Rudson Lane. Each of these area inlets should be connected to the existing 21-inch diameter RCP that extends from junction box 26M2-138D to outfall 26M2-141D. The backyards should also be regarded to provide positive drainage to the area inlets. The estimated probable project cost is approximately $41,000.



50 0 50 100 Feet

N
W E
S

CDM

Project: MC-13

8854-8866 Rudson Lane

Figure: 8-67

Table 8-98
Storm Sewer Priority Rating Sheet

ocation: MC-13 8854-8866 Rudson Lane   Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: A localized drainage problem exists in the backyards of residents located between 8854 and 8868 Rudson Lane. Ponding occurs in the rear yards of 8862 an 8860 Rudson Lane due to poor grading.

Recommended Action: Install a series of two four-sided area inlets behind 8866 and 8872 Rudson Lane.

Preliminary Estimated Cost: $41,000   By: KL   Date: 12/17/2001

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1				6	20		26
Residential Structure	Item 2							0
Commercial Structure	Item 3							0
Street		0	0	0	6	20		
Public Structure							Subtotal	26

Owner:

Drainage Structure

Type:

Improved Channel

Unimproved Channel

Item 1 Yard

Other

Describe:

Multiplier Number of Major Locations Affected	x	1	26
Multiplier Frequency Rating (flooding only)	x	1	26
Multiplier Degree of Risk	x	1	26

26
Total Benefit Points

Comments:
Improvements will benefit residents at 8854,8866,8862 and 8860 Rudson Lane.

Estimated Cost = $41,000
Divided by
Total Benefit Points = 26
Cost/Benefit Rating = **1,577**

Table 8-99
MC-13 8854-8866 Rudson Lane

Evaluation Category	Problem Type	Benefit Points: Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-100
Preliminary Cost Estimate
8854-8866 Rudson Lane

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price		Cost	
MC-13	**Enhance Existing Drainage System**						
	21" RCP	LF	90	$	115	$	10,350
	Area Inlets	EA	2	$	1,850	$	3,700
	Manholes	EA	2	$	2,600	$	5,200
	Seeding	SY	50	$	1	$	50
	Construction Subtotal=					$	19,300
	Utility Relocation @ 20%	LS				$	3,860
	Mobilization @ 4%	LS				$	772
	Construction with Percent Allowances Subtotal=					$	**23,932**
	Contingency @ 30%					$	7,180
	Probable Cost Estimate=					$	31,112

Design Engineering, Geotechnical, & Construction Management @ 30% $ 9,333

Total Conceptual Cost Estimate= **$ 41,000**
(Rounded up to the nearest $1000)

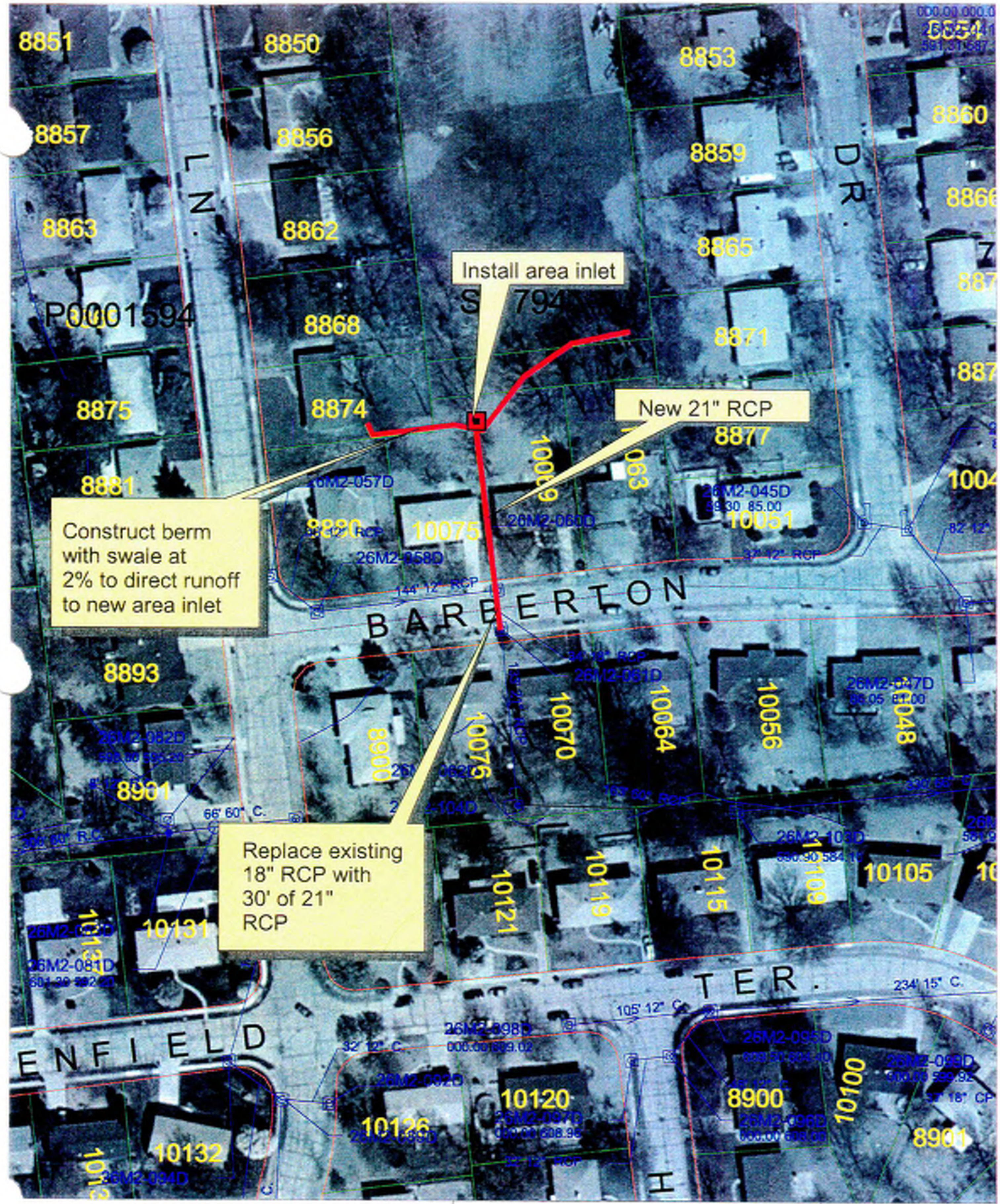
Figure 8-68. 8854 - 8866 Rudson Lane (MC-13)

Figure 8-69. 8854 - 8866 Rudson Lane (MC-13)

8.3.14 Project MC-14 10069-10075 Barberton Drive

Excessive stormwater runoff from the field behind 10069 Barberton, drains into the resident's backyard. The resident has complained that water comes from the church to the north and three adjacent residents on Manda Lane. The Manda Lane homes have connected downspouts that drain onto residence 10069 Barberton.

The recommended solution involves two components. The first component involves installing a berm and associated collection swale to capture the runoff from the church lot. The second component is an area inlet that must be constructed at the back corner of the property between 10075 and 10069 Barberton to collect the runoff from the new swale. The area inlet would drain into a new 21-inch RCP that would be connected 135 feet to curb inlet 26M2-061D, located on Barberton. Also, the existing 18-inch RCP beneath Barberton Drive will need to be replaced with 30 feet of 21-inch RCP. The estimated probable project cost is approximately $50,000.



50 0 50 100 Feet

CDM

Project: MC-14

10069-10075 Barberton Drive

Figure: 8-70

Table 8-101
Storm Sewer Priority Rating Sheet

cation: MC-14 100-69-10075 Barberton Drive Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: Excessive stormwater runoff from the field behind 10069 Barberton, drains into the resident's backyard.

Recommended Action: Install a berm and associated collection swale to capture the runoff from the church lot Install an area inlet in the back corner of the p property between 100075 nad 10069 Barberton

Preliminary Estimated Cost: $50,000 By: KL Date: 12/17/2001

Stormwater Problem		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1	16				20		36
Item 1 Residential Structure	Item 2							0
Commercial Structure	Item 3							0
Street		16	0	0	0	20		
Public Structure							Subtotal	36
Owner:								
Drainage Structure		**Multiplier** Number of Major Locations Affected			x		1	36
Type:								
Improved Channel								
Unimproved Channel		**Multiplier** Frequency Rating (flooding only)			x		0.8	28.8
Yard								
Other								
Describe:		**Multiplier** Degree of Risk			x		2	57.6

57.6
Total Benefit Points

Comments:
Improvements will benefit residents at 100075 and 100069 Barberton Rd.

Estimated Cost =	$50,000
Divided by	
Total Benefit Points =	58
Cost/Benefit Rating =	**868**

Table 8-102
MC-14 10069-10075 Barberton Drive

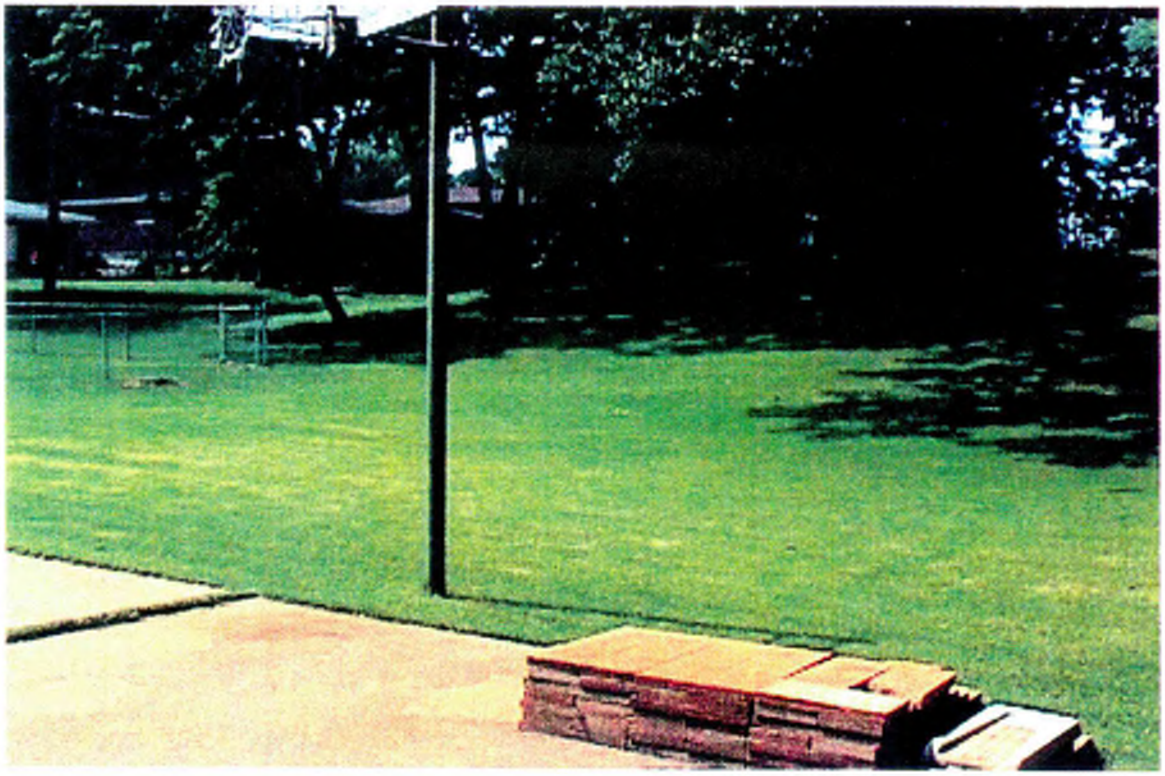
Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-103
Preliminary Cost Estimate
10069-10075 Barberton Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-14	**Enhance Existing Drainage System**				
	21" RCP	LF	135	$ 115	$ 15,525
	21" RCP (Under Pavement)	LF	30	$ 170	$ 5,100
	Area Inlet	EA	1	$ 1,850	$ 1,850
	Berm (Site Grading for Runoff Divertion, 12" High Berm)	CY	70	$ 12	$ 840
	Seeding	SY	480	$ 1	$ 480
	Construction Subtotal=				$ 23,795
	Utility Relocation @ 20%	LS			$ 4,759
	Mobilization @ 4%	LS			$ 952
	Construction with Percent Allowances Subtotal=				**$ 29,506**
	Contingency @ 30%				$ 8,852
	Probable Cost Estimate=				**$ 38,358**
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 11,507
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 50,000**

Figure 8-71. 10069 - 10075 Barberton Drive (MC-14)



8.3.15 Project MC-15 8901 Manda Lane

Flooding is affecting the basement garage at 8901 Manda Lane. Local drainage collects at area inlet 26M2-082D, which drains into the main system through a 12-inch RCP. Surcharge from the area inlet cannot be released downstream due to the lack of an overflow swale to Manda Lane. The capacity of the area inlet's 12-inch outlet pipe, which ties into the 60-inch main system, is significantly undersized for the 15-year event, according to MSD design standards. Also, poor grading in the vicinity of the area inlet is contributing to the problem.

The recommended solution is to replace the existing 12-inch RCP that connects main system, with 10 feet of 24-inch RCP. Also, 2-foot floodwall constructed across the corner of the driveway should be installed to provide a sump around the inlet. In addition, the backyards of residences along Manda Lane may need to be re-graded to efficiently drain the runoff to the area inlet. The estimated probable project cost is approximately $6,000.

50 0 50 100 Feet

CDM

Project: MC-15

8901 Manda Lane

Figure: 8-72

Table 8-104
Storm Sewer Priority Rating Sheet

xation: MC-15 8901 Manda Lane   Inspection Date: 12/17/2001

Tributary: Mulberry Creek

Problem Description: Flooding is affecting the basement garage at 8901 Manda Lane.

Recommended Action: Replace the existing 12-inch RCP that connects to the main system, with 10 feet of 24-inch RCP. A 2-foot floodwall should be installed across the corner of the driveway to provide a sump around the inlet.

Preliminary Estimated Cost: $6,000   By: KL   Date: 12/17/2001

Stormwater Problem

Item 1 Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Yard
Other
Describe:

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1	30				10		40
Item 2							0
Item 3							0
	30	0	0	0	10	Subtotal	40

Multiplier Number of Major Locations Affected	x	1	40
Multiplier Frequency Rating (flooding only)	x	0.6	24
Multiplier Degree of Risk	x	2	48

48
Total Benefit Points

Comments:
Residents at 8901 Manda Lane will benefit from this improvement project.

Estimated Cost =	$6,000
Divided by	
Total Benefit Points =	48
Cost/Benefit Rating =	**125**

Table 8-105
MC-15 8901 Manda Lane

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-106
Preliminary Cost Estimate
8901 Manda Lane

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-15	**Correct Local Drainage Catchment**				
	24" RCP	LF	10	$ 115	$ 1,150
	Excavation - Grading around the area inlet	CY	10	$ 11	$ 110
	Reinforced Concrete Wall	CY	2.9	$ 500	$ 1,450
	Seeding	SY	40	$ 1	$ 40
	Construction Subtotal=				$ 2,750
	Utility Relocation @ 20%	LS			$ 550
	Mobilization @ 4%	LS			$ 110
	Construction with Percent Allowances Subtotal=				$ 3,410
	Contingency @ 30%				$ 1,023
	Probable Cost Estimate=				$ 4,433

Design Engineering, Geotechnical, & Construction Management @ 30% $ 1,330

Total Conceptual Cost Estimate= **$ 6,000**
(Rounded up to the nearest $1000)

Figure 8-73. 8901 Manda Lane (MC-15)

8.3.16 Project MC-16 9501-9503 Crain Court

Residents at 9501 and 9503 Crain Court are experiencing ponding and erosion problems associated with storm water runoff from a vacant lot at 8510 Old Sappington Road. Stormwater has created a channel at 8510 Old Sappington which channels water to the corner of the above-referenced properties.

The recommended solution involves constructing an area inlet at the southwest corner of 8510 Old Sappington. This area inlet will connect to the existing storm water system near the east property line of 9501 Crain through a new 15" RCP. These improvements will require a storm water easement from 8510 Old Sappington and 9501 Crain Court. The estimated project cost of the recommended solution is approximately $55,000.

PLAN SCALE:

50 0 50 100 Feet

North

CITY OF CRESTWOOD

Project: MC - 16

9501-9503 Crain Ct.

Figure: 8-74

0

Table 8-107
Storm Sewer Priority Rating Sheet

Location: MC-16 9501 - 9503 Crain Court | Inspection Date: 3/14/2002

Tributary: Mulberry Creek

Problem Description: Residents at 9501 and 9503 Crain are experiencing erosion and ponding assoicated with stormwater runoff from vacant lot at 8510 Old Sappington.

Recommended Action: Construct area inlet and 15" RCP which will connect to existing stormwater system at 9501 Crain.

Preliminary Estimated Cost: $55,000 By: JAE Date: 2/5/2003

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1	2	12		6	20		40
Item 2							0
Item 3							0
	2	12	0	6	20	Subtotal	40

___ Residential Structure
___ Commercial Structure
___ Street
___ Public Structure
Owner: ___
___ Drainage Structure
Type: ___
___ Improved Channel
___ Unimproved Channel
Item 1 Yard
___ Other
Describe: ___

Multiplier Number of Major Locations Affected × 1 = 40

Multiplier Frequency Rating (flooding only) × 1 = 40

Multiplier Degree of Risk × 1 = 40

40
Total Benefit Points

Comments:
Residents at 9501 and 9503 Crain will benefit from improvements.

Estimated Cost = $55,000
Divided by
Total Benefit Points = 40
Cost/Benefit Rating = **1,375**

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Table 8-108
MC-16 9501-9503 Crain Court

Evaluation Category	Problem Type	Benefit Points			
		Very High	Hig h	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-109
Preliminary Cost Estimate
9501-9503 Crain Court

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price		Cost	
MC-16	**Improved Drainage System**						
	15" RCP	LF	150	$	115	$	17,250
	Area Inlet	EA	1	$	1,850	$	1,850
	Modify Existing Area Inlet to Accommodate new storm sewer	EA	1	$	1,500	$	1,500
	Remove and Re-install Existing Fence	LS	1	$	2,000	$	2,000
	Grading near proposed area inlet	CY	100	$	50	$	5,000
	Sod	SY	400	$	8	$	3,200
	Construction Subtotal=					$	30,800
	Mobilization @ 4%	LS				$	1,232

Construction with Percent Allowances Subtotal=	$	**32,032**
Contingency @ 30%	$	9,610
Probable Cost Estimate=	$	**41,642**
Design Engineering, Geotechnical, & Construction Management @ 30%	$	12,492
Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$**	**55,000**

9501 to 9503 Crain Court (MC-16)

9501 to 9503 Crain Court (MC-16)

8.3.17 Project MC-17 8701-8715 Gayle Avenue

Residents at 8701, 8709, and 8715 Gayle Avenue are experiencing standing water in their rear yards for several days after a rain due to poor rear yard grading. The residents cannot remedy the ponding by regrading alone, due to minimal elevation difference between their rear yards and Crestwood Drive. This ponding is a nuisance and also a possible breeding area for mosquitoes.

The recommended solution involves constructing an area inlet at the northwest corner of 8709 Gayle Avenue, and constructing a swale in the three yards to drain either toward the inlet or toward Crestwood Drive. This area inlet will connect to the existing storm water system on Crestwood Drive through a new 12" RCP. These improvements will require a storm water easement from 8709 and 8715 Gayle Avenue. The estimated project cost of the recommended solution is approximately $49,000

PLAN SCALE:

50 0 50 100 Feet

CITY OF CRESTWOOD

North

Project: MC-17

8701 - 8715 Gayle Avenue

Figure: 8-78

0

Table 8-113
Storm Sewer Priority Rating Sheet

Location: MC-17 8701-8715 Gayle Avenue

Inspection Date: 1/17/2003

Tributary: Mulberry Creek

Problem Description: Residents at 8701, 8709, and 8715 Gayle Avenue are experiencing ponding water for several days after rains due to poor rear yard layout. Residents cannot remedy ponding by grading alone, due to minimal elevation difference between rear yards and street.

Recommended Action: Construct area inlet and 12" RCP which will connect to existing stormwater system on Crestwood Drive. In addition, yards should be regraded to drain toward the new area inlet or the street.

Preliminary Estimated Cost: $49,000 By: JAE Date: 2/5/2003

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1	6			10	30		46
Item 2							0
Item 3							0
	6	0	0	10	30	Subtotal	46

Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Item 1 Yard
Other
Describe:

Multiplier
Number of Major Locations Affected x 1 = 46

Multiplier Frequency Rating (flooding only) x 1 = 46

Multiplier Degree of Risk x 1 = 46

46
Total Benefit Points

Comments:
Residents at 8701, 8709, and 8715 Gayle will benefit directly from this project. Additional residents in the area will benefit due to removal of standing water as a possible breeding ground for mosquitoes.

Estimated Cost = $49,000
Divided by
Total Benefit Points = 46
Cost/Benefit Rating = **1,065**

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Table 8-114
MC-17 8701-8715 Gayle Avenue

Evaluation Category	Problem Type	Benefit Points			
		Very High	Hig h	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-115
Preliminary Cost Estimate
8701-8715 Gayle Avenue

Site ID #	*Item Description*	*Unit*	*Estimated Quantity*	*Unit Price*	*Cost*
MC-17	**Improved Drainage System**				
	12" RCP	LF	105	$ 115	$ 12,075
	Tree Removal	LS	1	$ 2,000	$ 2,000
	Area Inlet	EA	1	$ 1,850	$ 1,850
	Manhole, Including Work Associated with Tying into Existing Storm Sewer	EA	1	$ 4,000	$ 4,000
	Earth Grading	CY	75	$ 50	$ 3,750
	Sod	SY	500	$ 8	$ 4,000
	Construction Subtotal=				$ 27,675
	Mobilization @ 4%	LS			$ 1,107
	Construction with Percent Allowances Subtotal=				$ 28,782
	Contingency @ 30%				$ 8,635
	Probable Cost Estimate=				$ 37,417
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 11,225
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)				**$ 49,000**

8701-8715 Gayle Avenue (MC-17)

8701-8715 Gayle Avenue (MC-17)

8.3.18 Project MC-18 8718-8722 Villa Crest Drive

Residents at 8718 and 8722 Villa Crest Drive are experiencing flooding into their homes due to runoff from properties along Sappington Road and properties to the north on Villa Crest Drive. These residents are also experiencing standing water in their rear yards after rain events.

The recommended solution involves constructing an area inlet in the rear yards of 8718 and 8722 Villa Crest Drive near the property line. This area inlet will connect to an existing curb inlet on Villa Crest Drive through approximately 100 LF of new 12"RCP. The rear yards of 8718 and 8722 Villa Crest Drive will be regraded as necessary to drain toward the new area inlet. These improvements will require a storm water easement from 8718 or 8722 Villa Crest Drive. The estimated project cost of the recommended solution is approximately $48,000.

PLAN SCALE:

50 0 50 100 Feet

North

CITY OF CRESTWOOD

Project: MC - 18

8718-8722 Villa Crest Drive

Figure: 8-82

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Table 8-119
Storm Sewer Priority Rating Sheet

Location: MC-18 8718-8722 Villa Crest Drive — Inspection Date: 1/22/2003

Tributary: Mulberry Creek

Problem Description: Residents at 8718 and 8722 Villa Crest are experiencing flooding in their homes due to runoff from yards to the north on Villa Crest Drive and yards to the northeast on Sappington Road.

Recommended Action: Install a new area inlet in the rear yard near the property line of 8718/8722 Villa Crest Drive. This new area inlet will connect to an existing curb inlet on Villa Crest Drive through a new 12" RCP.

Preliminary Estimated Cost: $48,000 — By: JAE — Date: 2/5/2003

Stormwater Problem

Item 1 Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Item 2 Yard
Other
Describe:

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1	12				20		32
Item 2				2			2
Item 3							0
	12	0	0	2	20	Subtotal	34

Multiplier Number of Major Locations Affected	x	1	34
Multiplier Frequency Rating (flooding only)	x	1	34
Multiplier Degree of Risk	x	1	34

34
Total Benefit Points

Comments:
Residents at 8718 and 8722 Villa Crest Drive will benefit from the improvements.

Estimated Cost = $48,000
Divided by
Total Benefit Points = 34
Cost/Benefit Rating = **1,412**

Table 8-120
MC-18 8718-8722 Villa Crest Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Table 8-121
Preliminary Cost Estimate
8718-8722 Villa Crest Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-18	8718-8722 Villa Crest Drive				
	Area Inlet	EA	1	$ 1,850	$ 1,850
	Modify Existing Curb Inlet to Accommodate New Storm Sewer	EA	1	$ 1,500	$ 1,500
	12" RCP	LF	130	$ 115	$ 14,950
	Remove and Re-install Existing Fence	LS	1	$ 2,000	$ 2,000
	Earth Grading	CY	65	$ 50	$ 3,250
	Sod	SY	400	$ 8	$ 3,200
	Construction Subtotal=				$ 26,750
	Mobilization @ 4%	LS			$ 1,070
	Construction with Percent Allowances Subtotal=				**$ 27,820**
	Contingency @ 30%				$ 8,346
	Probable Cost Estimate=				**$ 36,166**
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 10,850

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 48,000**

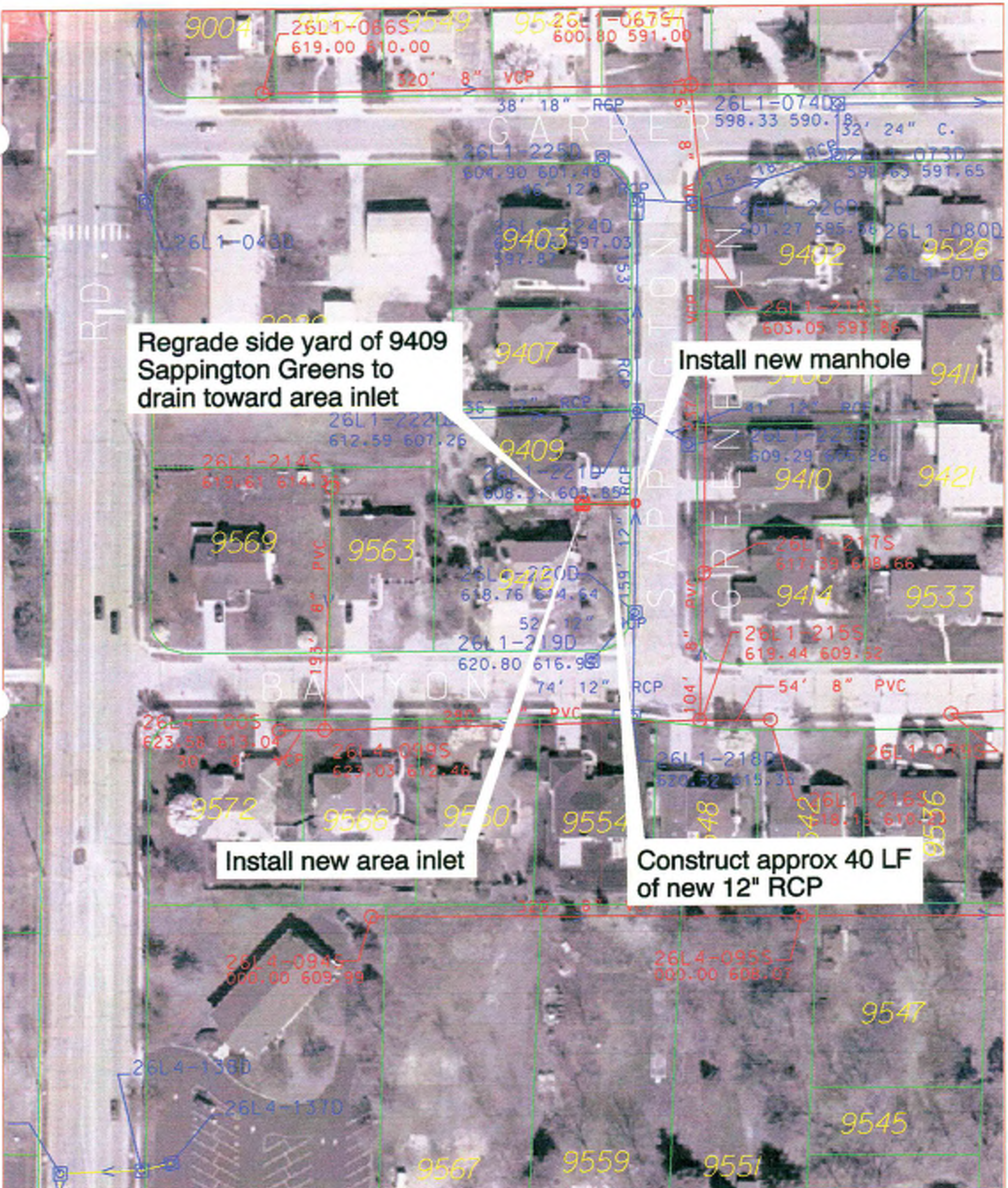
Villa Crest Drive (MC-18)

Villa Crest Drive (MC-18)

8.3.19 Project MC-19 9409 Sappington Greens Lane

Residents at 9409 Sappington Greens Lane are experiencing flooding problems associated with runoff from adjacent properties at higher elevations. Due to the foundation elevation of 9409 Sappington Greens, and the elevation of Sappington Greens Lane, there is very little that the residents can do to improve their situation. Water enters their basements through cracks in the foundation or over the sill of the foundation. The residents are also experiencing ponding water in their side yard due to poor drainage.

The recommended solution involves constructing an area inlet in the front yard of 9409 Sappington Greens near the south property line. This area inlet will connect to an existing storm sewer on Sappington Greens Lane through approximately 40 LF of new 12"RCP. The side yard of 9409 Sappington Green Lane will be regraded to drain toward the new area inlet, and the existing private storm drains will be connected to the new inlet. These improvements will require a storm water easement from 9409 Sappington Greens. The estimated project cost of the recommended solution is approximately $26,000.



PLAN SCALE:

50 0 50 100 Feet

North

Project: MC - 19

9409 Sappington Greens Lane

Figure: 8-84

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Table 8-122
Storm Sewer Priority Rating Sheet

Location: MC-19 9409 Sappington Greens Lane   Inspection Date: 2/13/2003

Tributary: Mulberry Creek

Problem Description: Residents at 9409 Sappington Greens are experiencing flooding problems associated with runoff from adjacent properties at higher elevations. Due to foundation elevation and elevation of the street, there is relatively little that residents can do to improve their situation. Their side yard also has poor drainage

Recommended Action: Install an area inlet in the front yard of 9409 Sappington Greens near the south property line. Inlet will connect to existing storm sewer on Sappington Greens Lane through a new 12" RCP. Side yard of 9409 Sappington Greens will be regraded to drain toward new area inlet, and private storm water drains will be connected to the new area inlet.

Preliminary Estimated Cost: $26,000   By: JAE   Date: 2/14/2003

Stormwater Problem

		Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
	Item 1	16				10		26
	Item 2				6			6
	Item 3							0
		16	0	0	6	10		
							Subtotal	32

Item 1 Residential Structure
Commercial Structure
Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Item 2 Yard
Other
Describe:

Multiplier Number of Major Locations Affected	x	1	32
Multiplier Frequency Rating (flooding only)	x	1	32
Multiplier Degree of Risk	x	1	32

32
Total Benefit Points

Comments:
Residents at 9409 Sappington Greens Lane will benefit from the improvements.

Estimated Cost = $26,000
Divided by
Total Benefit Points = 32
Cost/Benefit Rating = **813**

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Table 8-123

MC-19 9409 Sappington Greens Lane

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		Frequency Rating		Degree of Risk	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

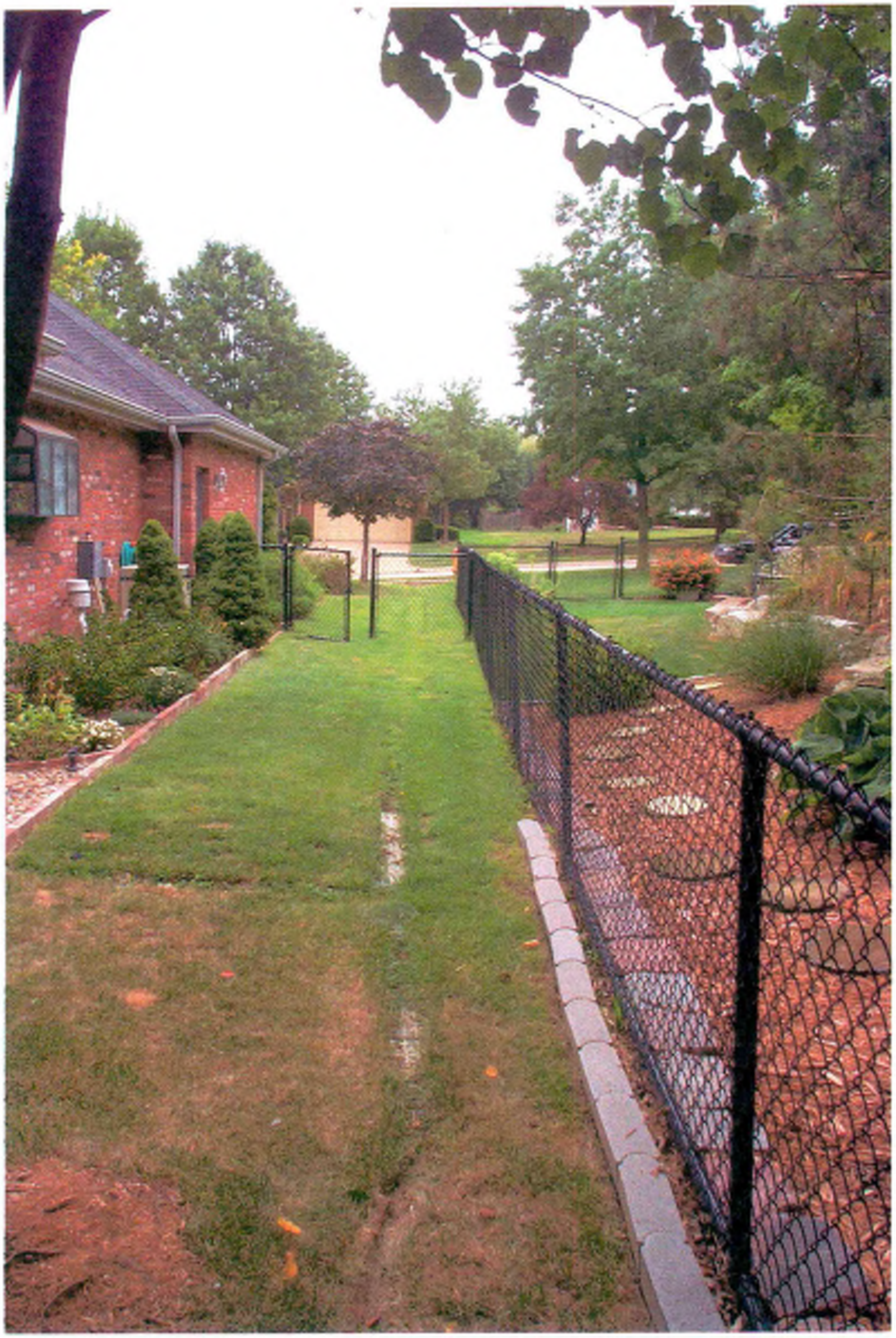
Table 8-124
Preliminary Cost Estimate
9409 Sappington Greens Lane

Site ID #	*Item Description*	*Unit*	*Estimated Quantity*	*Unit Price*	*Cost*
MC-19	**9409 Sappington Greens Lane**				
	Area Inlet	EA	1	$ 1,850	$ 1,850
	Manhole	EA	1	$ 2,000	$ 2,000
	12" RCP	LF	40	$ 115	$ 4,600
	Remove and Re-install Existing Fence	LS	1	$ 2,000	$ 2,000
	Tie in Existing Private Storm Drains to Area Inlet	LS	1	$ 1,000	$ 1,000
	Remove and Replace Sidewalk	SF	80	$ 6	$ 480
	Earth Grading	CY	30	$ 50	$ 1,500
	Sod	SY	150	$ 8	$ 1,200
	Construction Subtotal=				$ 14,630
	Mobilization @ 4%	LS			$ 585
	Construction with Percent Allowances Subtotal=				**$ 15,215**
	Contingency @ 30%				$ 4,565
	Probable Cost Estimate=				**$ 19,780**
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 5,934

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 26,000**

Green Springs Drive (MC-19)

Green Springs Drive (MC-19)



8.3.20 Project MC-20 8811-8821 Hemingway Drive

Residents at 8811, 8815, and 8821 are experiencing a constant flow of water in the gutter line due to sump pump and private drain line discharge onto the street right-of-way. The continuous flow of water is a nuisance, a cause of street deterioration, a potential mosquito breeding ground, and a road hazard (winter freezing).

The recommended solution involves constructing approximately 130 LF of drain line and discharging the line into the street curb just upstream of an existing curb inlet. The new drain line would connect two existing private drains and be routed under two driveways. No easements are required since the work will be performed in the street right-of-way. The estimated probable project cost of the recommended solution is approximately $6,000.

PLAN SCALE:

50 0 50 100 Feet

North

CITY OF CRESTWOOD

Project: MC - 20

8811 - 8821 Hemingway Drive

Figure: 8-87

Storm Sewer Priority Rating Sheet

Location: MC-20 8811-8821 Hemingway Drive   Inspection Date: 2/3/2004

Tributary: Mulberry Creek

Problem Description: Residents at 8811, 8815, and 8821 are experiencing a constant flow of water to the gutter line due to sump pump and private drain line discharge onto the street right-of-way.

Recommended Action: Construct 130 LF of 4" diameter drain line that connects existing private drain lines and discharges into street curb upstream of existing curb inlet.

Preliminary Estimated Cost: $6,000   By: JPK   Date: 2/3/2004

Stormwater Problem

- ___ Residential Structure
- ___ Commercial Structure
- Item 1 Street
- ___ Public Structure
  - Owner ___
- ___ Drainage Structure
  - Type ___
- ___ Improved Channel
- ___ Unimproved Channel
- ___ Yard
- ___ Other
  - Describe: ___

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1				12	20		32
Item 2							0
Item 3							0
	0	0	0	12	20	**Subtotal**	32

Multiplier Number of Major Locations Affected	x	1	32
Multiplier Frequency Rating (flooding only)	x	1	32
Multiplier Degree of Risk	x	2	64

64
Total Benefit Points

Comments:
Residents at 8811, 8815, and 8821 benefit from improvements.

Estimated Cost =	$6,000
Divided by	
Total Benefit Points =	64
Cost/Benefit Rating =	**94**

MC-20 8811-8821 Hemingway Drive

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Preliminary Cost Estimate
8811-8821 Hemingway Drive

Site ID #	Item Description	Unit	Estimated Quantity	Unit Price	Cost
MC-20	**Installation of Small Drainage Line**				
	4" PVC	LF	130	$ 15	$ 1,950
	Rem & Rep Concrete Drive Approach	SY	10	$ 45	$ 450
	Rem & Rep Asphalt Drive Approach	Tons	3	$ 100	$ 300
	Finish Grading & Sodding	SY	56	$ 11.00	$ 616
	Construction Subtotal=				$ 3,316
	Mobilization @ 4%	LS			$ 133
	Construction with Percent Allowances Subtotal=				**$ 3,449**
	Contingency @ 30%				$ 1,035
	Probable Cost Estimate=				**$ 4,483**
	Design Engineering, Geotechnical, & Construction Management @ 30%				$ 1,345

Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)	**$ 6,000**

Figure 8-88. 8811 – 8821 Hemingway Drive (MC-20)

Figure 8-89. 8811 – 8821 Hemingway Drive (MC-20)

Figure 8-90. 8811 – 8821 Hemingway Drive (MC-20)

8.3.22 Project MC-22 9875 Richter Lane

Residents on Craighurst Terrace are experiencing a constant flow of water on the street from a sump pump that is discharging an unusually large amount of water from the property at 9875 Richter Lane. Previously the sump pump was discharged on the property adjacent to the structure which allowed the water to flow down grade to the street over the sidewalk. The discharge was placed in its current location at the curb line in an effort to prevent a constant flow of water over this sidewalk, which created a hazardous condition. The water flow is still constant and has created a black and green stain on the pavement as well as an ice patch during freezing conditions. It is recommended that the sump pump discharge be routed to an inlet that is accress the cul-de-sac by means of directional boring. The estimated probable project cost of the recommended solution is approximately $6,000.

Table 8-1
Storm Sewer Priority Rating Sheet

Location: MC-22 9875 Richter Lane   Inspection Date: 12/5/2004

Tributary: Mulberry Creek

Problem Description: Residents on Craighurst Terrace are experiencing constant flows from a sump discharge at 9875 Richter.

Recommended Action: Tie sump discharge into storm inlet

Preliminary Estimated Cost: $6,000   By: Date. 12/16/2004

Stormwater Problem

	Flooding Severity +	Erosion Severity +	Maintenance of Existing Facilities +	Poor Drainage +	Project Benefits Properties	=	SUBTOTAL
Item 1			6	8	20		34
Item 2				10			10
Item 3							0
	0	0	6	18	20	Subtotal	44

Residential Structure
Commercial Structure
Item 1 Street
Public Structure
Owner:
Drainage Structure
Type:
Improved Channel
Unimproved Channel
Item 2 Yard
Other
Describe:

Multiplier Number of Major Locations Affected x 1 = 44

Multiplier Frequency Rating (flooding only) x 1 = 44

Multiplier Degree of Risk x 2 = 88

88
Total Benefit Points

Comments:

Estimated Cost = $6,000
Divided by
Total Benefit Points = 88
Cost/Benefit Rating = 68

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Table 8-2
MC-22 9875 Richter Lane

Evaluation Category	Problem Type	Benefit Points			
		Very High	High	Medium	Low
Flooding	Residential Structure	30	20	16	12
	Commercial Structure	30	20	16	12
	Public Structure	30	20	16	12
	Impassable Traffic		16	14	12
	Passable Traffic		12	8	4
	Accessory Structure		16	12	8
	Yard		10	6	2
Erosion	Residential Structure		18	14	10
	Commercial Structure		18	14	10
	Public Structure		18	14	10
	Retaining Wall (Public)		16	12	8
	Retaining Wall (Private)		12	8	4
	Drainage Structure		16	12	8
	Street R/W		16	12	8
	Yard		16	12	6
	Improved Channel		14	10	6
	Unimproved Channel		12	8	4
Maintenance	Drainage Structure		16	12	8
	Improved Channel		14	10	6
	Street Gutter		10	6	2
	Swale/Berm		14	10	6
Poor Drainage	Street		12	8	4
	Yard		10	6	2

Benefits to Properties		**Frequency Rating**		**Degree of Risk**	
>20	50				
11-20	40				
5-10	30	>1/yr	1.0	Danger to Life	3.0
2-4	20	1/yr	0.8	Limb	2.0
1	10	1/5 yr	0.6	Structure	2.0
None (0)	0	1/10 yr	0.3	None	1.0

Preliminary Cost Estimate
9875 Richter

ID #	Item Description	Unit	Estimated Quantity		Unit Price		Cost
MC-22	**Installation of Small Drainage Line**						
	2" PVC Directionally Bored	LF	125	$	20	$	2,500
	Inlet modification	Each	1	$	200	$	200
	Sump Pump Connection	Each	1	$	200	$	200
	Finish Grading & Sodding	SY	20	$	11.00	$	220
	Construction Subtotal=					$	3,120
	Mobilization @ 4%	LS				$	125
	Construction with Percent Allowances Subtotal=					**$**	**3,245**
	Contingency @ 30%					$	973
	Probable Cost Estimate=					**$**	**4,218**
	Design Engineering, Geotechnical, & Construction Management @ 30%					$	1,265
	Total Conceptual Cost Estimate= (Rounded up to the nearest $1000)					**$**	**6,000**

Section 9
NPDES Phase II Program

9.1 NPDES Program Overview

Stormwater quality is regulated under the National Pollutant Discharge Elimination System (NPDES) Program. Specifically, regulations pertaining to stormwater were introduced in the 1987 amendments to the Clean Water Act (CWA) and are enforced by the U.S. Environmental Protection Agency (EPA) and individual delegated states and tribes. Because the State of Missouri is a delegated state, the stormwater program in Missouri is implemented by the Missouri Department of Natural Resources (MDNR).

In 1972, Congress passed the CWA, which established the NPDES program. Until recently, efforts under the NPDES program have focused on non-stormwater discharges from industries and municipal wastewater treatment plants. In the last decade, EPA has expanded the NPDES program to cover stormwater discharges, using a two-phase permitting strategy. Phase I affected any discharge from a large or medium municipal separate storm sewer system (MS4). A large system serves a population greater than 250,000, while a medium system serves a population between 100,000 and 250,000. Based on the time the Phase I requirements were passed into law, the several cities within the jurisdiction of MSD were not required to comply with the regulations.

When the amendment to the Clean Water Act (1987) was passed in 1987, the intent for the Phase II program was to require MS4s that were under 100,000 in population to apply for a NPDES permit no later than October 1992. This date was later changed to October 1, 1994. The Phase II regulations were finally published in the Federal Register on December 8, 1999, and promulgated on December 22, 1999. These regulations apply to communities within MSD's service area, including the City of Crestwood. Communities will be required to implement at a minimum as part of any municipal stormwater management program the following measures:

- Public education and outreach on stormwater impacts - develop and implement a program to educate the public on impacts of stormwater discharges on water bodies and the steps necessary to reduce stormwater pollution
- Public involvement and education – develop and implement a public participation program to assist in the implementation of the stormwater management plan
- Illicit discharge detection and elimination – develop and implement a program that includes ordinance prohibiting illicit sewer connections or discharges (including dumping), creates sewer maps, and offers public education on the hazards of illicit discharges

- Construction site stormwater runoff control – develop, implement, and enforce a program to reduce stormwater runoff from construction activities on land disturbance of 1 or more acres

- Post-construction site stormwater management in new development and redevelopment – develop, implement, and enforce a program that addresses stormwater runoff from new development and redevelopment, generally using structural and non-structural BMPs

- Pollution prevent/good housekeeping for municipal operations – develop and implement a program that considers pollution prevention and good housekeeping measures for maintenance activities, street runoff controls, storm sewer waste disposal, and flood control management projects

9.2 Permit Compliance

The City of Crestwood will be required to submit a permit application to the MDNR addressing the six minimum measures by March 8, 2003. The City has the option of submitting an individual permit or to be included as part of a co-permit administered by MSD.

On November 13, 2001, MSD held a NPDES Phase II coordination meeting at the Clayton Community Center, in Clayton, Missouri. Each community within MSD's jurisdiction was invited to the meeting to discuss permit application requirements and submittal options. The following major discussion items were presented at the meeting:

- The MDNR prefers that communities within MSD's jurisdiction submit co-permittee application with MSD listed as the lead coordinator.

- A co-permittee application should provide the most cost-effective means of submitting the permit by avoiding redundancy. For example, some of the minimum measures can be conducted at the MSD level including the public education/outreach and public involvement measures, the drainage outfall map, and the illicit discharge detection and elimination program.

- Another coordination meeting will be scheduled in early 2002 to further discuss the co-permittee process, and to identify interested communities.

Appendix A
Unit Costs

Average unit costs have been developed from past stormwater construction projects in the St. Louis metropolitan area and surrounding communities. The unit costs have been adjusted to reflect 2001 pricing and were used to estimate probable costs for the recommended improvements. Table A-1 lists the average unit costs used for the study.

Table A-1
2001 Unit Costs*

Item	Unit	Unit Cost ($)
Pipe Under Pavement[1]		
36 inches or less in diameter	LF	170
42 to 66 inches in diameter/Box culvert (15-27 sf)	LF	350
72 to 84 inches in diameter/Box culvert (28-38 sf)	LF	640
90 to 96 inches in diameter/Box culvert (39-50 sf)	LF	880
Box culvert (51-60 sf)	LF	1,000
Pipe Under Earth[1]		
36 inches or less in diameter	LF	115
42 to 66 inches in diameter/Box culvert (15-27 sf)	LF	250
72 to 84 inches in diameter/Box culvert (28-38 sf)	LF	480
90 to 96 inches in diameter/Box culvert (39-50 sf)	LF	660
Box culvert (51-60 sf)	LF	750
Pipe in Tunnel		
36 inches or less in diameter	LF	700
42 to 66 inches in diameter	LF	1,400
72 to 84 inches in diameter	LF	2,500
90 to 96 inches in diameter	LF	3,200
Detention Basin Construction		
Detention basin construction	AC-FT	7,000
Excavation of Material		
Excavation of soil	CY	11
Pavement removal/replacement	SF	43
Embankment Construction, Grading and Restoration		
Additional fill	CY	14
Compaction of fill	CY	5
Material hauled from off-site	CY	10
Inlet Structures[2]		
36 inches in diameter of flared-end sections	EACH	1,300
42 to 66 inches in diameter of flared-end sections	EACH	3,000
Area inlets	EACH	1,850
Curb inlets	EACH	2,100
Curb & gutter	LF	15
Outlet Structures[2]		
36 inches in diameter of flared-end sections	EACH	3,000
42 to 66 inches in diameter of flared-end sections	EACH	5,000
Concrete swale	SY	40
Junction boxes	EACH	2,600
Pump station abandonment cost	EACH	3,000

Table A-1
2001 Unit Costs*

Item	Unit	Unit Cost ($)
Channel Treatments[3]		
Reinforced concrete banks or bed (10 inches thick assumed)	SY	100
Concrete filled fabric envelope	SY	60
Dumped rip-rap	SY	60
Sheet piling	SY	300
Bio-stabilization	SY	60
Soil stabilization and vegetative cover	SY	30
Vegetative cover only	SY	20
Gabions	FSF	20
Dumped rock	CY	65
Reinforced concrete wall	CY	200
Hand rail (limited access)	LF	25
Excavation for Channel Widening		
Excavation	CY	12
Additional fill	CY	14
Material to be hauled off-site	CY	10
Compaction	CY	17
Major Stream Maintenance		
Major stream maintenance	LF	14
Flood proofing		
Residence	EACH	20,000
Industry/Commercial	2,500 SF	20,000
Bio-stabilization		
Stacked geocell	FACE FOOT	30
Vegetated geogrid	FACE FOOT	25
Geocell surface	FACE FOOT	10
Geocell surface	EACH	2,200
Rock grade control	EACH	1,000
Sheet pile grade control	EACH	1,650
Coir encapsulated soil lifts	FACE FOOT	26
Soil inoculation/fertilization/seeding	SY	1
18" tall gabion toe	LF	30
Biogabion layer	FSF	28
Coir log toe	LF	15
TRM	SY	7
WTRM	SY	23
Geogrid reinforced fill slope (no soil import)	FACE FOOT	25
Soil filled TRM w/ sod	SY	12
Reforestation	ACRE	2,500

* The costs developed above are based upon a global basis. The actual cost of lateral bank stability can vary substantially.

[1] Includes typical excavation, shoring, traffic control, relocation, and bedding. Includes backfill, restoration, and appurtenances.

[2] Includes flared-end pipe section, headwall and rip-rap.

[3] Includes clearing, grubbing, dewatering and restoration. Includes any small excavation or preparation necessary for installation. Excavation for channel widening is additional

[4] Cost for grade controls as a total cost per structure. Each type of grade control would only be constructed to the minimum dimensions necessary to control grade and provide proper transitions across the structure. Typical constructed width (perpendicular to flow) is assumed to be 20 feet.

Appendix B
Other Problem Areas

Bank Stabilization/Bioengineering Projects

1. 1018 Ferndale Avenue.
2. 7811-7823 Cassia Court.
3. 880-944 Liggett Drive.
4. 9109 Watson Road.
5. Whitecliff Park tributary through Sophir property.

Rear Yard Storm Sewer Projects

1. 949 Volz Drive.
2. 8702-8709 Gayle Avenue.
3. 804-822 Rayburn Avenue.
4. Grantwood Trails Court.
5. Grantway Court Stormwater Project (necessary MSD easements denied by residents 1997).
6. 11906-11920 Beth Drive.
7. Glen Rose/Fox Park Drive.
8. 8701-8713 Fox Park Drive.
9. 8729-8741 Norcross Drive.
10. 1339-1349 Tahiti Drive.
11. 548-552 Joshua Drive.
12. 9307-9324 Tea Rose Lane.
13. 8808-8812 Sheryl Ann Drive.
14. 9203-9230 Laramie Drive.
15. 1036-1048 Sanders Drive.
16. 9024-9058 Sun Country Trail.
17. Shoppers Lane Storm Sewer (Design 2001, Constr. 8/02 complete).
18. 7811-7823 Cassia Court.
19. 880-944 Liggett Drive.
20. 9328 Lawndale Drive.
21. 9851 Amberley Drive.
22. 629 Sessions Avenue.
23. 11906-11920 Beth Drive.
24. 719-1301 Dallwood Drive.
25. 955 Liggett Drive.
26. 631-637 Rayburn Avenue.

Street Related Drainage Improvement Projects

1. 9718-9722 Twin Crest Drive – Reestablish curb and gutter.
2. 1432 Woodhue Drive – Reestablish curb and gutter.
3. Sanders Drive Street Drainage Improvement Project – Gravois Creek, Main Branch – Poor drainage on flat street (high frequency flooding at 936), plus structure flooding (at 963, and 967 Sanders) and continual sump pump discharge. Reconstruct street with adjusted grades to improve drainage. Sanders parallels Gravois Creek (within 100 feet).
4. Hawkins Court Street Improvement Project – Flooding of property and need for curb and gutter.
5. 9006-9012 Bardmont Drive – Reestablish curb and gutter.
6. Lindenhurst – Reestablish curb and cutter.
7. Pardee Road from Eddie & Park to Grant – Reestablish road-side ditch.

Major Maintence Projects

1. 1015 Reco Avenue – Kirkwood Creek - Damaged headwall on right bank. Need for grouted riprap extension.
2. Crestwood Park – Mulberry Creek - Damaged concrete trapezoidal channel needs repair.

Flooding Projects

1. Sanders Park – Gravois Creek, Main Branch – Primarily flooding with associated erosion. The failure of gabion basket foundations for intermittent stretches is partially addressed by GC-10.
2. 8612-8620 Grantwood Trails Court - Gravois Creek Watershed – Minor building (resident agrees this is low priority) flooding due to poorly graded swale and low berm.
3. Camera and Holmes storm channel.

Sewer Backup Areas

1. 624-626 Pinellas Drive and 735-739 Samoa Drive.
2. 9004-9034 Lowill Lane.
3. 8701-8737 Pardee Lane.
4. 9047-9071 Whitehaven Drive.

Appendix B – Prioritization Form

Date: 8/1/2025

		PROBLEM SOLVED CATEGORY Note:Problem points are awarded only for those problems solved by the proposed solution	Chronic (1-Yr) Flooding		Frequent (10-Yr) Flooding		Infrequent (100-Yr) Flooding		Total Points
			Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	Points per Category	No. Lots Affected	
1.0 STREAM	1.1 FLOODING	1.1.1 Structure Flooding							
		Habitable 1st floor, residential; includes spaces with mechanical equipment (1 lot per structure) Address:	300	0	150	0	25	0	0
		Basement (1 lot per structure) Address:	200	0	100	0	15	0	0
		Attached Garage (1 lot per structure) Address:	100	0	50	0	8	0	0
		Misc. structures including patio/decks, pools, sheds, tennis courts, detached garages, etc.(1 lot per structure) Address:	50	0	25	0	4	0	0
		Industrial, office, commercial and warehouse (1 lot per 2,500 sf of floor space flooded) Address:	300	0	150	0	25	0	0
		Yard Flooding/Poor Drainage (1 per lot) Address:	150	0	100	0	0	0	0
		1.1.2 Roadway Flooding (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)							
		Emergency Access restricted (>12" water over only access route to habitable structure), pts per structure. Address:	200	0	100	0	15	0	0
		Traffic obstruction (>6" of water) on arterial street. Address:	50	0	25	0	4	0	0
		Traffic obstruction (>6" of water) on collector street. Address:	25	0	12	0	2	0	0
		Traffic obstruction (>6" of water) on residential street. Address:	10	0	5	0	1	0	0
	1.2 EROSION	1.2.1 Threatening Structure (Ratio=Height of bank/distance from structure)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Habitable structures, residential (1 lot per structure) Address:	300	0	200	0	50	0	0
		Misc. structures including pools, patio/decks, sheds, tennis courts, detached garages, etc. (1 lot per structure). Address:	150	0	100	0	25	0	0
		Industrial, office, commercial or warehouse (1 lot per structure). Address:	300	0	200	0	50	0	0
		Reasonably assumed propensity for catastrophic failure* Address:	0	Number of Potentially Periled Structures 1000 points per structure					0
		Public Utility Infrastructure (pipes, culverts, manholes, etc.)	0	Per 10 ft. of Pipe or Specific Structure					0
		1.2.2 No. of lots (from 1.2.1) on outside of bend	0	lots	10 points per lot				0
		1.2.3 Threatening Roadway (allocate 1 lot per 250' of roadway impacted & 2 lots per intersection impacted)	Pts. For Ratio >0.70	No. Lots	Pts. For Ratio 0.36-0.70	No. Lots	Pts. For Ratio 0.15-0.35	No. Lots	
		Arterial Road:	75	0	50	0	12	0	0
		Collector Road:	35	0	25	0	6	0	0
		Residential Road:	20	0	12	0	3	0	0

* of habitable, commercial, or industrial structure.

Date: 8/1/2025

	SOLUTION BENEFIT CATEGORY					
2.0 REGIONAL	2.1 Combines smaller projects into regional solution (see note)	No. Add'l Projects:	0	Points per Add'l Proj.:	10	0
3.0 PROPOSED RESTORATIVE METHODS	3.1 Addresses erosion problems:	Amount of Solution		Points per Amount		
	End of Pipe Repair (helping the pipe slope, adding fes, rip rap, etc.)		EACH	1		0
	Outlet Pipe Extension		PER 10 LF	1		0
	Channel Realignment (includes upsizing undersized channel)		PER 10 LF	3		0
	Gabion Wall		PER 10 LF	2		0
	Channel Enclosure		PER 10 LF	3		0
	Rip Rap Revetment		PER 10 LF	1		0
	Streambank Biostabilization		PER 10 LF	2		0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
4.0 MISC.	4.1 Ease of Implementation (No. of Easements)	0-5 (20 pts)	6-10 (10 pts)	11-15 (5 pts)	>15 (0 pts)	
	Points for Easements					0
	TOTAL PROBLEM POINTS					0
	TOTAL SOLUTION POINTS					0
	GRAND TOTAL POINTS					0

Note: A regional solution combines several smaller projects into a watershed or subwatershed solution.

Note: 1 point is given to each solution for: aid to bed, aid to bank(s), effects more than that area.

TOTAL COST IN THOUSANDS =	0.1
(PROBLEM-SOLUTION)/COST RATIO = TOTAL COST IN THOUSANDS/TOTAL POINTS =	**0**