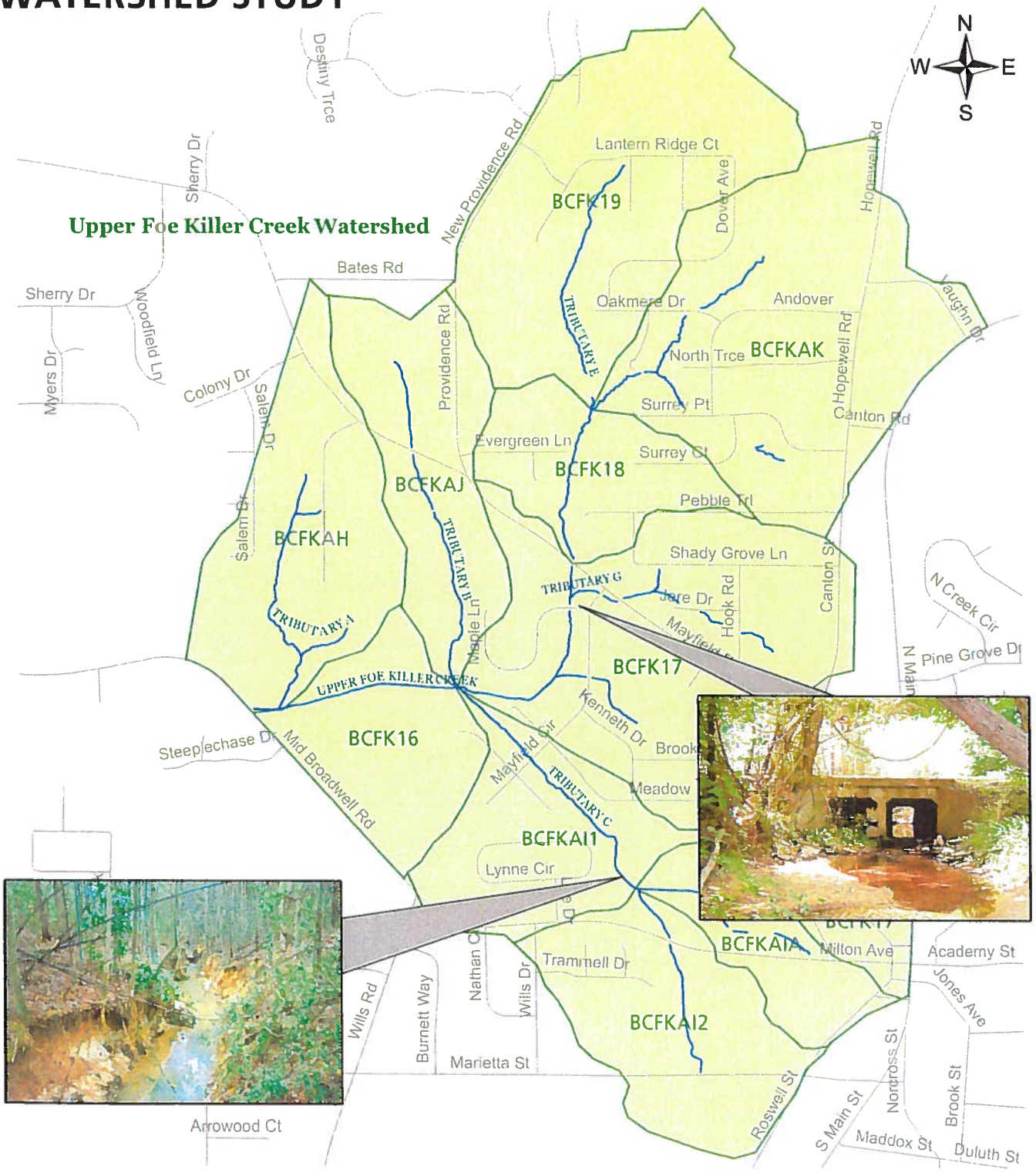
UPPER FOE KILLER CREEK WATERSHED STUDY



PREPARED FOR:

CITY OF ALPHARETTA
ENGINEERING/PUBLIC
WORKS DEPARTMENT

ARCADIS

Alpharetta GEORGIA

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ARCADIS

Upper Foe Killer Creek Watershed Study

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Note: Stormwater Structure Inventory (GIS/Geodatabase) provided separately

Executive Summary

The Upper Foe Killer Creek watershed encompasses approximately 1.45 square miles located in the northwestern portion of the City of Alpharetta. Most of the watershed has been developed, with land use consisting of a mixture of single-family residential, institutional, and commercial. Drainage conveyances within the watershed include the main stem of Foe Killer Creek and several tributaries identified and described within the study. Based on land use and associated percentage of impervious surface, a disproportionate percentage of the overall watershed runoff is generated from the densely developed downtown area, located in the southeasterly portion of the watershed.

With the exception of the downtown and adjacent areas, most of the Upper Foe Killer Creek watershed consists of older residential development, served by small drainage channels and somewhat aged (and undersized) drainage infrastructure. According to numerous drainage complaints over the past several years, residents are concerned that the increasing development in and adjacent to the downtown area has resulted in increased stormwater flows, further compromising the downstream open channel conveyances and drainage infrastructure. Concern has been expressed that the creek will eventually flood homes and properties due to a combination of additional increases in stormwater flows and loss of conveyance capacity caused by the accumulation of debris and sediment in the stream channels. For this reason, the City of Alpharetta commissioned ARCADIS to conduct a watershed study, including preparation of a Capital Improvement Program (CIP), to address stormwater improvement needs within the watershed.

This watershed study has been prepared to address a variety of drainage concerns, to identify improvement alternatives aimed at reducing peak stormwater runoff rates and replacing undersized or deteriorating stormwater infrastructure, and to recommend repairs or maintenance to existing stormwater conveyances and drainage systems. A stepped approach was used to accomplish the plan objectives, including the following major elements:

- A detailed stormwater structure inventory
- Development of a hydraulic model of the existing drainage system
- Identification of drainage problems and concerns

- Development of drainage improvement alternatives
- Preparation of a CIP with preliminary construction cost estimates

This plan culminates in a recommended CIP that identifies and prioritizes specific stormwater improvement projects to alleviate the identified drainage problems.

CIP projects include:

CIP Project No. 1 – Jere Drive Detention Pond

CIP Project No. 2 – Stormwater Detention at Milton High School

CIP Project No. 3 – Tributary C Detention Facilities

CIP Project No. 4 – Stormwater System Replacement and Detention Along Lantern Ridge Court

CIP Project No. 5 – Stormwater Detention Along Upper Foe Killer Creek

CIP Project No. 6 – Stormwater Conveyance Improvements in Vicinity of Brook Drive

1. Introduction

1.1 Study Area

The study area is the Upper Foe Killer Creek watershed inclusive of areas generally north of Mid-Broadwell Road and Milton Avenue, east of Salem Drive and New Providence Road, and west of Canton Street. Figure 2 provides a delineation of the overall watershed and drainage sub-watersheds, and the locations of primary streams and tributaries. Various land uses and a description of the physical characteristics of the watershed are provided in Section 2.1.

1.2 Drainage Problems and Concerns

Drainage problems and concerns have been identified primarily through the following sources:

- Review of drainage complaint files
- Interviews with City staff
- Field reconnaissance
- Stormwater system inventory observations
- Hydrologic/hydraulic modeling
- Discussions with local property owners

For purposes of this study, drainage problems are defined as previously reported or observed drainage conditions that present a hazard or significant nuisance to the general public or private property. Drainage problems may also include adverse drainage conditions identified through hydraulic modeling. Certain drainage problems identified within this study can be alleviated through design and implementation of stormwater improvement projects that can readily be constructed either on existing City right-of-way or within single parcels that can be purchased by the City for construction of the intended improvement. Such drainage problems will be addressed within the Capital Improvement Program (CIP), with specific improvement projects identified. CIP project types may include one or more of the following:

- Stormwater system replacement/upgrade

- Channel improvements/stream restoration
- Localized or regional stormwater detention systems

For drainage problems identified, but lying completely within private property, this report describes private improvement projects that can be implemented either by an individual homeowner or by a homeowners' association. Those types of improvements are not included as part of the recommended CIP.

Drainage concerns include adverse or nuisance drainage conditions that again, may be located within City right-of-way, or may fall outside of the City of Alpharetta's authorized jurisdiction or current administrative policies. Drainage concerns further include the following conditions, which may require some corrective action to be taken by the City:

- Channel erosion
- Debris within channels or structures
- Local sinkholes or washouts
- Minor structure repair/replacement needs
- Other stormwater system maintenance needs

The locations of drainage problems and concerns identified by this study are shown on Figures 6 and 7. The projects developed as part of the CIP to address drainage problems are described in more detail in Sections 5 and 6.

1.3 Goals, Approach, and Objectives

The goal of this watershed study is to identify solutions to the existing drainage problems and concerns described previously in Section 1.2. To reach this objective, ARCADIS developed and implemented a stepped approach, which included the following elements:

- A detailed stormwater structure inventory within the watershed
- Development of a hydrologic/hydraulic model of the existing drainage system
- Identification of drainage problems and concerns

- Development of drainage improvement alternatives
- Preparation of preliminary construction cost estimates

Upon completion of these tasks, a CIP was developed that outlines and prioritizes specific stormwater projects aimed at alleviating the known flooding problems, as well as required drainage system repairs, replacements, and maintenance needs.

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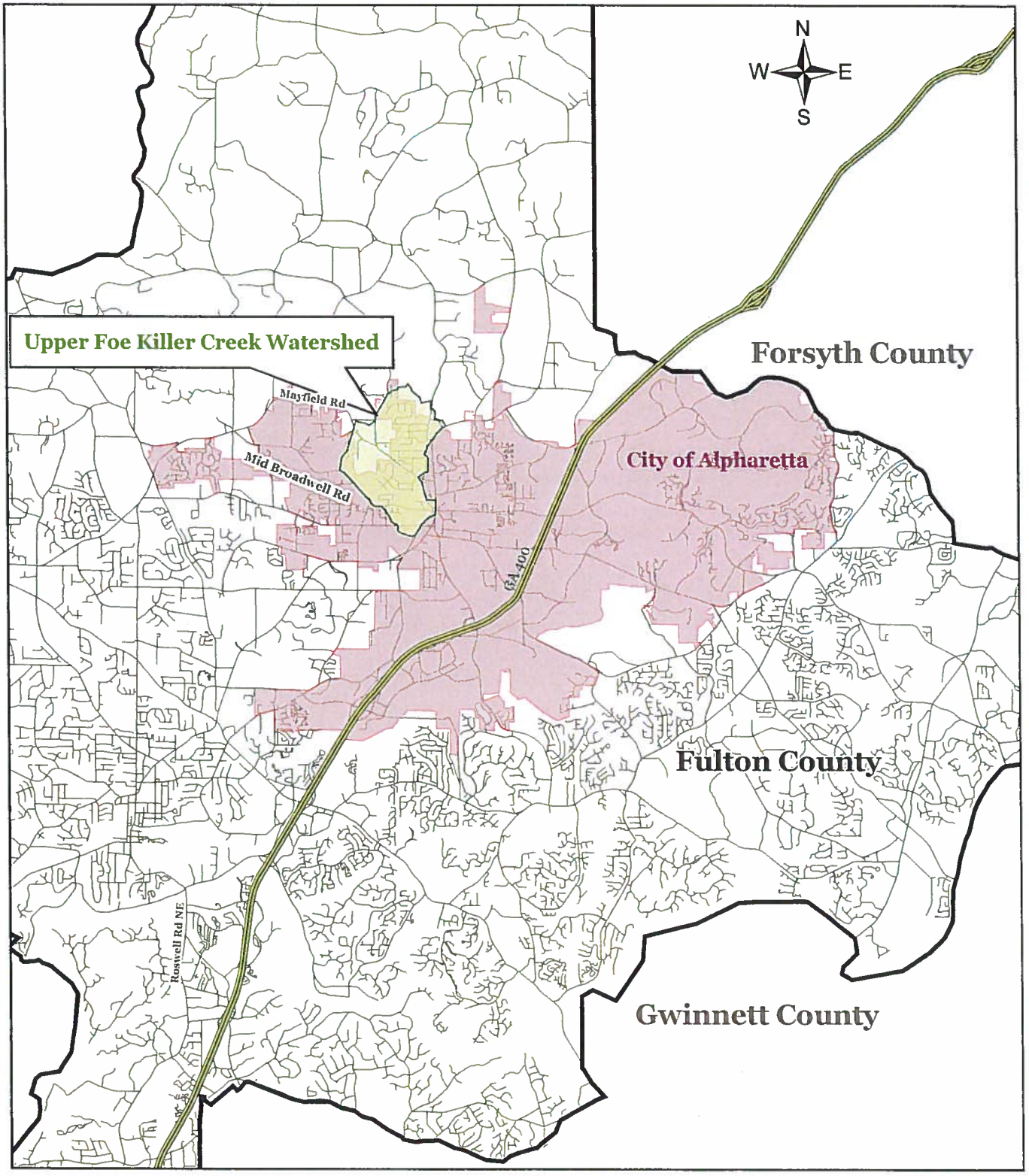
Figure 1
Location Map

Upper Foe Killer Creek
Watershed Study



2. Description of Study Area

2.1 Upper Foe Killer Creek Watershed

The Upper Foe Killer Creek watershed consists of 1.45 square miles in the northwest portion of the City of Alpharetta. The main stem of Foe Killer Creek begins in the northeast portion of the watershed (just west of Canton Street), and flows approximately 1.4 miles to its crossing under Mid-Broadwell Road. Foe Killer Creek is predominantly open channel, with culvert crossings occurring at the locations indicated in Table 2.1.

Table 2.1
Foe Killer Creek Culvert Crossings
(upstream to downstream)

Location	Culvert Description
Oakmere Drive	48-inch RCP
Brookford Drive (driveway culvert)	54-inch RCP
Evergreen Lane	One 72-inch CMP, one 48-inch CMP
Mayfield Road	96-inch CMP
Maple Lane	Two 4-foot by 4-foot concrete box culverts
Mid-Broadwell Road	Two 60-inch RCPs

2.1.1 Area North of Mayfield Road

North (upstream) of Mayfield Road, Foe Killer Creek is typically a narrow and relatively shallow channel, with segments having steep side slopes and evidence of erosion. The overall channel slope within this upstream segment is 0.77 percent (21.3 feet over the 2,760-foot segment), relatively steep in comparison to the downstream section south of Mayfield Road. Channel conditions are indicative of high-velocity flow and limited stream sedimentation. Being located at the headwaters of the watershed, there are few reported significant drainage complaints related to flooding; however, several complaints have been received related to channel erosion and general maintenance needs. Drainage concerns within this portion of the watershed are identified in Section 5. The floodplain within this upstream portion of the watershed is typically narrow, as would be expected based on local topography and other physical characteristics.

2.1.2 Area South of Mayfield Road

Foe Killer Creek south (downstream) of Mayfield Road to the Mid-Broadwell crossing is also a relatively narrow and shallow channel; however, the overall slope within this segment is only about .49 percent (18.3 feet over 3,770 feet). In contrast to the upstream segment, channel characteristics below Mayfield Road show evidence of slower flow velocity and significant sedimentation within the channel. The floodplain within this portion of the watershed is substantially broader, especially immediately upstream of Mid-Broadwell Road. Channel erosion is again evident in the segment, primarily attributed to high runoff rates and relatively small channel cross sections. Drainage complaints in the lower portion of the watershed include significant flooding, channel erosion, and maintenance-related concerns (see Section 5). Hydrologic and hydraulic conditions attributing to the flooding conditions experienced in this area are further defined and documented in Section 4.

2.2 Tributaries and Sub-Watershed Delineations

In addition to the main stream of Foe Killer Creek, seven drainage tributaries have been identified within the overall watershed. These tributaries are shown on Figure 2, with the contributing sub-watersheds also delineated.

2.2.1 Tributary A

Tributary A flows from north to south, providing drainage relief for the Mayfield Place subdivision, as well as residential development west of Mayfield Place. A stormwater detention pond exists along a secondary branch of this tributary, as shown on the aerial photography (Figure 3). This tributary measures approximately 2,500 feet in length, and consists of a few isolated culvert crossings. There are no known significant drainage problems reported or otherwise identified along this tributary; however, some areas of channel erosion have been identified.

2.2.2 Tributary B

Tributary B also conveys stormwater flows from north to south, and is located immediately east of the Mayfield Place subdivision. This tributary originates at a point north of Mayfield Road and includes a double 30-inch culvert crossing at Mayfield Road. A second culvert crossing (two 48-inch corrugated metal pipes [CMPs]) exists south of Mayfield Road, as shown on Figure 5. Similar to Tributary A, there are no

known significant drainage problems reported or otherwise identified along this tributary.

2.2.3 Tributary C

This tributary originates in the vicinity of Marietta Street and conveys stormwater flows in a north/northwest direction toward Foe Killer Creek. Tributary C converges with the main stem of Foe Killer Creek at a location very near the confluence with Tributary B. Culvert crossings along this tributary include a 66-inch CMP at Mayfield Circle, a twin 30-inch reinforced concrete pipe (RCP) at Milton Avenue/Mid-Broadwell Road, and a 36-inch RCP at Marietta Street. A secondary segment of this tributary branches off to the east, conveying stormwater generated from a portion of the Milton High School campus and a portion of the downtown area. The most noticeable drainage problem along this tributary is a collapsed headwall in need of replacement on the north side of Milton Avenue. No other major drainage problems were identified along this tributary; however, the volume of runoff delivered to Foe Killer Creek by this sub-watershed has a direct impact on the flood stages for the main stem of Foe Killer Creek.

2.2.4 Tributary D

Tributary D is a combination of open channel conveyance and closed drainage system, as depicted on Figures 3 and 5. This tributary originates east of Milton High School and drains a significant portion of both the high school campus and downtown area. Although some detention is provided near the high school, stormwater releases from the upper portion of this sub-watershed exceed the capacity of the downstream storm sewer system to adequately convey peak stormwater runoff. This storm sewer system is the subject of several drainage complaints, as further described later in this study. As shown on Figure 5, the closed drainage system and Tributary D convey flows from southeast to northwest, crossing Upshaw Drive, Meadow Drive, Brook Drive, and finally Mayfield Circle, prior to the confluence with Foe Killer Creek.

2.2.5 Tributary E

Tributary E is located in the northern portion of the Upper Foe Killer Creek watershed, conveying stormwater flow from north to south. This tributary originates in the vicinity of Lantern Ridge Court and converges with Foe Killer Creek at a point just east of Cobblestone Way. There is an existing detention pond in the upstream reach of Tributary E (west of Coventry Court), and another detention facility located on the east

side of the Spence's Field subdivision, near the confluence of Tributary E with Foe Killer Creek. This tributary consists of segments having evidence of substantial debris, sedimentation, and channel erosion; however, there are no known significant drainage problems identified along Tributary E.

2.2.6 Tributary F

Tributary F is a relatively short tributary, originating just west of Canton Street (between Surrey Point and Pebble Trail), and flowing from southeast to northwest to its confluence with Foe Killer Creek. A secondary branch along this tributary crosses Surrey Point and drains a single-family attached residential development lying east of Canton Street. Only minor drainage concerns and maintenance needs have been identified along this tributary.

2.2.7 Tributary G

This tributary lies just north of Mayfield Road and conveys flows from east to west across Hook Road, Jere Drive, and finally Mayfield Road prior to its confluence with Foe Killer Creek. This tributary has been the subject of past drainage complaints (particularly erosion problems); however, it is evident that most of the historic problem areas have been corrected through construction of gabions or placement of riprap along previously eroding stream segments.

The primary drainage problem along Tributary G appears to be periodic flooding of Jere Drive and adjacent properties located immediately north and south of Jere Drive. This drainage problem is addressed in Section 6 of this report. Further, some of the roadside catch basins along lateral drainage systems (particularly along Pebble Trail and Shady Grove Lane) require periodic cleaning and maintenance. This concern is also addressed further in Section 6.

2.3 Existing and Future Land Use

The Upper Foe Killer Creek watershed is almost completely developed, with land uses consisting primarily of residential, commercial, and institutional. For purposes of this study, the 2003 zoning map and Future Land Use Map were used as a basis to assign future buildout land use conditions, as shown on Figure 4.

Approximately 95 percent of the Upper Foe Killer Creek watershed north of Mayfield Road is single-family residential development. Only a small and remote segment of

this portion of the watershed (in the vicinity of Vaughn Road) is designated for commercial use.

South of Mayfield Road, the mixture of land use includes single-family residential (approximately 75 percent), institutional or special uses (approximately 10 percent), and commercial (approximately 10 percent), with the remaining designated as either multifamily residential (approximately 3 percent) or community unit plan (approximately 2 percent).

Based on the land use mapping, a higher rate of stormwater runoff is generated from the more densely developed and commercialized downtown area. Most of the runoff from this area (which also includes Milton High School) is directed into the Tributary C and D drainage sub-watersheds. As described previously, Tributary D consists of an aged and undersized drainage system and is the subject of several of the drainage complaints on record.

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Figure 2
Watershed and Sub-watersheds Map

Upper Foe Killer Creek Watershed Study

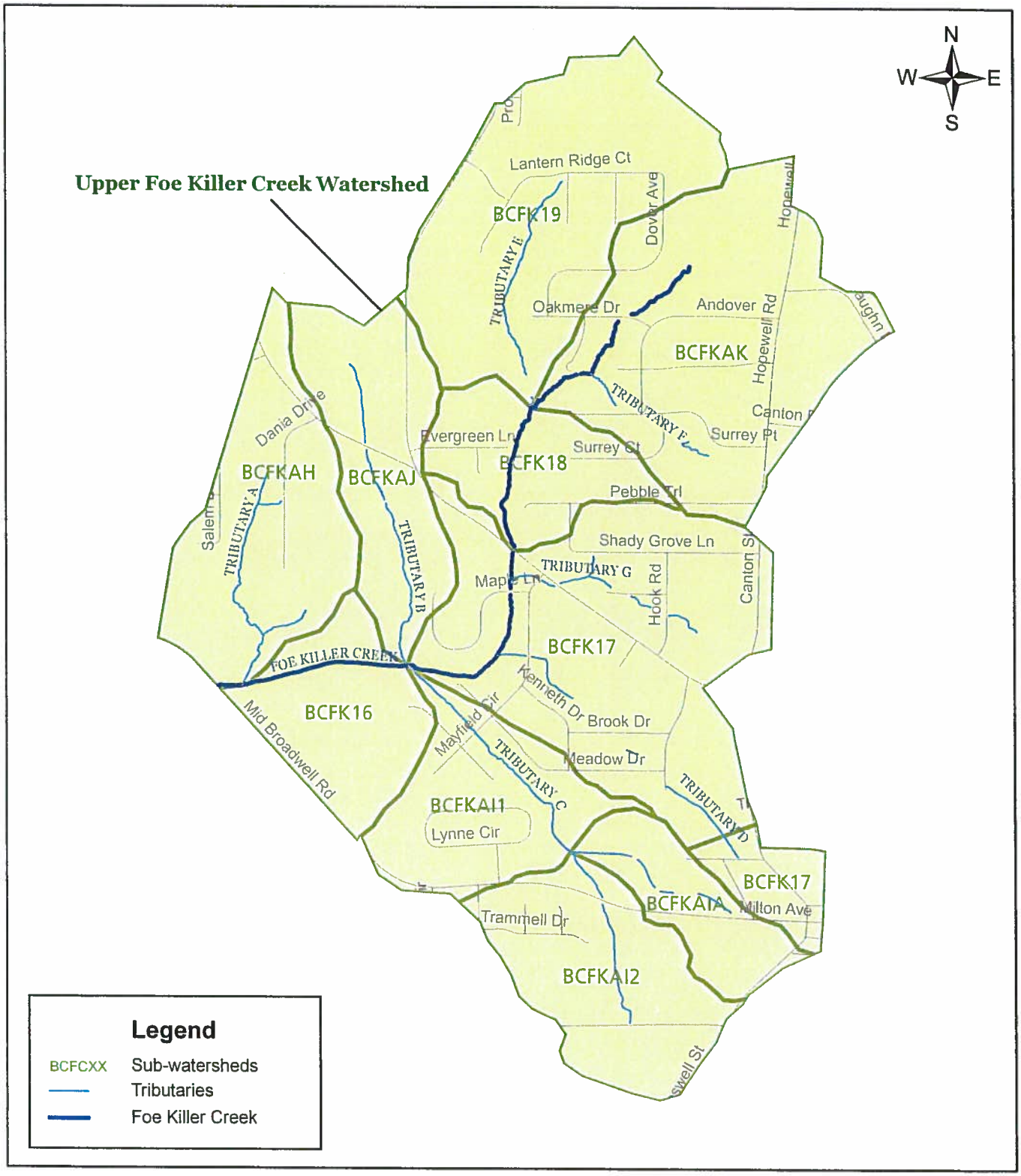

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Figure 3
Aerial Photograph
Upper Foe Killer Creek Watershed Study

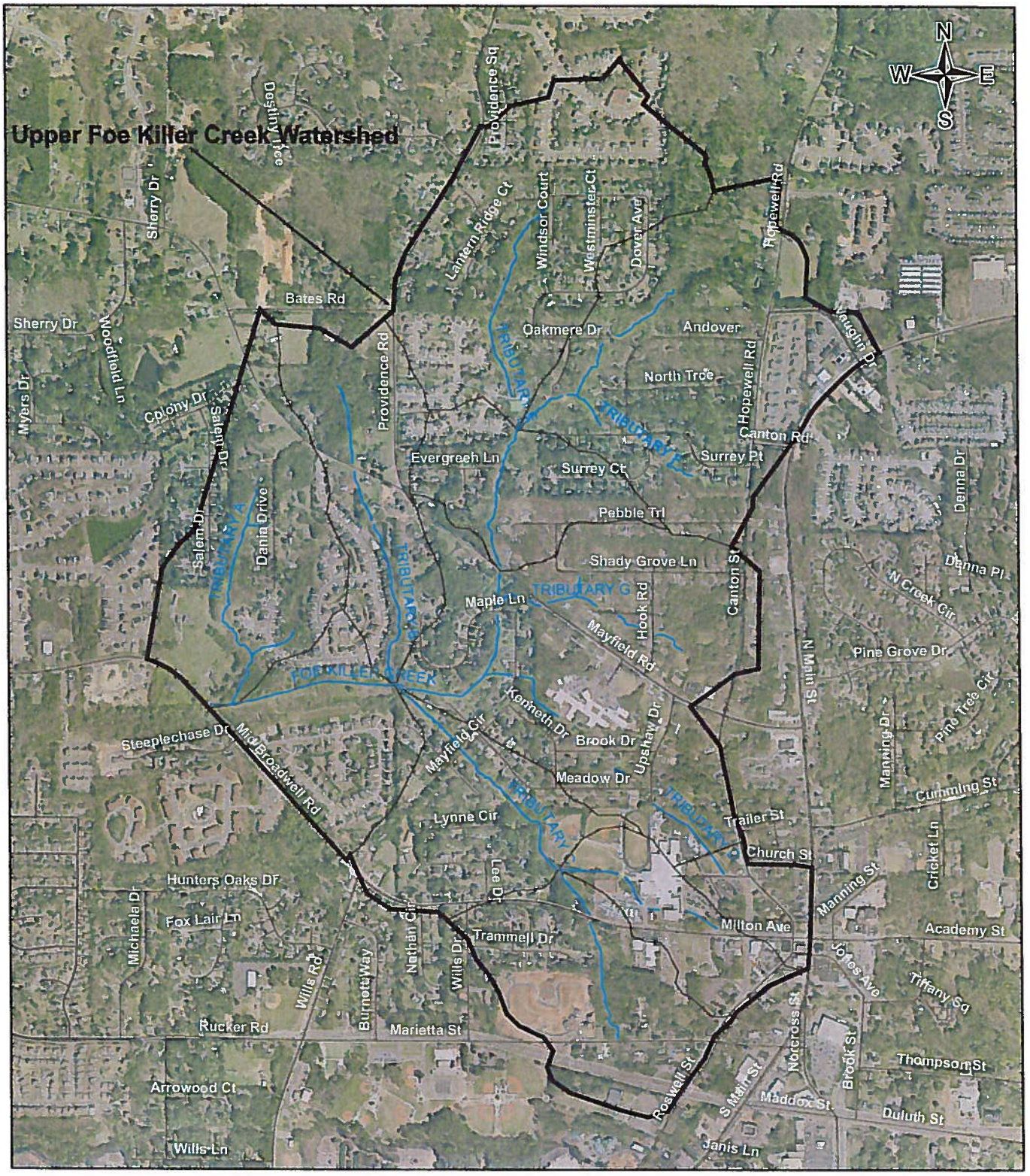

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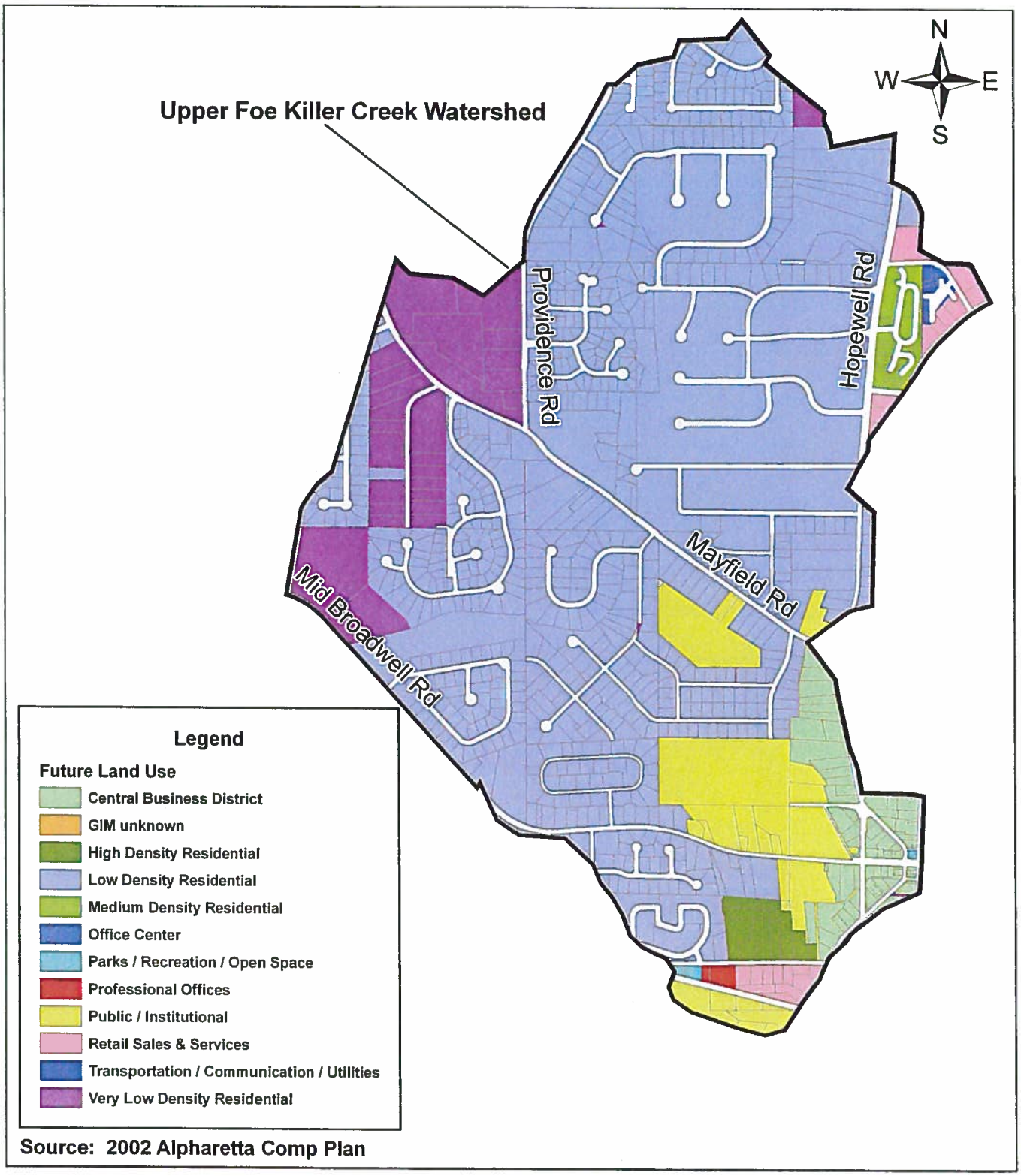
Figure 4
Land Use Map

Upper Foe Killer Creek Watershed Study



Source: 2002 Alpharetta Comp Plan

3. Stormwater System Inventory

A key element of this watershed study is the preparation of a drainage structure inventory. Drainage structures such as culverts, drop inlets, catch basins, headwalls, detention pond outlet structures, etc. were located using Global Positioning Satellite (GPS) equipment and were photographed, and the appropriate data was entered in a geodatabase. The structure locations, photographs, and pertinent data can be linked to the City's Geographic Information System (GIS). This system will allow the Engineering/Public Works staff to quickly locate a structure and access pertinent data. In addition to making it easier to address drainage problems, the information contained in the drainage structure inventory will also be useful in upgrading and maintaining the City's overall infrastructure. The details of the existing drainage system within a watershed have been presented separately in a GIS format. Approximately 680 stormwater structures were inventoried as part of this study.

3.1 Inventory Methodologies

The inventory phase of the study required identifying, locating, and creating fully attributed storm structure data for the stormwater infrastructure. Structures inventoried included all structures within the public rights-of-way, or those that are the responsibility of the City, and structures on private property serving more than one parcel or public property. The inventory included all peripheral structures, including lateral pipes, catch basins, drop inlets, pond outlet structures, and other stormwater structures, that are the responsibility of the City. Each structure was assigned a node with attributes obtained, including location (XYZ coordinates), structure type, size, and materials; physical condition; structure and pipe invert elevations; and other information provided in the structure inventory. Horizontal accuracy was sub-meter, and vertical accuracy was obtained within a 1-foot tolerance. Structures in need of repair, maintenance, or replacement were also identified.

Stormwater structure inventory personnel employed the Leica GS530 GPS to locate the stormwater structures. The GPS unit located at the structure to be inventoried communicated by modem to a base station set up by a remote known point. This procedure, known as Real Time Kinematic (RTK), offered results equal to or better than 1 foot vertically. Access to certain structures required the use of conventional survey methods.

ArcPad 6.0 was utilized as the collection software for the inventory. This software provided ARCADIS location personnel with the ability to quickly and accurately

attribute the locations collected by the Leica GS530 GPS unit. With ArcPad 6.0 loaded into Panasonic CF-M34 Toughbook laptop computers, the Toughbook was loaded with raster images of the watershed study area along with relevant GIS data, such as roads, property lines, and previously collected storm structure data. The GPS data was linked directly into the computer so that collected data could constantly be monitored and automatically input into the attribute table.

3.2 Stormwater System Mapping

Complete stormwater system mapping is provided as part of the GIS-based geodatabase delivery, provided separately from this study. A copy of the graphical representation of the overall stormwater structure inventory is provided in Appendix A, with major structures and conveyances identified on Figure 5. The detailed GIS-based stormwater inventory includes the following information relative to stormwater pipes and structures:

- Structure types, locations, and conditions
- Pipe sizes, types, elevation (within 1 foot vertically), and condition
- Pipe to structure connectivity
- Notes related to required maintenance, repairs, or replacement needs
- Photographs

Structure types obtained in the inventory included catch basins, drop inlets, manholes, junction boxes, headwalls, outlet structures, and weirs. Access to complete structure and pipe attributes is provided as part of the geodatabase delivery.

3.3 Conditions of the Existing Infrastructure

As part of the stormwater system inventory, each stormwater structure was field-assessed in terms of condition and ability to function in its intended use. Structures were identified in terms of good, fair, or poor condition, with notes provided for structures in poor condition or otherwise requiring attention. These structures, along with the identified replacement, repair, or maintenance needs, are documented in Section 6 of this study.

3.4 Geodatabase Delivery

Approximately 680 stormwater structures have been inventoried and fully attributed as part of this study. In addition to the value of this database for the field assessment and modeling performed, the database will be valuable to the City in locating structures, accessing pertinent data, and planning necessary repair, replacement, and maintenance programs.

4. Hydrologic and Hydraulic Analysis

The objectives of the hydrologic and hydraulic modeling were to evaluate flooding locations in the Upper Foe Killer Creek watershed under built-out land use conditions and to develop the management plan components to alleviate channel erosion and flooding. This section of the report presents the hydrologic and hydraulic modeling methodologies and assumptions. The models were used to evaluate future land use conditions for the 2-, 10-, 25-, 50-, and 100-year design storms.

For this study, ARCADIS used the Stormwater Management Model (SWMM) RUNOFF module for the hydrology and the SWMM EXTRAN module for the hydraulics. SWMM RUNOFF and EXTRAN were used to estimate future land use water surface elevations, velocities, and flows for the watershed.

A portion of the previous SWMM model prepared by CDM in 2001 for Fulton County was used as the basis for the modeling efforts; however, additional watershed characteristics and tributary analysis were necessary to refine the model, assess various improvement alternatives, and accomplish the objectives of this study.

4.1 Hydrology

The objectives of the hydrologic model are to develop runoff hydrographs for the 2-, 10-, 25-, 50-, and 100-year design storms under future (build-out) land use conditions for input into the hydraulic model. The design storm is SCS Type II distributed over a 24-hour period.

4.1.1 Sub-Watersheds

The Upper Foe Killer Creek watershed has been subdivided into 12 sub-watersheds, averaging approximately 25 acres per sub-watershed. The size of each individual sub-watershed depends on problem areas, road crossings, land use changes, and topography. Figures 2 and 5 illustrate the sub-watershed delineations throughout the study area.

In comparison to the 2001 SWMM model, several modifications have been made in order to refine the model and more accurately evaluate proposed improvement alternatives. Listed below are some of the modifications made to the previous model.

- Modified future condition hydrologic parameters to better match the current zoning and comprehensive land use plan.
- Added a sub-watershed to evaluate existing and proposed conditions along Tributary D.
- Added several culvert crossings along the main stem of Foe Killer Creek, not previously included in the 2001 study.
- Extended the model to include open channel conveyances (cross sections) and drainage system (based on recent inventory) in the vicinity of Tributary D.

4.1.2 Rainfall Information

The SCS Type II 24-hour distribution was used for the various design storms. Table 4.1 presents the design storm data.

Table 4.1
Design Rainfall Depths

Design Storm (year)	Rainfall Depth (in)	Peak Intensity (in/hr)
2	3.7	4.1
10	5.7	6.3
25	6.5	7.2
50	7.4	8.2
100	7.8	8.6

4.1.3 Impervious Calculations

Each sub-watershed was delineated and measured for size using ArcView. The land use shape files were joined with the sub-watershed shape files to determine the percentage of each land use within each sub-watershed. Percent impervious values were assigned to land uses consistent with the City's zoning and comprehensive land use plan. A summary of the sub-watershed areas, land uses, and impervious values is provided in Table 4.2.

Table 4.2
Hydraulic Model (SWMM) Input Parameters

Catchment ID	Load Point	Area (ac)	Percent Imperv. (%)	Slope (ft/ft)	Impervious (n)	Pervious (n)	Minimum Infiltration (in/hr)
		-	-	-	-	-	-
FK17A	FK17A	171	40.7	0.023	.015	.317	0.16
FK17B	FK17B	17	79.4	0.024	.015	.284	0.16
FK15	FK15	175	48.9	0.017	.015	.303	0.16
FK16	FK16	60	37.8	0.037	.015	.310	0.16
FK18	FK18	30	35.0	0.031	.015	.322	0.16
FK19	FK19	39	38.8	0.013	.015	.305	0.16
FKAH	FKAH	44	34.9	0.021	.015	.314	0.16
FKAI1	FKAI1	51	33.7	0.024	.015	.310	0.16
FKAI2	FKAI2	61	50.8	0.009	.015	.306	0.16
FKAIA	FKAIA	66	48.2	0.026	.015	.338	0.16
FKAJ	FKAJ	78	34.2	0.015	.015	.318	0.16
FKAK	FKAK	38	40.4	0.017	.015	.301	0.18

4.1.4 Other Model Input Parameters

The overland flow slope used in the SWMM model was determined by dividing the hydraulic length along a flow path by the difference in elevation. Manning's roughness values were assigned using typical shallow overland flow coefficients. Soil storage and infiltration rates were assigned based on available depth to water table data, assuming soils within the watershed to consist primarily of Hydrologic Group B. Initial abstractions were used to account for topographic features, small lakes, and best management practices (BMPs) that retain runoff. Documentation of the various input parameters used for this analysis is provided in Appendix C.

4.2 Hydraulic Modeling

SWMM EXTRAN was used as the primary hydraulic model for this analysis. The areas modeled using SWMM RUNOFF and EXTRAN are shown on Figures 2 and 5.

The channel cross sections for the hydraulic model were obtained using the previous modeling efforts, field survey, and available digital HEC-2 and HEC-RAS model files from the 1998 Federal Emergency Management Agency (FEMA) studies. The design storm flood stages at Mid-Broadwell Road based on the 2001 study were used to establish the downstream boundary condition for this analysis.

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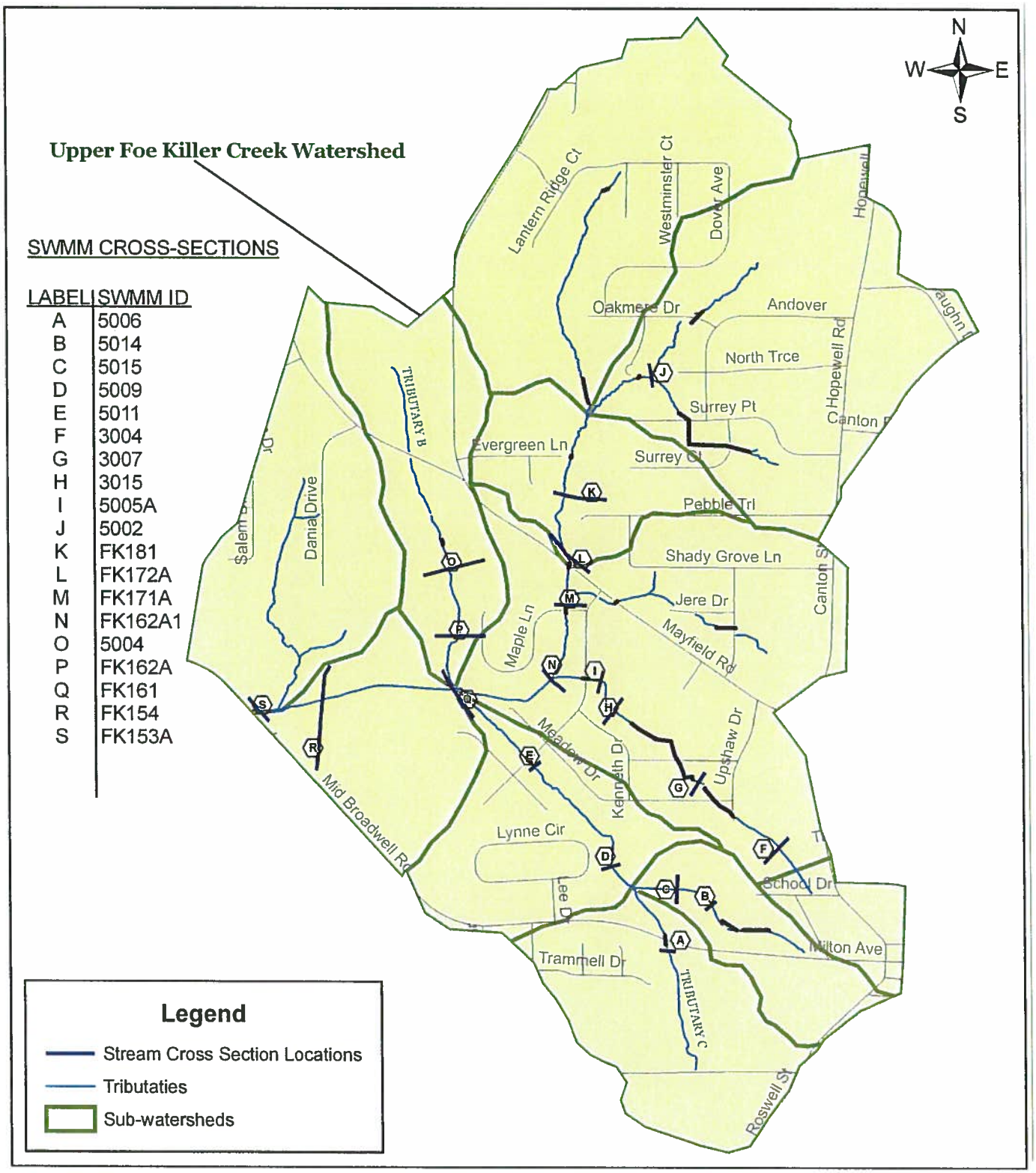
Figure 5
Hydraulic Modeling Cross Sections & Structures

Upper Foe Killer Creek Watershed Study



5. Identification of Drainage Problems and Concerns

This section describes drainage problems and concerns within the Upper Foe Killer Creek watershed. Problems and concerns have been identified through review of the City's drainage and complaint records, interviews with City staff, site investigations, hydraulic modeling, and previous investigations. Several of the drainage problems and concerns found within the City's drainage complaint record appear to have been addressed, and are therefore excluded from this study. Verification that past problems and concerns have been addressed was done through field inspections and interviews with staff.

Drainage problems identified in Section 5.1 below include previously reported or observed drainage conditions involving City-owned and maintained drainage systems that present a hazard or significant nuisance to the general public. Drainage problems may also include adverse drainage conditions identified through hydraulic modeling. For each of the drainage problems identified in this section, a CIP project has been developed (see Section 6.1) aimed at alleviating the adverse drainage condition. Drainage concerns associated with City-owned and maintained systems are presented in Section 5.2. Drainage concerns include channel erosion, debris within channels or structures, minor sinkholes or washouts, minor structure repairs or replacement needs, and other stormwater system maintenance needs. For each drainage problem or concern, this section includes the approximate location and a brief description of the existing conditions.

Drainage problems and concerns located within private property are identified in Sections 5.3 and 5.4, respectively. Because these drainage conditions are typically not associated with City-owned and maintained drainage systems and require improvements within private property, such conditions are not directly addressed within the recommended CIP. Possible improvement options to alleviate private property drainage issues, however, are provided in Section 7. Further, some of the recommended CIP projects will result in a reduction of stormwater runoff, thereby improving (to some degree) several of the private drainage problem area.

5.1 Drainage Problems – City-Owned and Maintained Systems

Five drainage problems related to City-owned and maintained systems have been identified, as shown on Figure 6, with a brief description provided below.

Drainage Problem No. 1

Stormwater flow within Tributary G directs runoff from east to west across Hook Road, and then moves in a northwesterly direction across Jere Drive. The small pipe at Jere Drive cannot adequately pass high flows, resulting in occasional overtopping of the roadway. This results in significant ponding within two private properties on the north side of Jere Drive, and downstream erosion due to the subsequent release of stormwater into the receiving system.

Drainage Problem Nos. 2 and 3

Although only two locations are identified on Figure 6, drainage problems in this area are wide-ranging and are typically attributed to inadequate stormwater system capacity to handle the flows being delivered from the sub-watersheds located upstream. As shown on Figures 3 and 4, the area upstream of this problem area includes Milton High School and a portion of the densely developed downtown area. Although some stormwater detention exists in the vicinity of the school, aged and undersized drainage infrastructure within the piped sections of Tributary D (vicinity of Upshaw Drive, Meadow Drive, and Brook Drive) are not large enough to convey peak stormwater discharge.

Photo 1. Undersized storm drain located along Tributary D, between Meadow Drive and Brook Drive.

Photo 2. Grated drop inlet at private residence located west of Upshaw Drive and south of Meadow Drive. Bricks were inserted by property owner to reduce clogging and increase hydraulic capacity.

Drainage Problem No. 4

Drainage Problem No. 4 is located at the southeast corner of the Lantern Ridge Court and Coventry Court intersection. An existing weir-type drop inlet located on the property has developed significant sinkholes, which appear to be forming as a result of failing CMPs entering the structure. Maintenance has been performed on this inlet in the past, but the CMPs have not been repaired or replaced.

Photo 3. Developing sinkholes adjacent to drainage structure located near Lantern Ridge Court and Coventry Court.

Drainage Problem No. 5

This drainage problem involves recurring flooding of the home located at 205 Mayfield Circle. Relative to other residences along Mayfield Circle, this particular house was built very low and experiences flooding for storm events equal to or greater than the 2-year storm. The drainage conveyance (Tributary D) adjacent to this residence is a relatively small, open channel, with significant vegetative growth.

5.2 Drainage Concerns – City-Owned and Maintained Systems

Drainage concerns associated with City-owned and maintained drainage systems are shown on Figure 7, with a brief description provided in Table 5.1 below.

Table 5.1
Summary of Drainage Concerns (Public Property)
Recommended for Maintenance or Repair by City Forces

Concern ID No.	Location	Description	Required Action
C3	Broadwell Oaks Drive	Sinkholes at drainage structure	Repair structure/pipe
C5	Surrey Court	Sinkholes at catch basin	Repair structure/pipe
C6 – C9; C11 – C15	Pebble Trail; Shady Grove Lane	Debris buildup at catch basins (hood type)	Scheduled maintenance, or replace with single-wing/double-wing catch basin tops
C17	Mayfield Road	Erosion on south side of roadway	Matting/bank stabilization[(1)]
C20	Meadow Drive	Occasionally clogged inlet	Maintain drainage system
C22	Milton Avenue/Mid-Broadwell Road	Washout around headwall	Matting/bank stabilization

[(1)]Fulton County has previously addressed this issue, however, it is recommended that the City continue to monitor conditions to ensure that the remediation efforts of the County provide adequate stabilization.

5.3 Drainage Problems – Private Property

Four private property drainage problems have been identified as shown on Figure 6, with a brief description provided below.

Drainage Problem No. 6

This drainage problem consists of a series of developing sinkholes within the Broadwell Oaks subdivision. It is not clear whether the sinkholes are the result of decaying subsurface materials, overland flow, or generally poor soil conditions. Although the sinkholes have developed in a somewhat linear alignment, they do not follow the drainage path for overland flow. It is also possible that the sinkholes are developing along a former ditch line that was filled and regraded during development of the subdivision.

Photo 4. Developing sinkholes within Broadwell Oaks subdivision.

Drainage Problem No. 7

Significant erosion and stream sedimentation have occurred over time along Foe Killer Creek, in the immediate vicinity of Maple Lane. Particularly upstream of Maple Lane (a double 4-foot by 4-foot concrete box culvert), the easterly channel bank has eroded to within a few feet of residential structures and improvements. Although previous investigations have recommended increasing the size and capacity of this culvert to

pass more flow, it appears that stream segments consisting of significant sediment and debris are hydraulically more constricting than the Maple Lane culvert. Culvert replacement at this location is not recommended as part of this study.

Photo 5. Main stem of Foe Killer Creek upstream of Mid-Broadwell Road.

Drainage Problem Nos. 8 and 9

These two drainage problems are described concurrently because of the similar nature of the problems. At least four residences are impacted by recurring flooding along Foe Killer Creek. Two residences in particular (3110 Maple Lane and 381 Meadow Drive) are significantly impacted by flooding; residents have indicated that creek stages reach levels above the finish floor elevation almost on an annual recurring basis. Adjacent residences experience flooding within the yards, but do not appear to have flooding above the finished floor elevation. It should be noted that each of these residences is at least partially located within the 100-year floodplain based on FEMA studies.

Photo 6. Private residence located along Maple Lane and adjacent to Foe Killer Creek.

Photo 7. Foe Killer Creek in vicinity of Maple Lane (same general location as shown on Photo 6).

5.4 Drainage Concerns – Private Property

Drainage concerns located within private property are shown on Figure 7, with a brief description provided in Table 5.2 below.

Table 5.2
Summary of Drainage Concerns (Private Property)
Requires Maintenance or Repair by Homeowners

Concern ID No.	Location	Description	Required Action
C1	1386 Salem Drive (detention pond)	Sediment within detention pond	Sediment removal and pond maintenance
C2	1300 Mayfield Place	Deposition of sand/debris from Foe Killer Creek flooding	Property owner to maintain
C4	Surrey Point	Local drainage issues on private property	Locate storm drain and assess potential to improve local drainage
C10	West side of Shady Grove Lane	Small drainage pipes inadequate	Property owners to replace, or request riprap for ditch
C16	Shady Grove Lane/Pebble Trail	Inadequate ditch conveyance behind properties	Property owners to maintain
C18	Maple Lane/ Mayfield Circle	Channel erosion	Address using riprap program
C19	Upshaw Drive	Occasional flooding in channel	Channel maintenance/ vegetative removal
C21	East of Lynne Circle	Excessive channel erosion	Bioengineered channel after detention placed upstream

Photographs of selected drainage concerns are provided below.

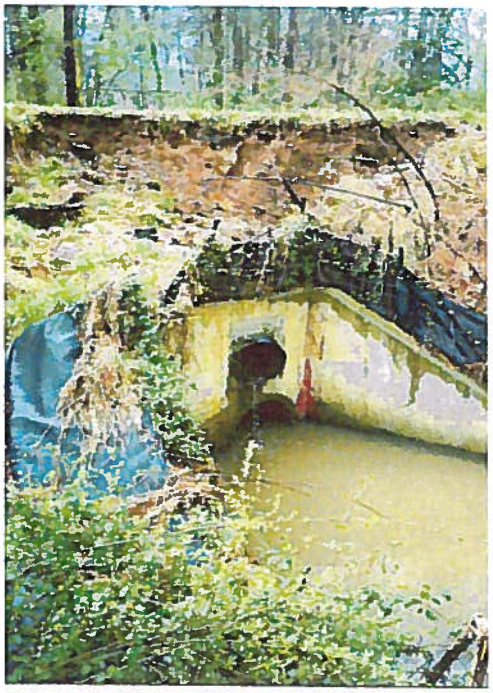


Photo 8. Washout of embankment, north side of Mid-Broadwell Road (see drainage concern C22).

Photo 9. Channel erosion along Tributary C (see drainage concern C21).

Photo 10. Ponding/sedimentation in backyard adjacent to Foe Killer Creek, at 1300 Mayfield Manor Drive (see drainage concern C2).

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Figure 6
Drainage Problems

Upper Foe Killer Creek Watershed Study

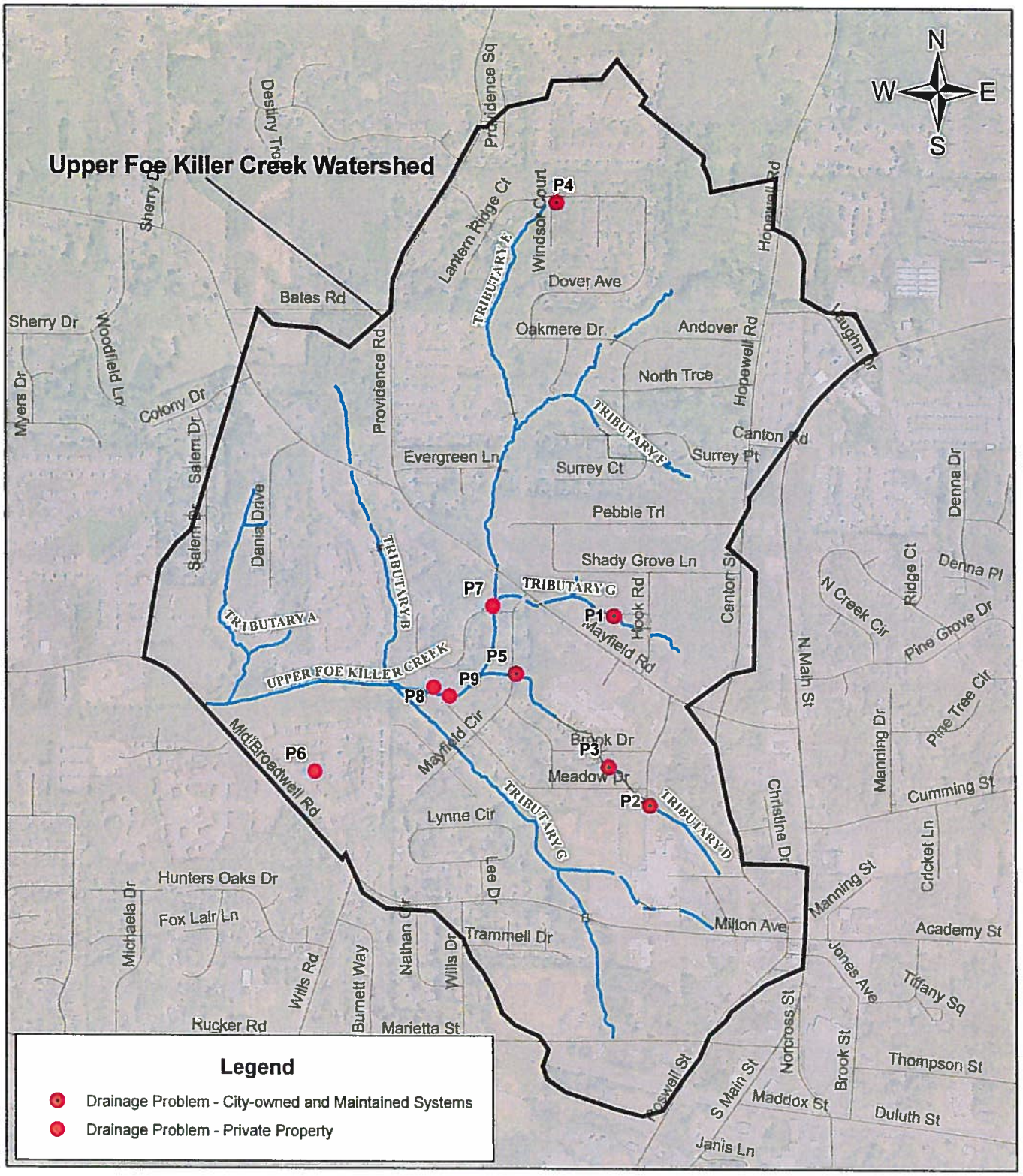

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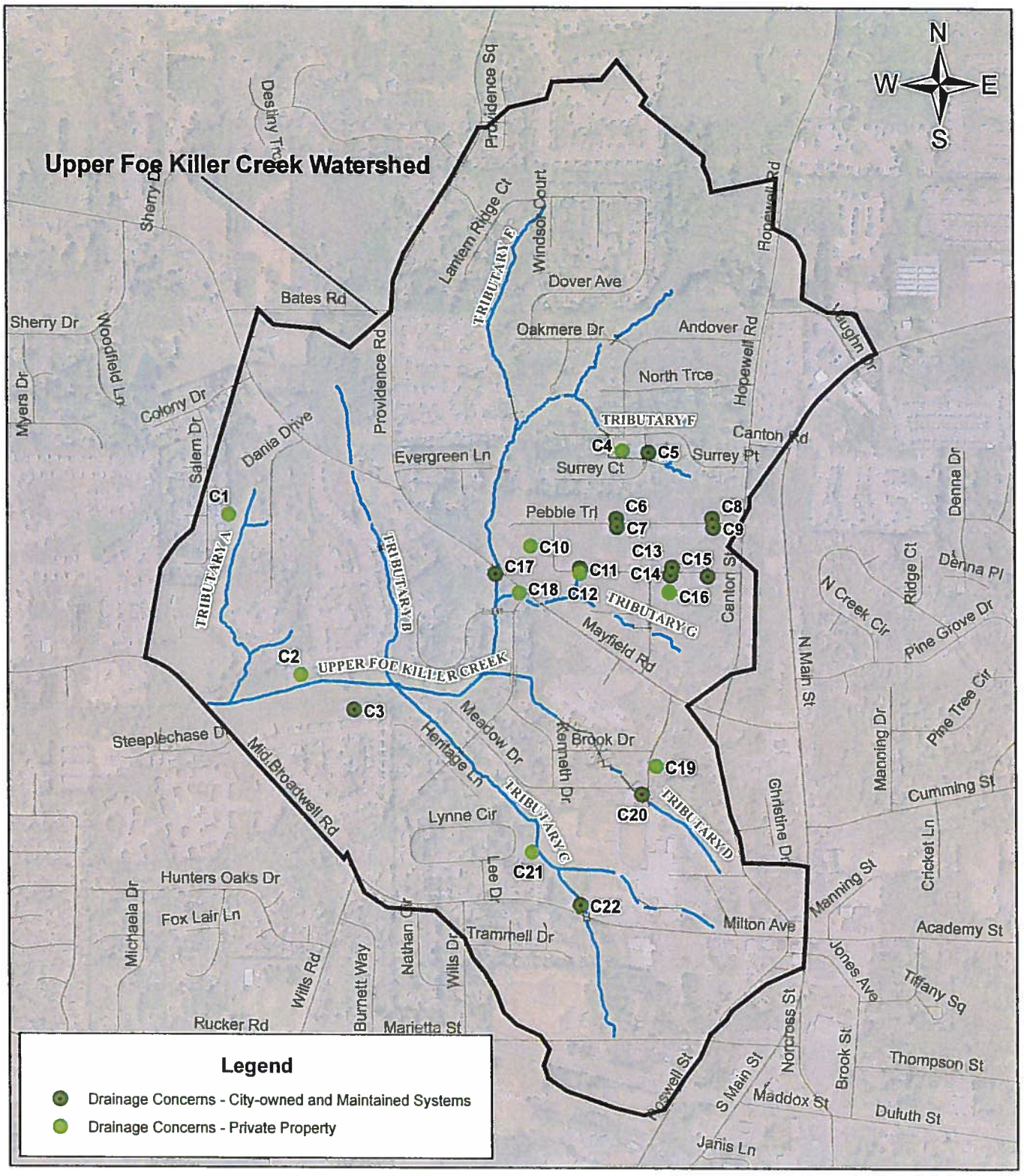
Figure 7
Drainage Concerns

Upper Foe Killer Creek Watershed Study



6. Capital Improvement Plan (CIP) Development and Recommendations

This section introduces specific stormwater improvement projects recommended to address the drainage problems identified in Section 5. In many cases, the recommended improvement projects are not located in the immediate drainage problem area, but are upstream from the problem area and designed to reduce peak discharges. In essence, this approach more directly addresses the source of the problem rather than "correcting" the result of the problem (area impacted) by increasing system capacity. Two significant benefits are achieved by developing a CIP with this approach in mind:

1. Limiting peak runoff rates in the developed upstream sub-watersheds reduces overall watershed runoff and restores the hydrology to predevelopment conditions.

2. Because system/channel hydraulic capacity at the drainage problem area is not increased, the drainage problems are not simply transferred downstream to a new location.

Recommended CIP projects related to limiting the stormwater discharge in developed upstream sub-watersheds are identified in Section 6.2 below (see CIP Projects 1 through 5). One exception (CIP Project 6) does not meet this description, but is a recommended CIP project because of the significance of the problem and the need to expedite the improvement. This project involves needed upgrades to an undersized drainage system in the vicinity of Brook Drive, but is recommended for construction either following or concurrently with stormwater detention at Milton High School (CIP Project 2).

CIP projects will be designed for protection up to the 25-year storm, with detention pond emergency spillways designed to handle the 100-year storm.

These projects have been developed to include improvements that are considered to be constructible and permitable through the regulatory agencies, and that will potentially alleviate multiple drainage problems. For each project developed, this section identifies the project construction requirements, the specific drainage problems being addressed, and any drainage concerns that may also benefit from the improvement. Note that the City may also elect to systematically address the multiple drainage concerns identified in Section 5.2 using City forces. The CIP projects are arranged below in order of priority.

6.1 Recommended Capital Improvement Plan (CIP) Projects

6.1.1 CIP Project No. 1 – Jere Drive Detention Pond

This project involves construction of a dry detention pond on the south side of Jere Drive. Detention at this location will reduce peak flows released from the headwaters of Tributary G, while alleviating flooding conditions across Jere Drive (see description of Drainage Problem No. 1 in Section 5.1). Construction activities required for this project include clearing and excavation, construction of a stormwater outlet structure and associated pipes, fencing, and site restoration.

6.1.2 CIP Project No. 2 – Stormwater Detention at Milton High School

This project includes construction of four dry detention ponds located within, or adjacent to, Milton High School. Proposed pond locations are shown on Figure 8. Three of these ponds will effectively attenuate peak discharge from the downtown area, which currently discharges into the undersized tributary storm drain system. This project further includes construction of a detention pond within school property, but at the headwaters of Tributary C. Elements of construction will include clearing and excavation, stormwater diversion structures/pipes, outlet structures and weirs, emergency spillways, fencing, and site restoration.

6.1.3 CIP Project No. 3 – Tributary C Detention Facilities

This project includes construction of either a dry detention pond or underground pipe detention system at the headwaters of Tributary C (see Figure 8). Detention at this location will offset peak discharges associated with Marietta Street and alleviate channel erosion downstream within the tributary.

Elements of construction are similar to CIP Project Nos. 1 and 2, with the exception of possible underground detention piping. This project also includes further examination and possible retrofitting of the southerly (upstream) headwall at Milton Avenue in order to increase storage capacity within the upstream reach of Tributary C.

6.1.4 CIP Project No. 4 – Stormwater System Replacement and Detention Along Lantern Ridge Court

Located at the headwaters of Tributary E, this project involves replacement of a deteriorating CMP drainage system (pipe and structures) with a new RCP drainage

system. However, the new system would be oversized and fitted with an outlet structure to detain runoff from the headwaters of this tributary. Recommended improvements are shown graphically on Figure 9.

6.1.5 CIP Project No. 5 – Stormwater Detention Along Upper Foe Killer Creek

CIP Project No. 5 involves construction of a detention basin at the headwaters of Upper Foe Killer Creek (see Figure 9). This project will attenuate peak discharge released from the upper sub-watershed, which currently contributes to the flooding and erosion problems downstream. Elements of construction include clearing and excavation, installation of an outlet structure and emergency spillway, fencing, and site restoration.

6.1.6 CIP Project No. 6 – Stormwater Conveyance Improvements in Vicinity of Brook Drive

This project includes the replacement of aged, undersized, or otherwise dysfunctional segments of the existing drainage infrastructure originating at Upshaw Drive and crossing Meadow Drive and Brook Drive. The upgrades typically involve replacing segments that are currently CMP or less than 30 inches in diameter. As shown on Figure 8, this project will involve installation of approximately 1,200 linear feet of storm drain pipe, and construction of junction boxes, inlets, catch basins, and headwalls.

6.2 Regulatory Considerations

For detention pond projects, the U.S. Army Corps of Engineers (USACOE) currently allows construction of on-line detention within drainage ditches or at the headwaters of streams, with provisions applying under a nationwide permit. A stream buffer variance from Georgia Environmental Protection Division (EPD) would also be required, but should be obtainable. Local permitting and National Pollutant Discharge Elimination System (NPDES) construction permits would also apply. For stormwater infrastructure improvements (CIP Project Nos. 4 and 6), only local and NPDES construction permits would apply. Stream restoration projects would require a stream buffer variance approval through EPD, but only a preconstruction notification to the USACOE as long as no dredging or filling within the existing stream channel takes place. Again, local and NPDES construction permits would apply.

6.3 Summary of CIP Recommendations

A summary of the CIP project recommendations and estimated construction costs are provided in Table 6-1.

Table 6.1
Summary of Capital Improvement Plan

Project No.	Description	Problems and Concerns Addressed	Level of Protection	Estimate of Construction Cost
Project No. 1	Jere Drive Detention Pond	P3, P4, P5, P5, C2, C18	25-year event	$155,250
Project No. 2	Stormwater Detention at Milton High School	P5, P6, P7, P8, C20	25-year event	$348,250
Project No. 3	Tributary C Detention Facilities	P5, P6, C2, C21, C22	25-year event	$153,750
Project No. 4	Stormwater System Replacement and Detention Along Lantern Ridge Court	P1, P3, P5, P6, C2	25-year event	$101,875
Project No. 5	Stormwater Detention Along ~~Tributary E~~ Foe Killer Creek	P3, P5, P6, C2	25-year event	$275,875
Project No. 6	Stormwater Conveyance Improvements in Vicinity of Brook Drive	P8, C19, C20	25-year event	$215,000
Total				$1,250,000

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Figure 8
CIP Projects South of Mayfield Road

Upper Foe Killer Creek Watershed Study

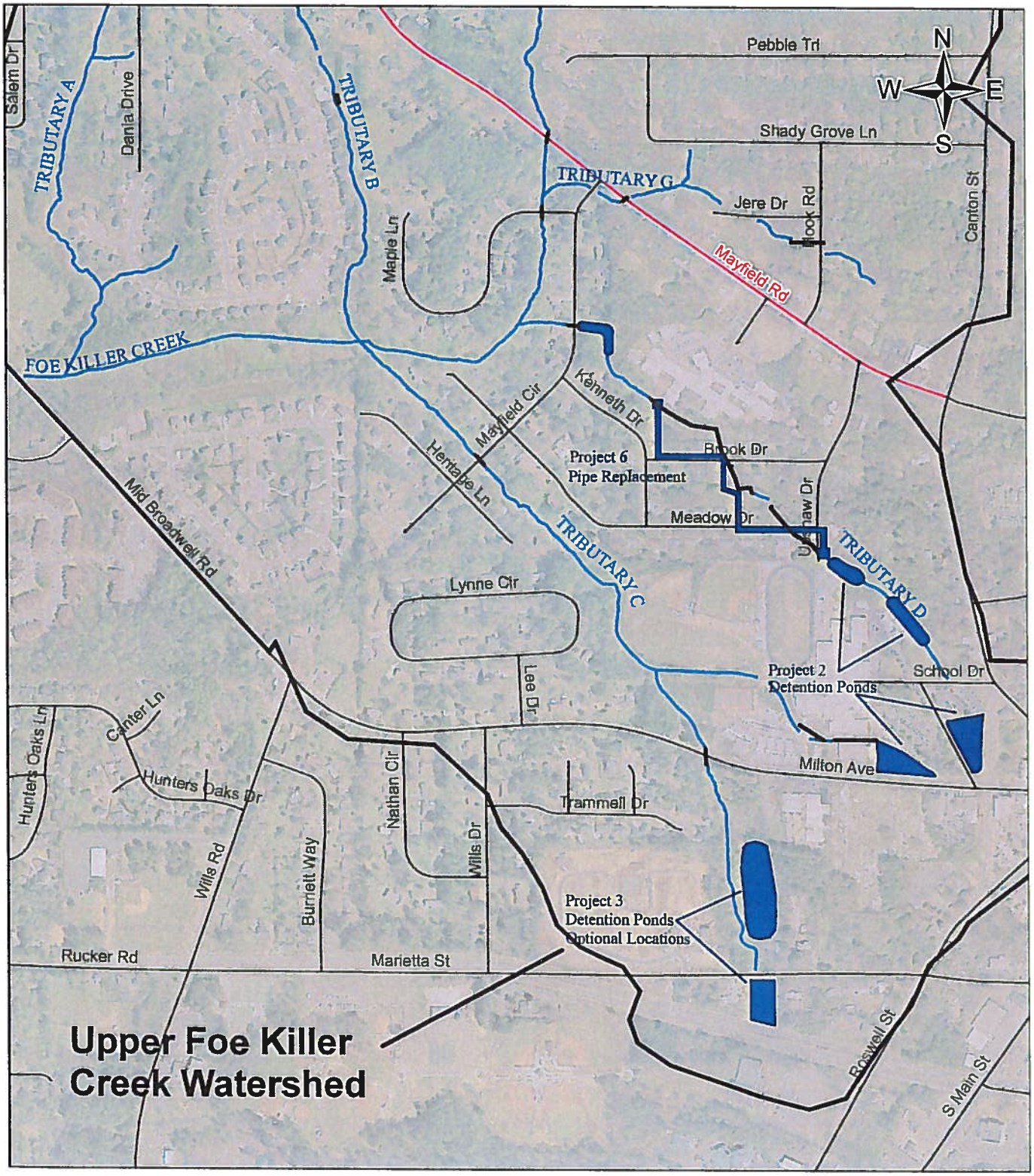

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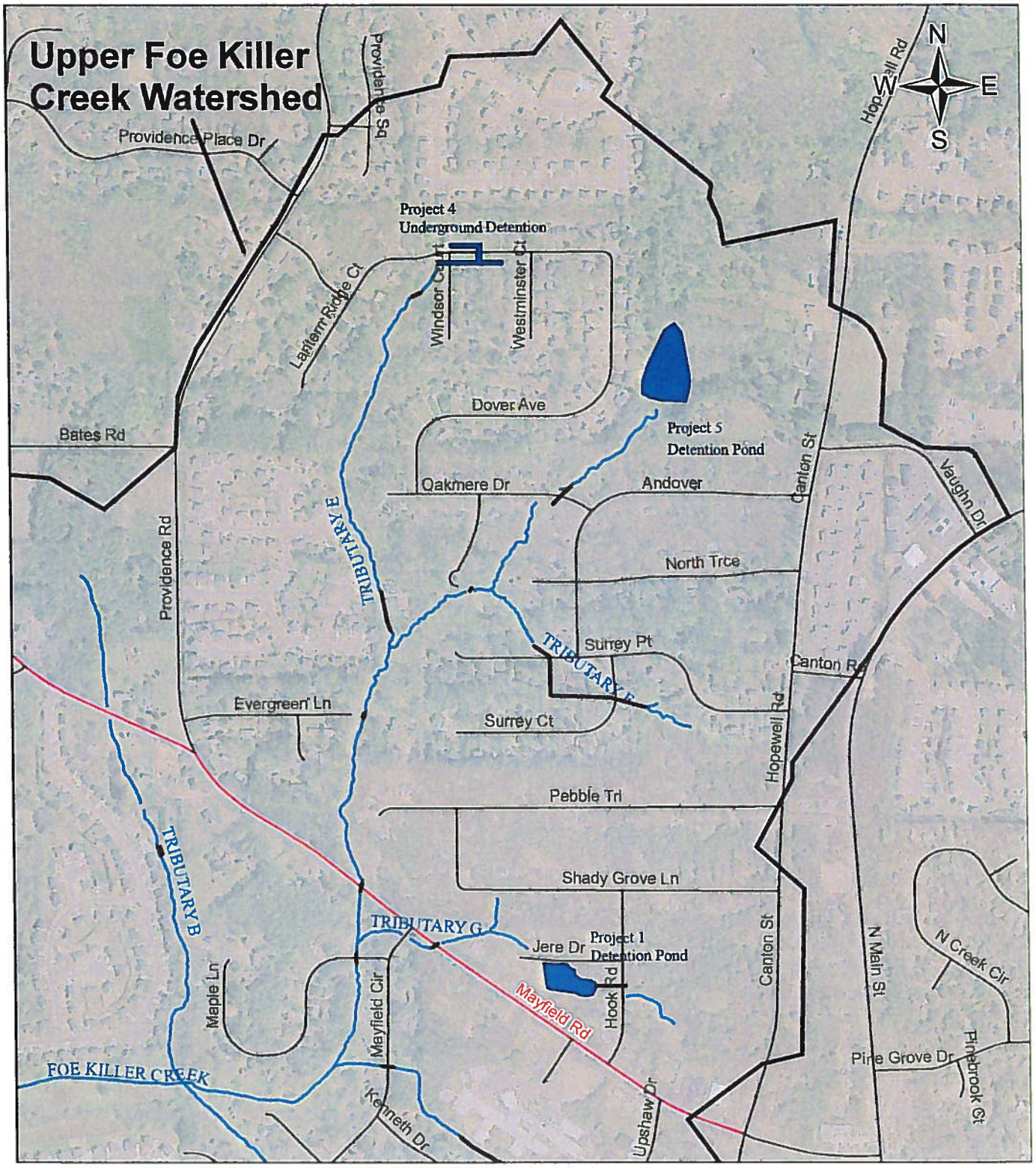
Figure 9
CIP Projects North of Mayfield Road

Upper Foe Killer Creek Watershed Study



7. Private Property Drainage Improvements

This section describes potential drainage improvements that could be implemented either by individual private property owners or by homeowner associations to alleviate adverse drainage conditions on properties not owned by the City of Alpharetta. Because these potential improvements involve drainage problems located outside of City-owned property, they are identified in this section separately and not made part of the recommended capital improvement projects described in Section 6.

7.1 Description of Private Property Drainage Improvements

Four private property drainage problems were identified previously in Section 5.3. Below is a brief summary of possible improvement projects that could be undertaken by the homeowners to address these problems.

7.1.1 Private Improvement No. 1 – Channel Improvements Near Mayfield Circle

The purpose of this private property improvement project is to improve channel conditions, thereby providing increased channel capacity in the vicinity of 205 Mayfield Circle. This drainage channel is currently undersized in comparison with the channel capacity farther upstream and is overgrown with vegetation. Implementation of this project will provide better flood protection for the adjacent property. Construction will involve clearing, channel reshading, bank stabilization, and site restoration.

7.1.2 Private Improvement No. 2 – Broadwell Oaks Drainage Improvements

This private property improvement project is designed to address existing drainage problems and development of sinkholes within the Broadwell Oaks subdivision. A description of the drainage problem is provided in Section 5.1, Drainage Problem Nos. 2 and 3. Approximately 300 linear feet of 18-inch storm drain pipe is required, along with associated inlets, junction boxes, and headwalls.

7.1.3 Private Improvement No. 3 – Foe Killer Creek Stream Restoration South of Mayfield Road

This improvement project is intended to address the high flow and erosion/ sedimentation conditions present along Foe Killer Creek, immediately south of Mayfield Road. Approximately 1,000 linear feet of stream restoration is required. The

creek reconfiguration would include "laying back" the bank slopes on one side of the creek, thereby eliminating steep and eroding side slopes and reducing stream velocities. The restored stream would then be stabilized with a combination of matting and vegetative controls. Existing channel obstructions would also be removed.

7.1.4 Private Improvement No. 4 – Optional Improvements Along Foe Killer Creek, South of Maple Lane

As previously described in Section 5.3 (refer to Drainage Problem Nos. 8 and 9), at least four residences are significantly impacted by recurring flooding along Foe Killer Creek. The residences impacted the most are 3110 Maple Lane and 381 Meadow Drive, which experience flooding on a regular basis. These residences are located within the FEMA 100-year floodplain and will continue to experience some flooding even if all of the recommended CIP improvements are constructed.

The following optional recommendations will address this issue:

- Option 1 – Purchase the properties currently located within the floodplain, or
- Option 2 – Extend Private Improvement No. 3 stream restoration another 1,500 to 2,000 feet.

With Option 1, the drainage problems are eliminated through purchase of the properties. With Option 2, the level of flood protection is improved (to as much as the five-year storm), but periodic flooding will continue to occur for the higher storm events.

7.2 Summary of Private Property Drainage Improvements

A summary of the private property drainage improvements is provided in Table 7.1.

Table 7.1
Summary of Private Property Drainage Improvements

Project No.	Description	Problems and Concerns Addressed	Level of Protection	Estimate of Construction Cost*
Project No. 1	Channel Improvements Near Mayfield Circle	P7	5-year event	$34,375
Project No. 2	Broadwell Oaks Drainage Improvements	P2	25-year event	$52,500
Project No. 3	Foe Killer Creek Stream Restoration South of Mayfield Road	P3, C18	25-year event	$298,750
Project No. 4	Optional Improvements Along Foe Killer Creek, South of Maple Lane	P5, P6	25-year event (Option 1)/ 5-year event (Option 2)	$325,000**
Total				$710,625

*See Appendix D for a detailed breakdown of estimated construction costs.

**Assuming stream restoration option.

8. Funding Options

This section provides a brief description of the options available to the City for funding of the stormwater improvements recommended with this report. Funding strategies may consist of one of the five, or a multiple of the funding sources/options described below. ARCADIS recommends consideration of each of these general funding options to support the City's CIP.

8.1 Option 1 – Stormwater Utility Service Fee (Stormwater Utility)

Stormwater utility service fees are typically based on a rate structure that considers the amount of impervious area (roofs, pavement, etc.) contributing stormwater runoff to a receiving stream. A well-planned stormwater utility service fee is equitable because the cost is borne by the customer on the basis of the demand placed on the drainage system.

8.2 Option 2 – General Fund Appropriations

The General Fund can generate revenue to better fund stormwater management, but may require reallocation of current resources or property tax increases. Through this funding option, however, stormwater management needs are likely to be better funded following years having significant or severe rainfall events. Inconsistent funding would make it difficult to plan and implement a long-term CIP.

8.3 Option 3 – Bonding for Capital Improvements

The Georgia statutes authorize the use of bonding for capital improvements to local infrastructure, including stormwater systems. Bonds are not a revenue source, but rather a method of borrowing dependent for debt service on other revenue sources, such as taxes, fees or assessments. Funding in this way allows for construction of major improvements in advance of what could be funded from annual budget resources. Such bonds may be either revenue bonds or general obligation bonds.

8.4 Option 4 – Special Assessment Districts

Capital improvements to stormwater drainage systems may be funded through special assessments imposed upon directly and specially benefited properties. In this case, the distribution of cost must be proportionate to the direct and special benefit provided to each property assessed.

8.5 Option 5 – Impact Fees

Impact fees may be administered in several different ways, including development impact fees and in lieu of construction fees. Development impact fees can be administered through the local government development review and approval process, whereby new development bears the cost of stormwater infrastructure capital improvements. In lieu of construction fees typically relate to alleviating developer requirements to provide on-site detention systems when regional detention may be a more practical option. In this case, developers would be assessed a fee in lieu of providing on-site controls or of being required to physically construct a regional facility.

Each of the options described above has a unique set of advantages and disadvantages, depending on the City's needs. For example, a stormwater service fee may be more advantageous than some of the other options to address a variety of long-term stormwater needs on a citywide scale. Special tax districts, on the other hand, are beneficial for localized drainage issues that typically impact a defined area or group of citizens. Some communities have also successfully used SPLOST revenues to fund stormwater capital improvement projects.

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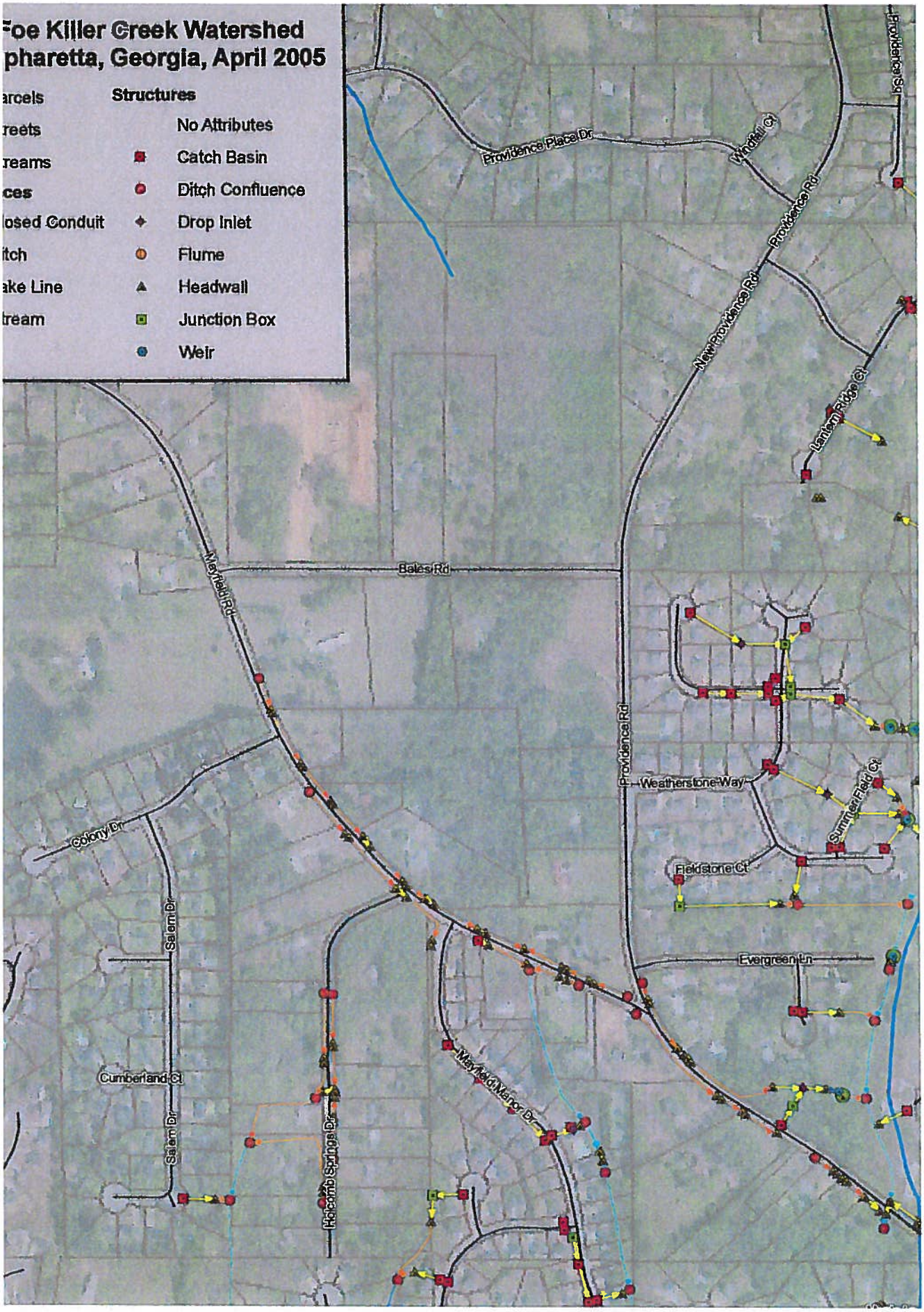
Appendix A

Stormwater Structure Inventory Map


Foe Killer Creek Watershed
pharetta, Georgia, April 2005
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Structures
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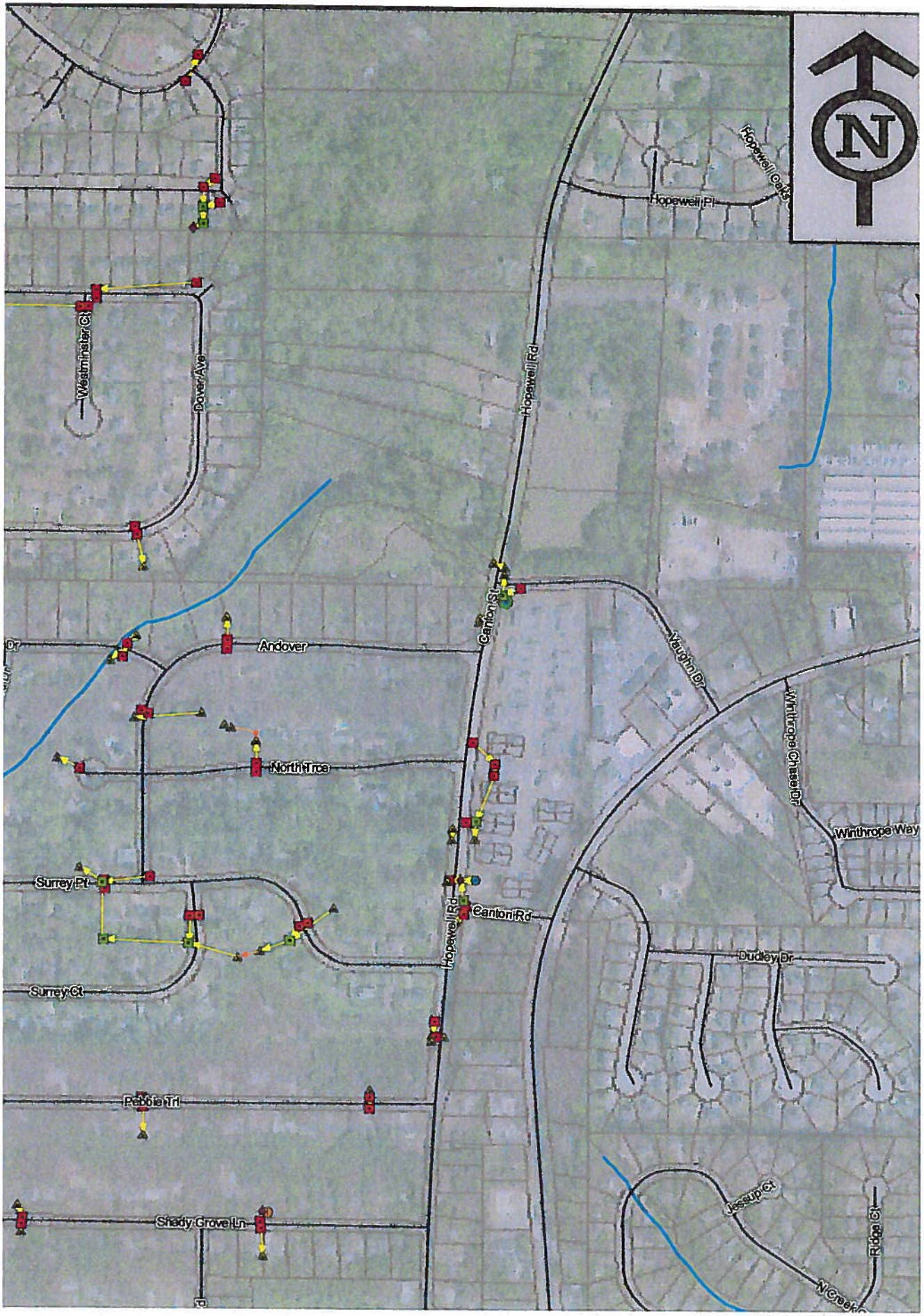
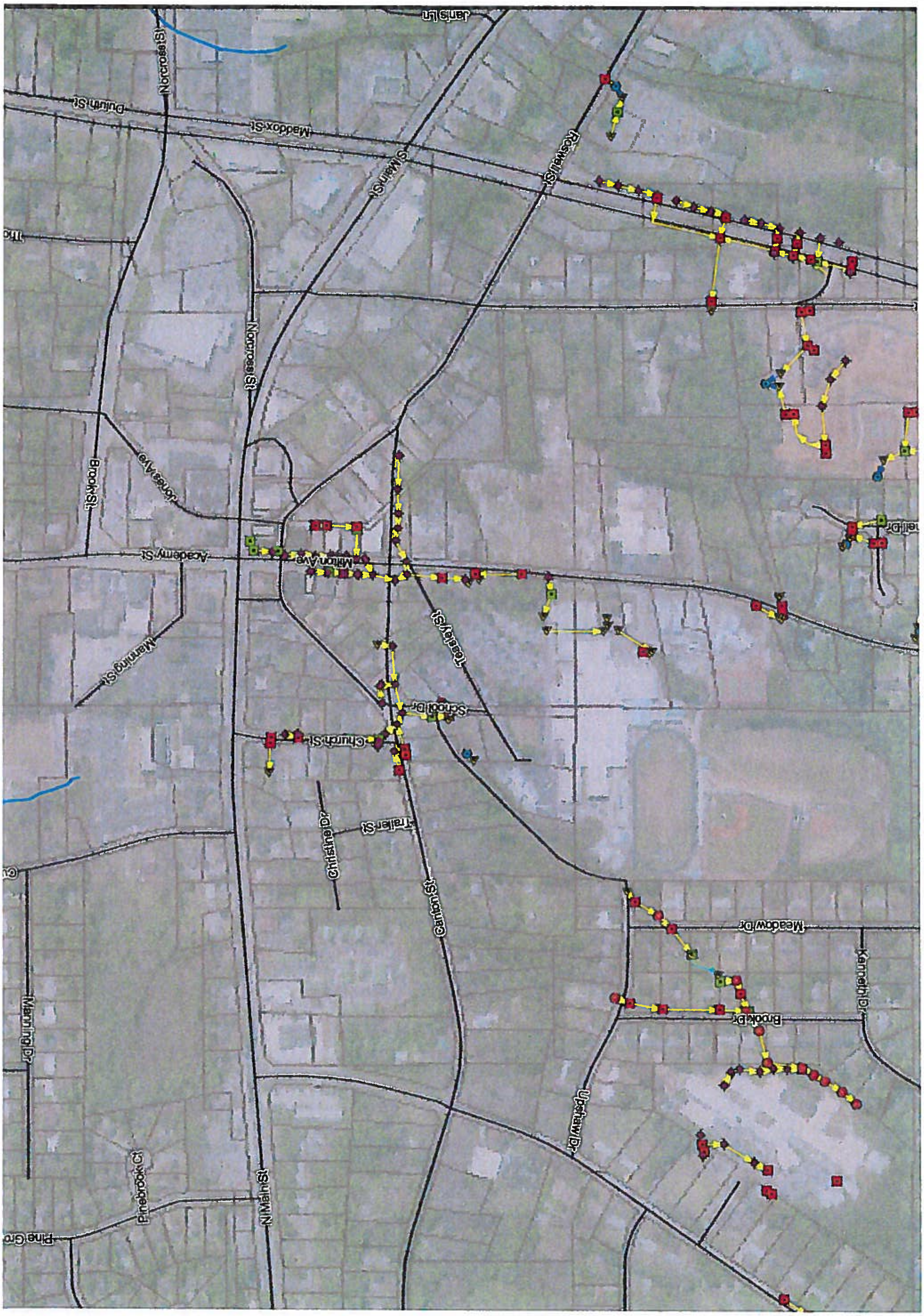
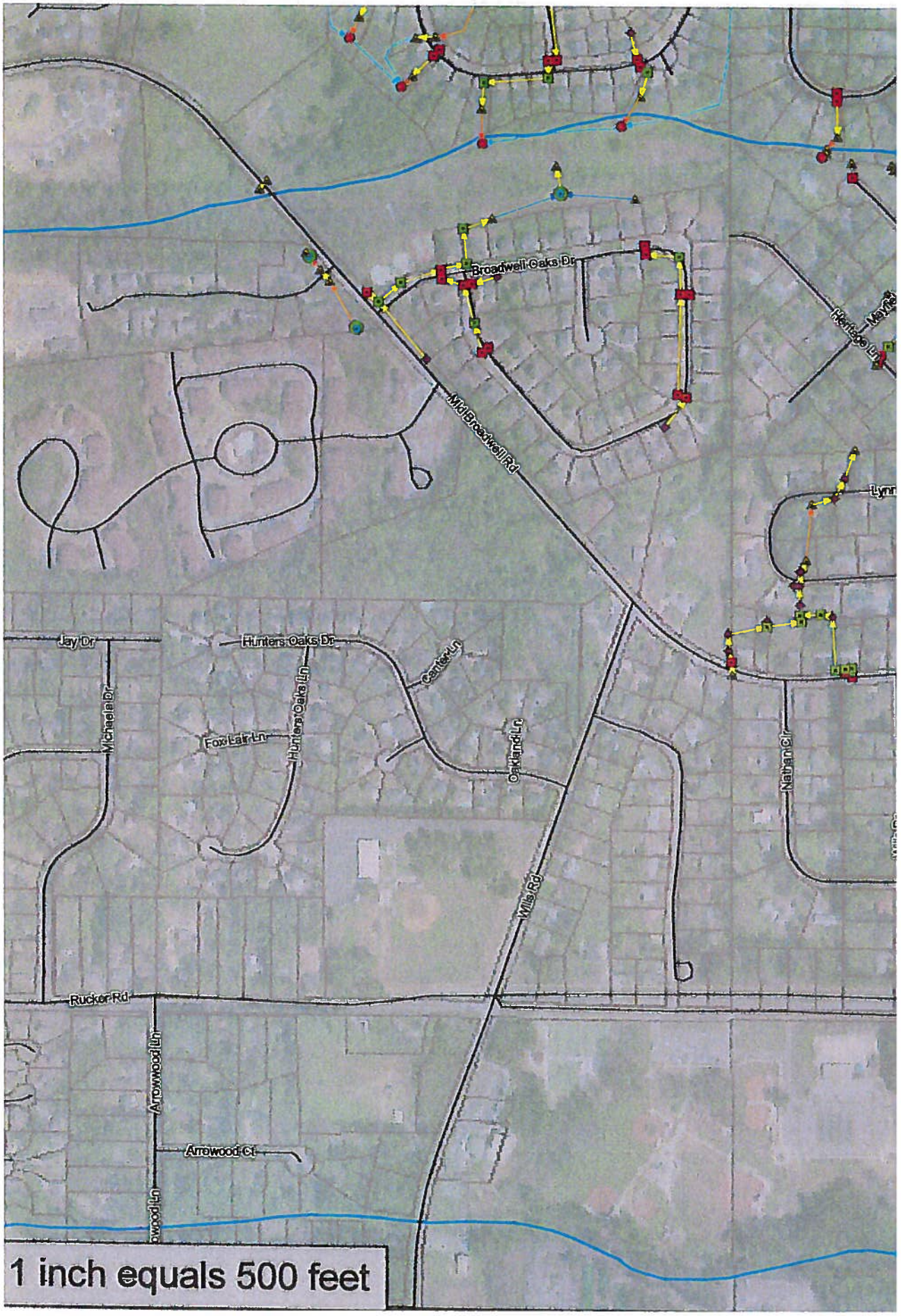
Catch Basin
Ditch Confluence
Drop Inlet
Flume
Headwall
Junction Box
Weir
Providence Place Dr
Windfall Ct
Providence Rd
New Providence Rd
Providence Sq
Lantern Ridge Ct
Bates Rd
Mayfield Rd
Providence Rd
Weatherstone Way
Summer Field Ct
Fieldstone Ct
Colony Dr
Salem Dr
Evergreen Ln
Cumberland Ct
Salem Dr
Holcomb Springs Dr
Mayfield Manor Dr


N
Hopewell Oaks
Hopewell Pl
Westminster Ct
Dover Ave
Hopewell Rd
Andover
Canton St
Vaughn Dr
Winthrope Chase Dr
Winthrope Way
North Trce
Surrey Pt
Canton Rd
Hopewell Rd
Dudley Dr
Surrey Ct
Pebble Trl
Shady Grove Ln
Jessup Ct
Ridge Ct



Jan's Ln
Norcross St
Duluth St
Maddox St
S Main St
Roswell St
Norcross St
Brook St
Jones Ave
Academy St
Milton Ave
Manning St
Teasley St
School Dr
Church St
Christine Dr
Trailer St
Canton St
Meadow Dr
Kenneth Dr
Brook Dr
Manning Dr
Upshaw Dr
Pinebrook Ct
N Main St


Broadwell Oaks Dr
Mid Broadwell Rd
Jay Dr
Hunters Oaks Dr
Michaela Dr
Fox Lair Ln
Hunters Oaks Ln
Center Ln
Oakland Ln
Nathan Cir
Wills Rd
Rucker Rd
Arrowood Ln
Arrowood Ct
1 inch equals 500 feet

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Appendix B

Drainage Problems
and Concerns Map

Upper Foe Killer Creek Basin Drainage Complaints

No.	Name	Address	Contact Number	Description of Complaint	Date of Complaint	File Available
	Kyle Strickland	1402 Salem Drive		concerns regarding detention pond on adjacent property	03/21/1988	Y
	Charlie Sheffield	1386 Salem Drive		inadequate drainage system needs repair	11/15/1990	Y
	Richard Whittington	Lots 9 & 10, Surrey Place Subdivision		modification of storm without approval	01/16/1991	Y
	Nellie Rogers	39 Teasley Street		runoff from Teasley Street	02/04/1991	Y
	Evelyn Walker	170 Meadow Drive	770-442-0647	failing storm system	07/07/1993	Y
	Jim Green	320 Hook Street		erosion of drainage ditch	10/04/1993	Y
	Kevin Holewinski	3110 Maple Lane		flooding of yard, Foe Killer Creek	12/14/1993	Y
	Addie Greer	381 Lynne Circle		flooding of crawl space due to obstructed and inadequate storm drain	05/30/1995	Y
		388 Lynne Circle		excessive runoff-part of Lynne Circle Watershed Improvements		Y
	John & Claire Santoros	Broadwell Oaks Subdivision		sinkholes, improper drainage	03/16/1996	Y
	Dave Riches	1875 Broadwell Oaks Drive		sinkholes, improper drainage	03/16/1996	Y
	Robert Leeper	135 Lantern Ridge Court		replace drop inlet	03/18/1997	Y
	Carol Koslowsky	133 Upshaw Drive	770-475-4337	flooding of property during heavy rains	04/25/1998	Y
	Robert Trapino	630 Brookford Drive	770-475-4836	inadequate wier system, flooding of Foe Killer Creek	10/01/1998	Y
	Tim Mitchell	324 Meadow Drive	770-475-8702	flooding due to improper drainage	02/03/2000	Y
	William Bagwell	172 Upshaw Drive	770-475-5782	sinkhole at storm drain	12/03/2001	Y
	Kurt Close	7154 Surrey Point		standing water due to inadequate drainage	02/08/2002	Y
	Eric Crossfield	200 Lantern Ridge Court	706-265-6666	sinkhole	05/13/2002	Y
	Blair Christian	275 Shady Grove Lane	770-619-2370	obstructed storm drain	06/05/2002	Y
	Lee Martin	Broadwell Oaks Subdivision	678-339-0934	seeping water at sidewalk in front of subdivision on Mid-Broadwell Road	07/12/2002	Y
	Melvin/Martha Nichelson	171 Upshaw Dive		sinkhole, new storm pipe needed	10/01/2002	Y
	Kwame Davis	335 Summer Field Court	770-475-1903	streambank stabillzation; rip rap request	01/03/2003	Y
	Diane Leonard	229 Meadow Drive		beasement leaks due to excess runoff from roadway	01/31/2003	Y
	Bobbie Geiger	245 Pebble Trail	770-663-7687	standing water in back yard	03/06/2003	Y
	Buck Bailie	170 Mayfield Circle	770-442-0620	continuing drainage problems in yard	03/13/2003	Y
	Holly Sanders	381 Meadow Drive		house in flood plain; wants creek dredged out	04/30/2003	Y
	Martha Martin	409 Lynne Circle		excessive runoff- part of Lynne Circle Watershed Project	05/06/2003	Y
	H D Bagley	345 Heritage Lane		excessive runoff- part of Lynne Cir. Watershed Project	05/06/2003	Y
	Belinda Bailey	204 Brook Drive	770-355-7734	flooding of yard and shed	05/06/2003	Y
	Al Galsford	285 Mayfield Road		flooding of yard, Foe Killer Creek, rip rap request	05/06/2003	Y
	Sheila James	413 Lynne Circle	770-750-2543	basement flooded- part of Lynne Circle Watershed Project	05/07/2003	Y
	Gene Tutor	3120 Maple Lane	770-458-8341; (	workshop flooded	05/07/2003	Y
	Dwayne Savage	352 Pebble Trail	770-346-9899	flooding of Foe Killer Creek into yard and crawlspace	05/07/2003	Y
	Steve Gatson	342 Pebble Trail	770-442-5291	undersized pipe, standing water, & blocked headwall at edge of property, rip rap request, te	05/13/2003	Y
	Denise Manning	1322 Salem Drive	770-384-2486	sinkhole in backyard	05/27/2003	N
	Randy Myers	249 Milton Avenue		erosion at stream bank, losing property close to house	05/29/2003	Y
	Tony Pendley	31 Church Street	678-297-6200	repair catchbasin	06/11/2003	Y
	Charles Ennis	490 Trammel Court	770-667-0432	runoff from Wills Commons; will need rip rap	06/18/2003	Y
	Laura Danforth	160 Shady Grove Lane	770-475-2326	erosion at stream bank, rip rap request	06/18/2003	Y
	Dale Wilson	3003/3004 Maple Lane	770-442-0376	obstructed culvert	06/18/2003	Y
	Linda Harp	255 Lantern Ridge Court	770-360-2594	rip rap for drainage ditch in front yard; storm line needs to be cleaned out	06/23/2003	Y
	Peggy Donoho	170 Cobblestone Way	404-271-8864	rip rap delivery	06/25/2003	Y
	Michelle Holcomb	10 Roswell Street	404-846-4003	sinkhole at storm drain in City parking lot behind Alpharetta Town Commons	07/02/2003	Y
	Katie Epps	5510 Surrey Court	678-297-6200	sinkhole at catchbasin	07/15/2003	Y
	Adam Oberson	203 Jere Drive	678-297-6200	repair catchbasin	07/17/2003	N
	Nelson Allen	1394 Salem Drive	770-475-7656	retention pond maintenance questions	07/21/2003	Y
	Pam Ferguson	211 Brook Drive	770-475-0137	runoff from roadway flooding driveway and yard	07/21/2003	Y
	Jeff Hawkins	Jere Drive	678-297-6200	debris and vegetation in dra nage ditch	07/22/2003	N
	Jennifer Anderson/Mitch McKinney	1430 Salem Drive	770-664-9864	sinkhole in yard, rip rap request	08/05/2003	Y
	Katie Epps	Trailer Street		inadequate detention pond at Arrow Exterminator	08/22/2003	Y

Upper Foe Killer Creek Basin Drainage Complaints

No.	Name	Address	Contact Number	Description of Complaint	Date of Complaint	File Available
	Earl Chatham	Lynne Circle	678-297-6200	sand bag delivery to prevent flooding	09/18/2003	N
	Lee Stevens	700 Windsor Court	770-325-2233	2 sinkholes at drop inlet, 1 at CB on Windsor Ln, 1 forming at CB on Lantern Ridge	11/04/2003	Y
	Mrs. Miller	220 Pebble Trail		rip rap/baby surge stone delivery	11/13/2003	N
	Laurie Padgett	230 Mayfield Circle		severe erosion along creek bank	12/18/2003	Y
	Adam Orberson	Canton St at Old Canton St	678-297-6200	repair catchbasin	12/30/2003	N
	Adam Orberson	Roswell St at Old Roswell St	678-297-6200	repair catchbasin	12/30/2003	N
	Chris Carter	1300 Mayfield Manor Drive	404-230-5217	obstructed stream, flooding backyard	02/13/2004	Y
	Nancy Emmons	348 Meadow Drive	770-752-1830	erosion at stream bank, rip ra request	03/17/2004	Y
	Kathryn Williams	212 Canton Street		standing water in driveway, runoff from Mayfield & Upshaw, reroute water towards Canton S	03/23/2004	Y
	Chance Moore	191 Brooke Drive	770-569-5294	water/sand runoff from Elementary School, inspect grate inlet and sidewalk	03/24/2004	Y
	Kevin Smith	Canton Street	678-297-6200	remove debris from storm drains	04/08/2004	N
	Todd Chernick	150 Shady Grove Lane	770-329-4135	standing water in backyard after rain events, inspect of headwall/backyard	04/14/2004	Y
	Todd Chernick	221 Brook Drive	770-329-4135	standing water in backyard, runoff from Elementary School	04/16/2004	Y
	James Simon	355 Heritage Lane	404-580-9282	erosion at stream bank, rip rap request	04/20/2004	Y
	Katie Epps	Upshaw Dr at Meadow Dr	678-297-6200	clear headwall of vegetation	05/19/2004	N
	Terry Allen	Mayfield Manor Drive	678-297-6200	inspection of catchbasins	05/27/2004	N
	Ron Hyman	310 Shady Grove Lane	770-667-6436	inspection of drainage, technical advice, rip rap delivery	06/16/2004	N
	Fred Hetzel	322 Pebble Trail		inspection of drainage, technical advice rip rap delivery	06/16/2004	N
	David Jurczak	332 Pebble Trail		inspection of drainage, technical advice, rip rap delive	06/16/2004	N
	Mike Stephens	Milton Avenue	678-297-6200	remove debris from utters, storm drains	06/25/2004	N
	Mike Stephens	Brook Drive	678-297-6200	remove debris from utters, storm drains	06/25/2004	N
	Mike Stephens	285 Shady Grove Lane	678-297-6200	remove debris from gutters storm drains	06/25/2004	N
	Mike Stephens	120 Shady Grove Lane	678-297-6200	remove debris from utters storm drains	06/25/2004	N
	Mike Stephens	125 Shad Grove Lane	678-297-6200	remove debris from gutters, storm drains	06/25/2004	N
	Mike Stephens	310 Shad Grove Lane	678-297-6200	remove debris from utters storm drains	06/25/2004	N
	Mike Stephens	201 Brook Drive	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Mike Stephens	211 Brook Drive	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Mike Stephens	221 Brook Drive	678-297-6200	remove debris from utters, storm drains	06/28/2004	N
	Mike Stephens	215 Ma ld Circle	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Mike Stephens	Milton Avenue	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Mike Stephens	160 Shady Grove Lane	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Mike Stephens	165 Shady Grove Lane	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Mike Stephens	285 Shady Grove Lane	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Mike Stephens	310 Shady Grove Lane	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Mike Stephens	210 Pebble Trail	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Mike Stephens	215 Pebble Trail	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Mike Stephens	120 Pebble Trail	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Mike Stephens	125 Pebble Trail	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Katie Epps	Brook Drive	678-297-6200	remove debris from gutters, storm drains	06/28/2004	N
	Kevin Walls	Milton Avenue	678-297-6200	remove debris from gutters, storm drains	07/26/2004	N

☐ North of Mayfield Road

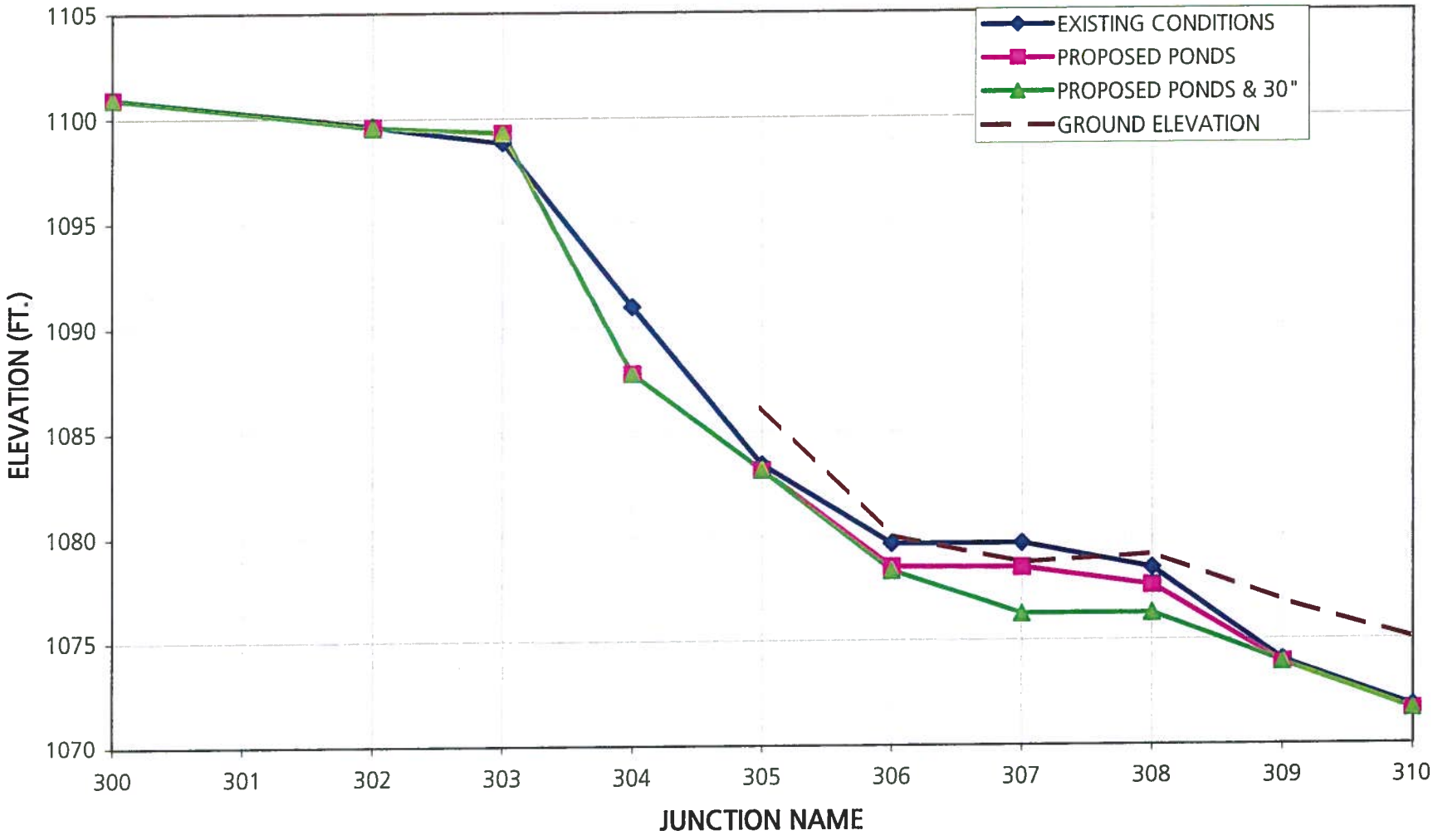
☐ North of Mid-Broadwell, South of Mayfield

ARCADIS

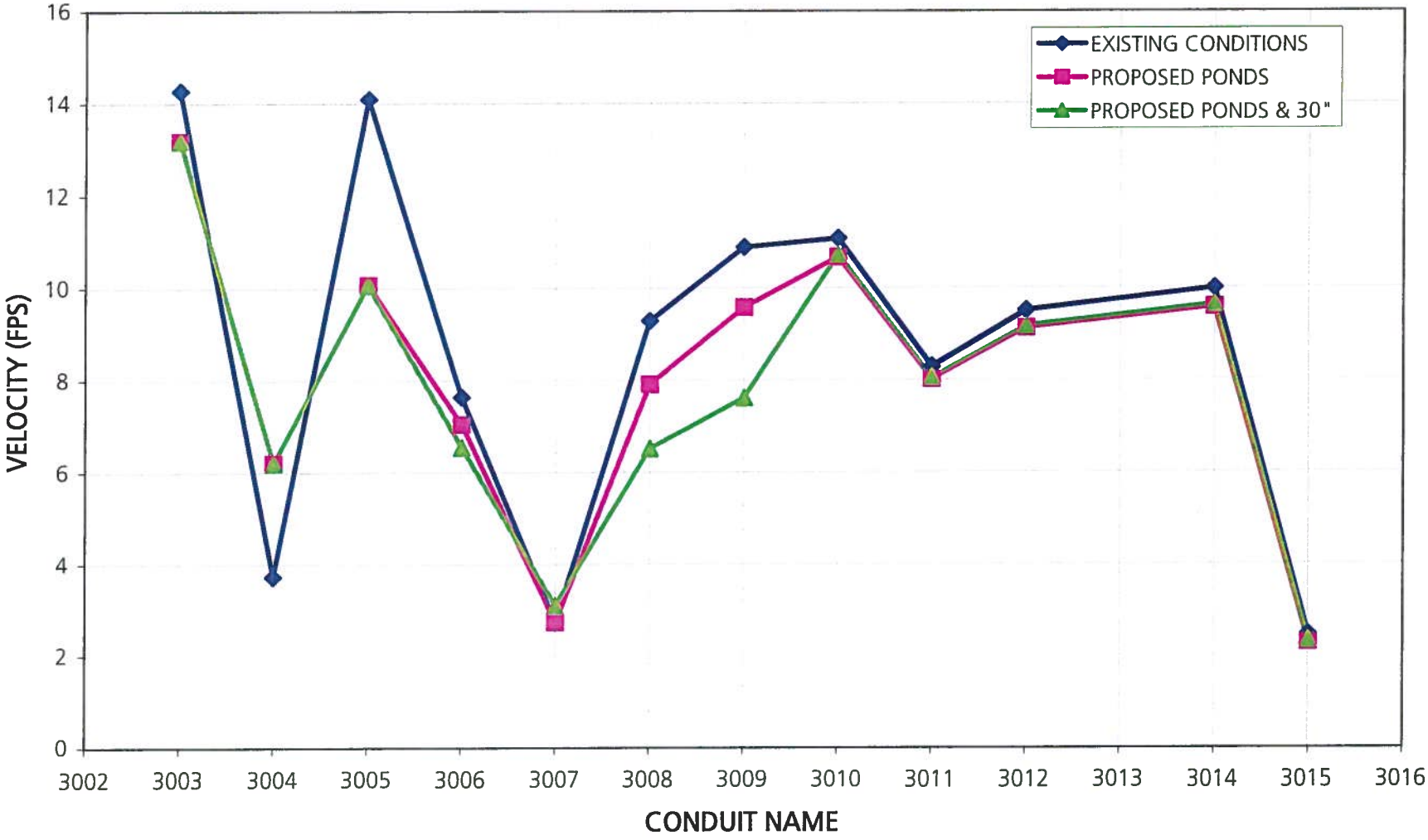
Appendix C

Hydrologic/Hydraulic Modeling Data

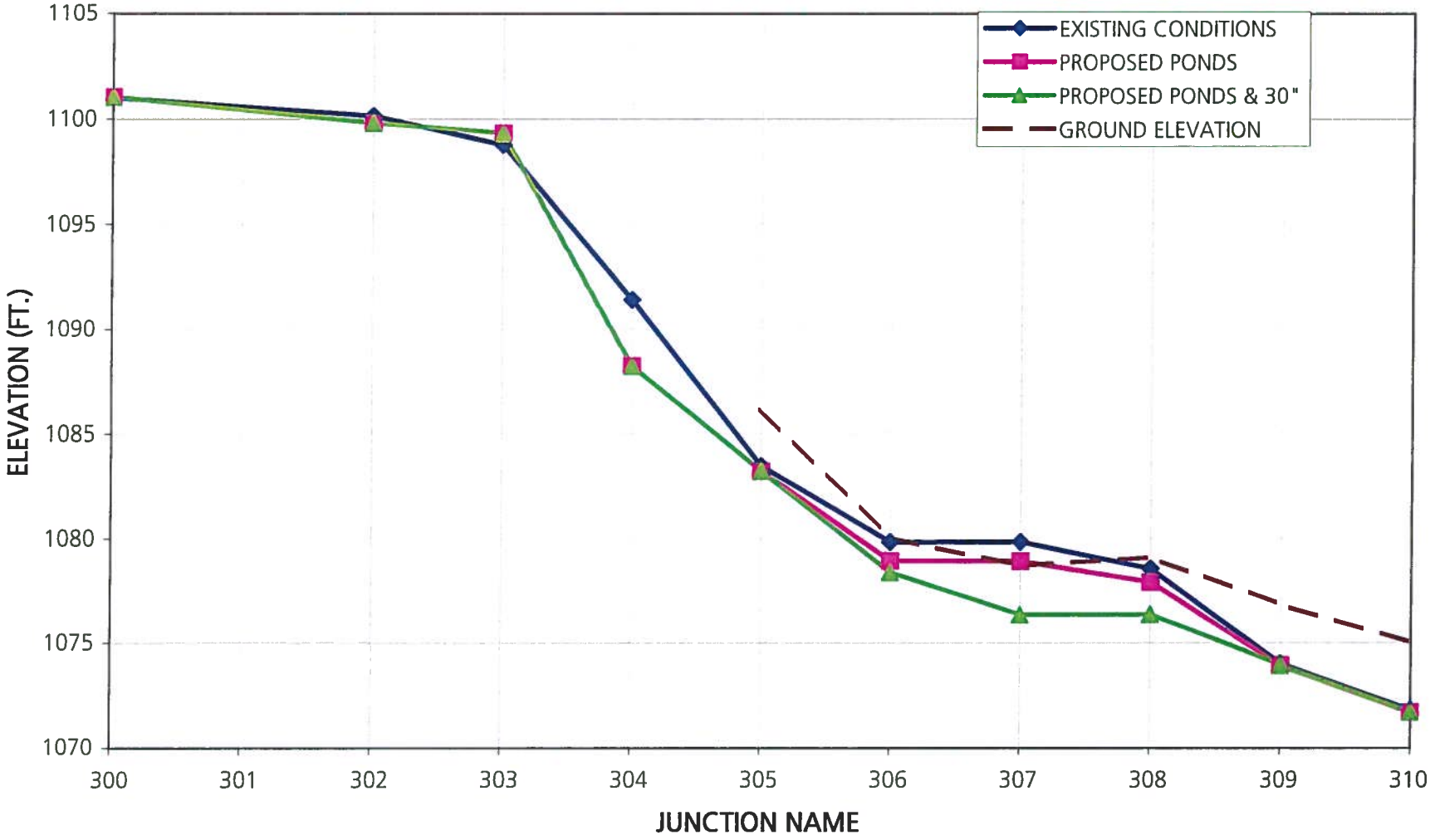
10 YEAR PEAK WATER SURFACE ELEVATIONS



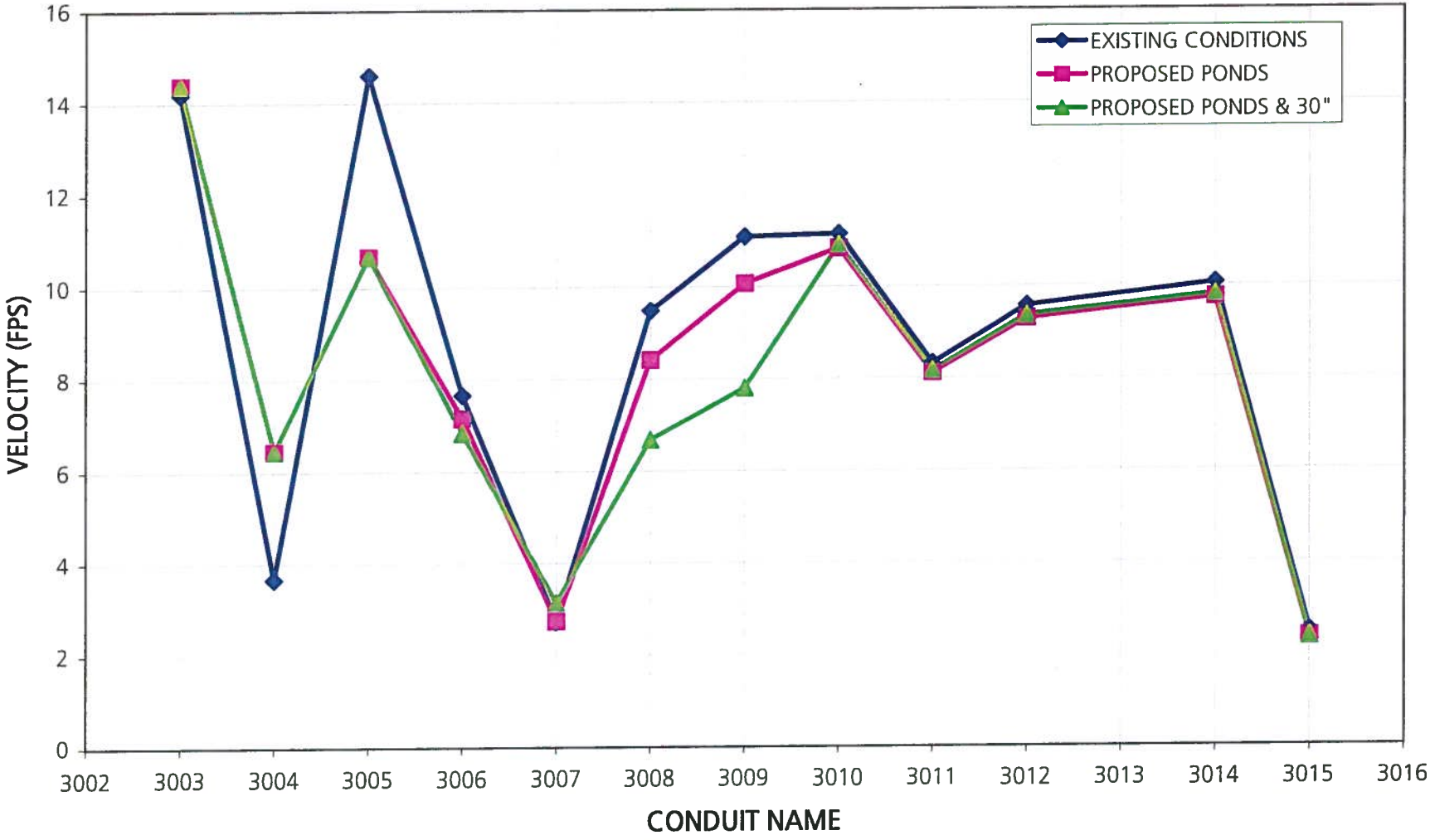
10-YEAR PEAK VELOCITIES



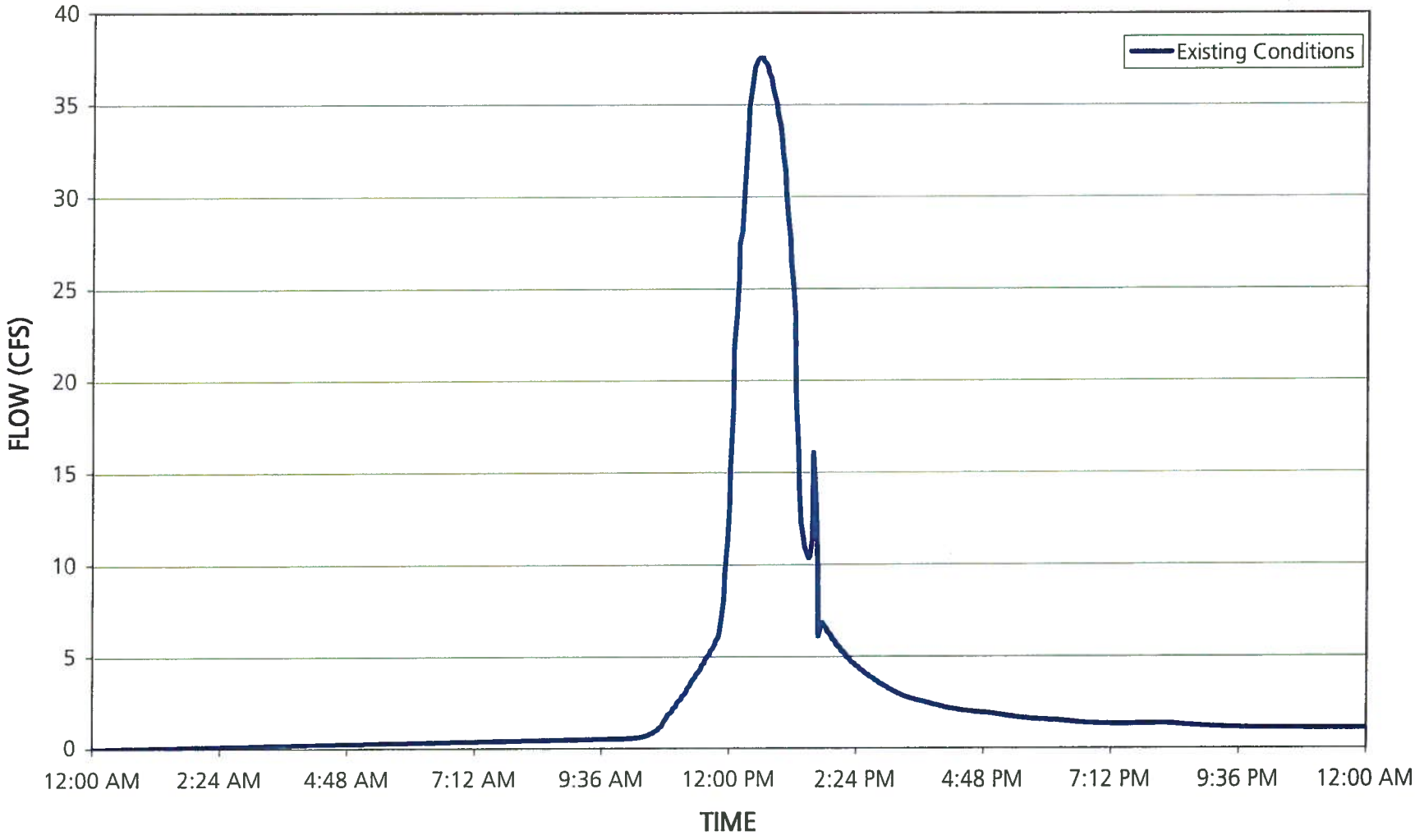
25-YEAR PEAK WATER SURFACE ELEVATIONS



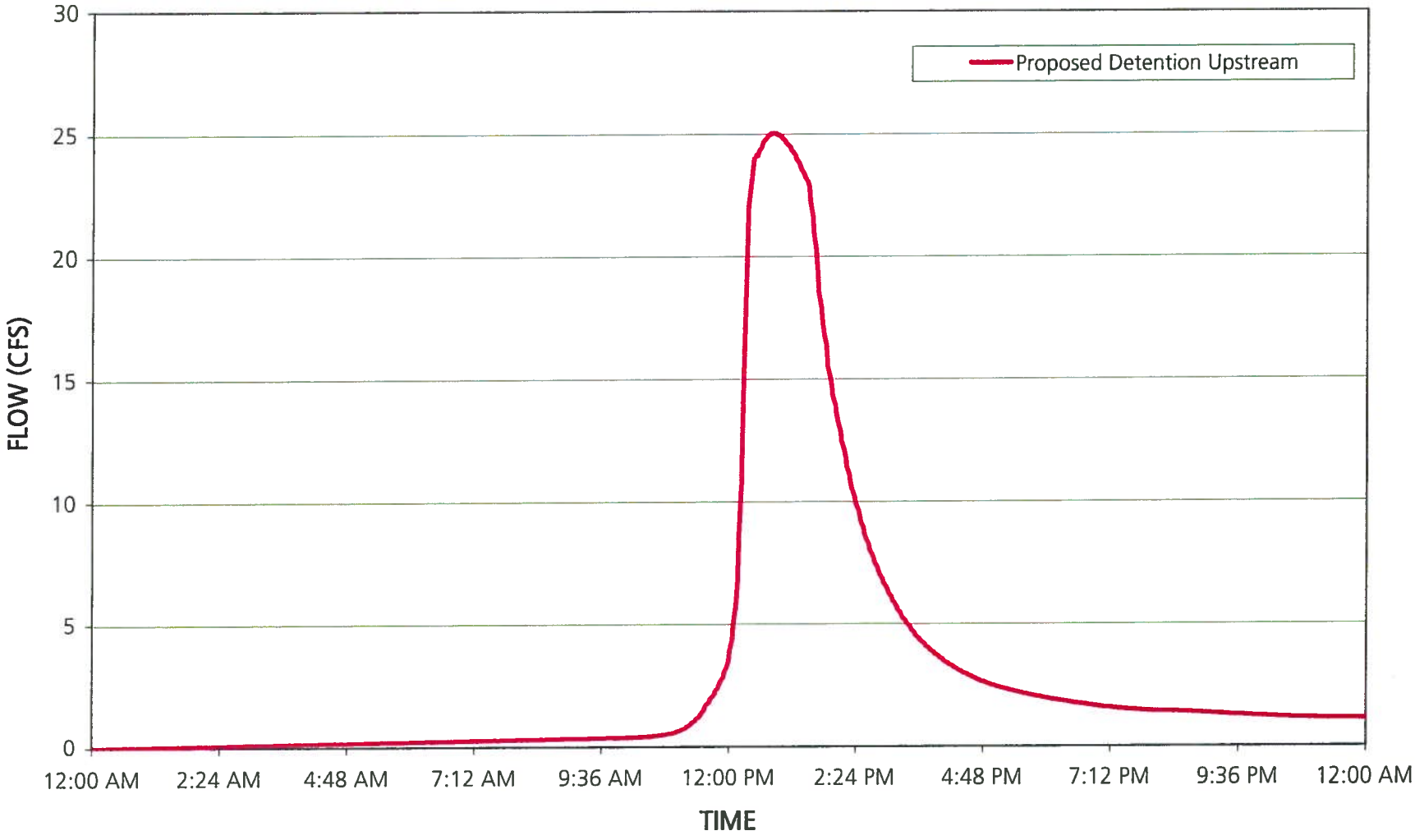
25-YEAR PEAK VELOCITIES



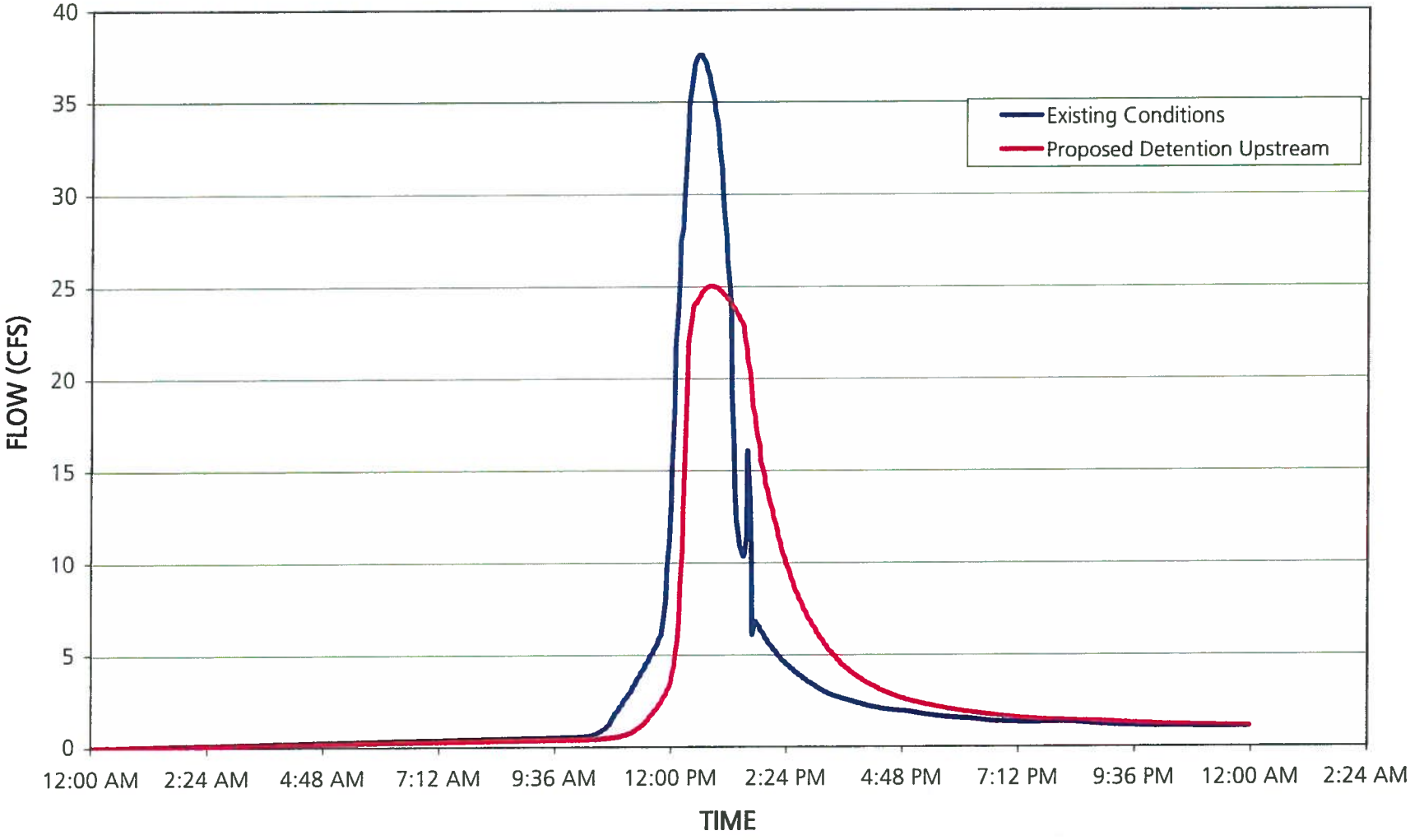
10-YEAR PEAK FLOW
CONDUIT 3008 (SOUTH OF BROOK DRIVE)



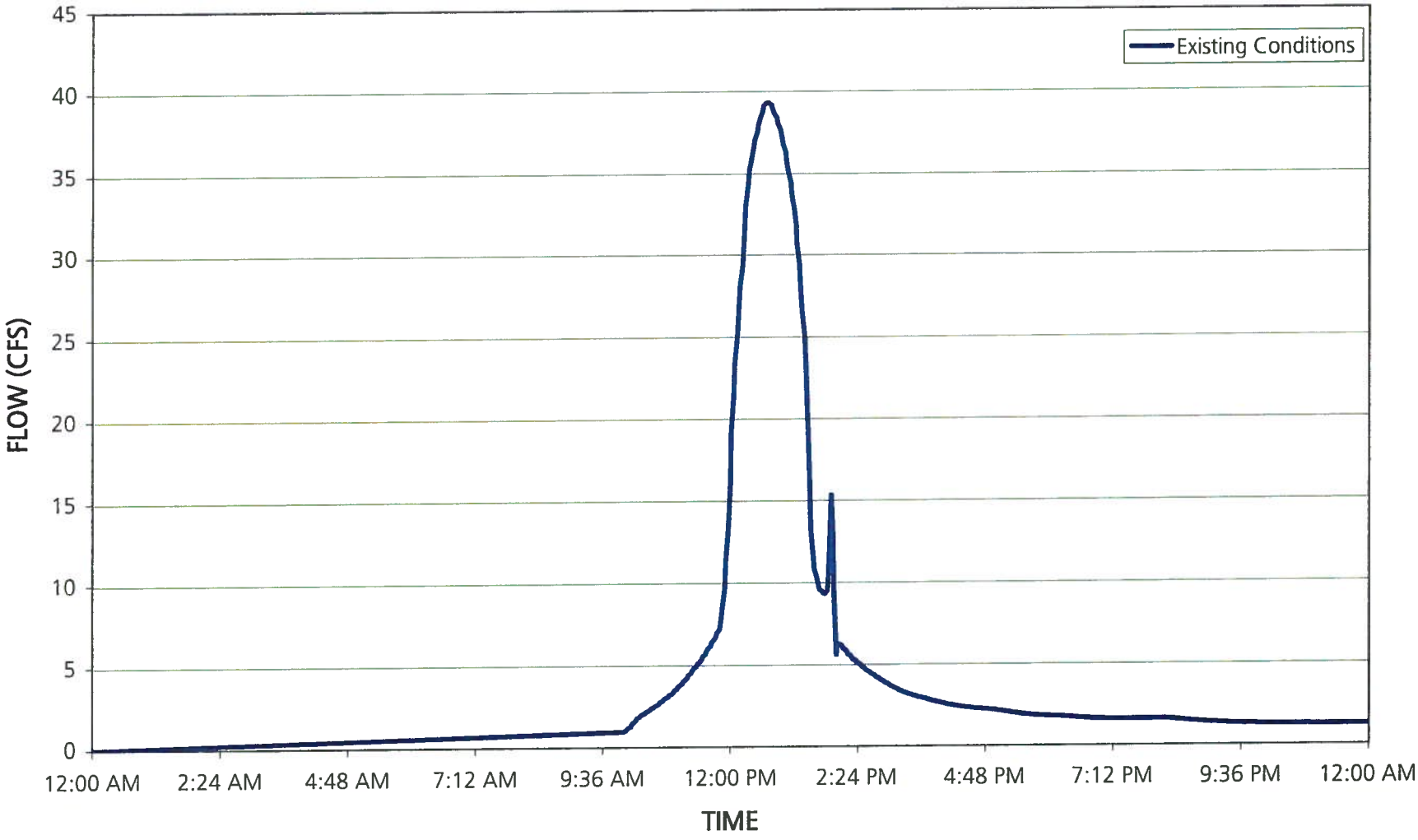
10-YEAR PEAK FLOW
CONDUIT 3008 (SOUTH OF BROOK DRIVE)



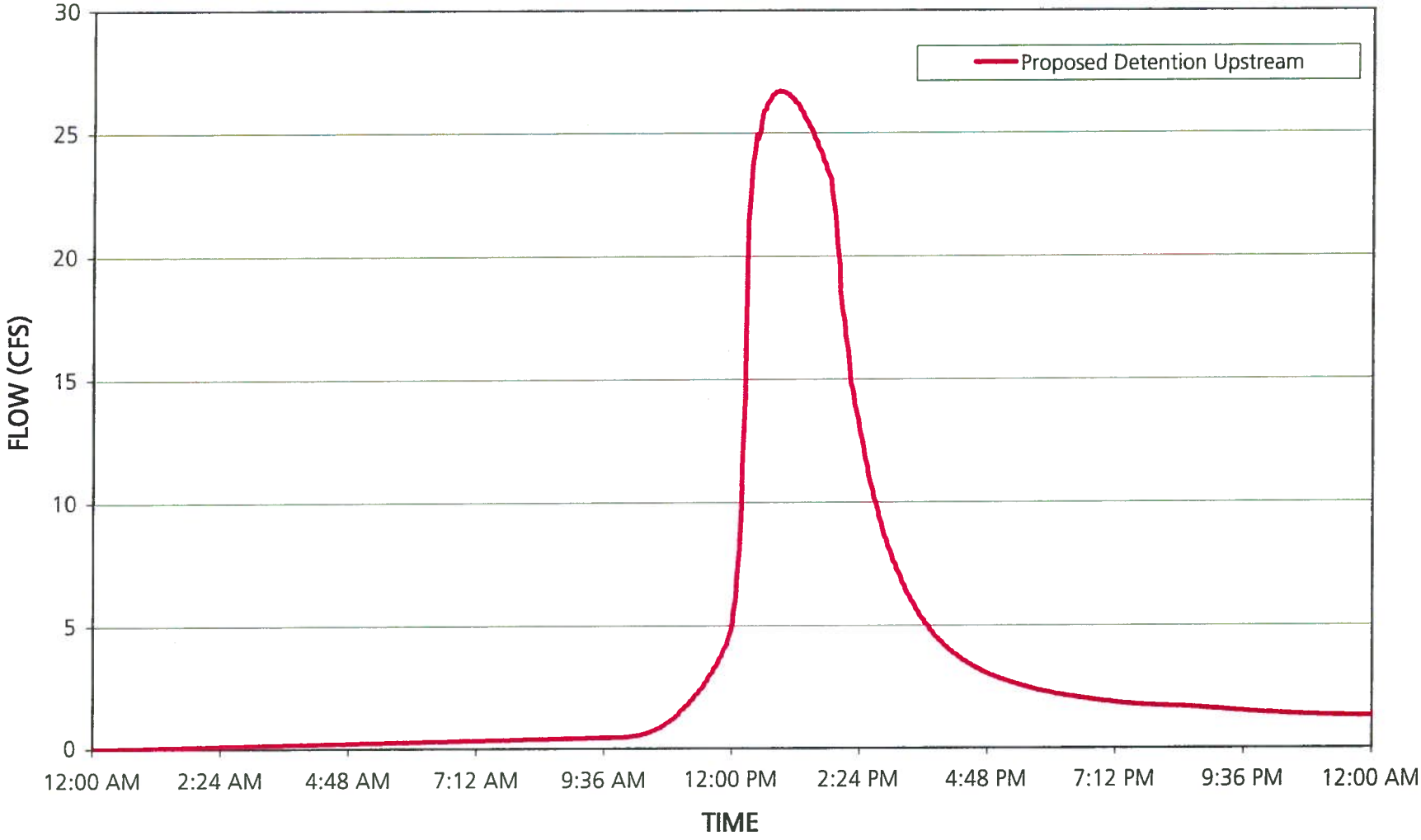
10-YEAR PEAK FLOW
CONDUIT 3008 (SOUTH OF BROOK DRIVE)



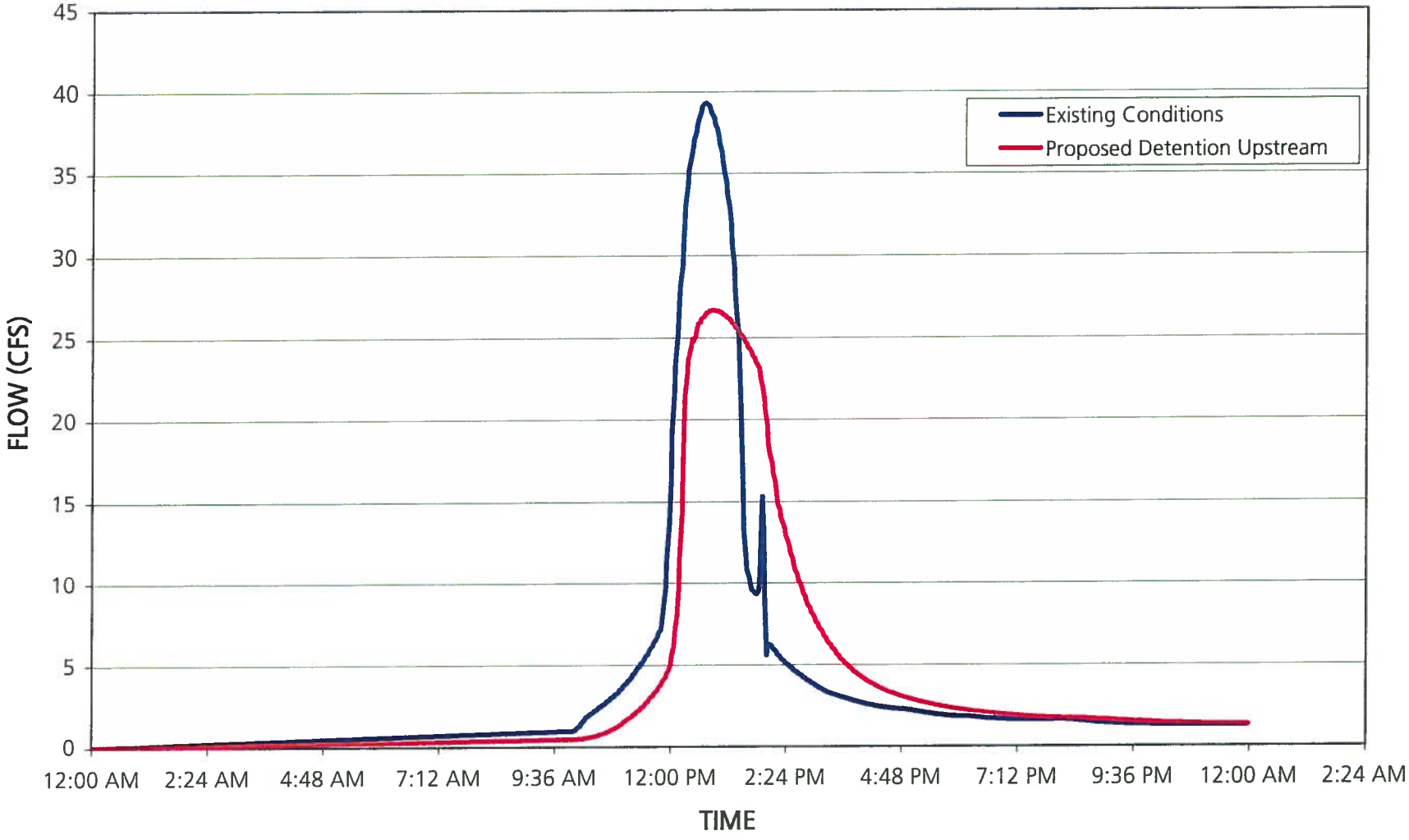
25-YEAR PEAK FLOW
CONDUIT 3008 (SOUTH OF BROOK DRIVE)



25-YEAR PEAK FLOW
CONDUIT 3008 (SOUTH OF BROOK DRIVE)



25-YEAR PEAK FLOW
CONDUIT 3008 (SOUTH OF BROOK DRIVE)



Estimated Construction Cost
CIP Project No. 1 - Jere Drive Detention Pond

Item	Quantity	Unit	Unit Price	Estimated Cost
1. Property Acquisition	1	LS	$40,000.00	$40,000.00
2. Clearing and Grading	1	LS	$6,000.00	$6,000.00
3. Excavation	2000	CY	$20.00	$40,000.00
4. Stormwater Structures				
a. Headwalls	2	EA	$1,500.00	$3,000.00
b. Manholes/Junction Boxes	1	EA	$2,500.00	$2,500.00
c. Inlets/Catch Basins		EA	$3,000.00	
d. Outlet Structures	1	EA	$4,500.00	$4,500.00
e. Retrofits		EA	$5,000.00	
f. Spillways	1	EA	$8,000.00	$8,000.00
5. Storm Drain				
a. 18-inch RCP	40	LF	$30.00	$1,200.00
b. 30-inch RCP		LF	$60.00	
c. 48-inch RCP		LF	$90.00	
d. 60-inch RCP		LF	$120.00	
6. Fencing	400	LF	$20.00	$8,000.00
7. Riprap	10	CY	$100.00	$1,000.00
8. Stream Restoration		LF	$60.00	
9. Utility Conflicts/Adjustments		LS		
10. Site Restoration	1	LS	$10,000.00	$10,000.00
			Sub-Total	$124,200.00
			Contingency (25 %)	$31,050.00
			Grand Total	$155,250.00

Note: Costs shown above do not include engineering and permitting

Estimated Construction Cost
CIP Project No. 2 - Stormwater Detention at Milton High School

Item	Quantity	Unit	Unit Price	Estimated Cost
1. Property Acquisition	1	LS	$20,000.00	$20,000.00
2. Clearing and Grading	1	LS	$15,000.00	$15,000.00
3. Excavation	6000	CY	$20.00	$120,000.00
4. Stormwater Structures				
a. Headwalls	4	EA	$1,500.00	$6,000.00
b. Manholes/Junction Boxes	2	EA	$2,500.00	$5,000.00
c. Inlets/Catch Basins		EA	$3,000.00	
d. Outlet Structures	3	EA	$4,500.00	$13,500.00
e. Retrofits	1	EA	$5,000.00	$5,000.00
f. Spillways	2	EA	$8,000.00	$16,000.00
5. Storm Drain				
a. 18-inch RCP		LF	$30.00	
b. 30-inch RCP	60	LF	$60.00	$3,600.00
c. 48-inch RCP	50	LF	$90.00	$4,500.00
d. 60-inch RCP		LF	$120.00	
6. Fencing	2000	LF	$20.00	$40,000.00
7. Riprap	100	CY	$100.00	$10,000.00
8. Stream Restoration		LF	$60.00	
9. Utility Conflicts/Adjustments	1	LS	$10,000.00	$10,000.00
10. Site Restoration	1	LS	$10,000.00	$10,000.00
			Sub-Total	$278,600.00
			Contingency (25 %)	$69,650.00
			Grand Total	$348,250.00

Note: Costs shown above do not include engineering and permitting

Estimated Construction Cost
CIP Project No. 3 - Tributary C Detention Facilities

Item	Quantity	Unit	Unit Price	Estimated Cost
1. Property Acquisition	1	LS	$20,000.00	$20,000.00
2. Clearing and Grading	1	LS	$4,000.00	$4,000.00
3. Excavation	2400	CY	$20.00	$48,000.00
4. Stormwater Structures				
a. Headwalls	2	EA	$1,500.00	$3,000.00
b. Manholes/Junction Boxes	2	EA	$2,500.00	$5,000.00
c. Inlets/Catch Basins		EA	$3,000.00	
d. Outlet Structures	1	EA	$4,500.00	$4,500.00
e. Retrofits		EA	$5,000.00	
f. Spillways	1	EA	$8,000.00	$8,000.00
5. Storm Drain				
a. 18-inch RCP		LF	$30.00	
b. 30-inch RCP	100	LF	$60.00	$6,000.00
c. 48-inch RCP		LF	$90.00	
d. 60-inch RCP		LF	$120.00	
6. Fencing	500	LF	$20.00	$10,000.00
7. Riprap	20	CY	$100.00	$2,000.00
8. Stream Restoration		LF	$60.00	
9. Utility Conflicts/Adjustments	1	LS	$5,000.00	$5,000.00
10. Site Restoration	1	LS	$7,500.00	$7,500.00
			Sub-Total	$123,000.00
			Contingency (25 %)	$30,750.00
			Grand Total	$153,750.00

Note: Costs shown above do not include engineering and permitting

Estimated Construction Cost
CIP Project No. 4 - Stormwater System Replacement and Detention along Lantern Ridge Court

Item	Quantity	Unit	Unit Price	Estimated Cost
1. Property Acquisition		LS		
2. Clearing and Grading	1	LS	$5,000.00	$5,000.00
3. Excavation		CY	$20.00	
4. Stormwater Structures				
a. Headwalls		EA	$1,500.00	
b. Manholes/Junction Boxes	2	EA	$2,500.00	$5,000.00
c. Inlets/Catch Basins	3	EA	$3,000.00	$9,000.00
d. Outlet Structures	1	EA	$4,500.00	$4,500.00
e. Retrofits		EA	$5,000.00	
f. Spillways		EA	$8,000.00	
5. Storm Drain				
a. 18-inch RCP		LF	$30.00	
b. 30-inch RCP		LF	$60.00	
c. 48-inch RCP		LF	$90.00	
d. 60-inch RCP	400	LF	$120.00	$48,000.00
6. Fencing		LF	$20.00	
7. Riprap		CY	$100.00	
8. Stream Restoration		LF	$60.00	
9. Utility Conflicts/Adjustments		LS		
10. Site Restoration	1	LS	$10,000.00	$10,000.00
			Sub-Total	$81,500.00
			Contingency (25 %)	$20,375.00
			Grand Total	$101,875.00

Note: Costs shown above do not include engineering and permitting

Estimated Construction Cost
CIP Project No. 5 - Stormwater Detention along Upper Foe Killer Creek

Item	Quantity	Unit	Unit Price	Estimated Cost
1. Property Acquisition	1	LS	$50,000.00	$50,000.00
2. Clearing and Grading	1	LS	$20,000.00	$20,000.00
3. Excavation	4000	CY	$20.00	$80,000.00
4. Stormwater Structures				
a. Headwalls		EA	$1,500.00	
b. Manholes/Junction Boxes		EA	$2,500.00	
c. Inlets/Catch Basins		EA	$3,000.00	
d. Outlet Structures	1	EA	$4,500.00	$4,500.00
e. Retrofits		EA	$5,000.00	
f. Spillways	1	EA	$8,000.00	$8,000.00
5. Storm Drain				
a. 18-inch RCP		LF	$30.00	
b. 30-inch RCP	20	LF	$60.00	$1,200.00
c. 48-inch RCP		LF	$90.00	
d. 60-inch RCP		LF	$120.00	
6. Fencing	1600	LF	$20.00	$32,000.00
7. Riprap	50	CY	$100.00	$5,000.00
8. Stream Restoration		LF	$60.00	
9. Utility Conflicts/Adjustments		LS		
10. Site Restoration	1	LS	$20,000.00	$20,000.00
			Sub-Total	$220,700.00
			Contingency (25 %)	$55,175.00
			Grand Total	$275,875.00

Note: Costs shown above do not include engineering and permitting

Estimated Construction Cost
CIP Project No. 6 - Stormwater Conveyance Improvements in Vicinity of Brook Drive

Item	Quantity	Unit	Unit Price	Estimated Cost
1. Property Acquisition		LS		
2. Clearing and Grading	1	LS	$10,000.00	$10,000.00
3. Excavation		CY	$20.00	
4. Stormwater Structures				
a. Headwalls	1	EA	$1,500.00	$1,500.00
b. Manholes/Junction Boxes	5	EA	$2,500.00	$12,500.00
c. Inlets/Catch Basins	5	EA	$3,000.00	$15,000.00
d. Outlet Structures		EA	$4,500.00	
e. Retrofits		EA	$5,000.00	
f. Spillways		EA	$8,000.00	
5. Storm Drain				
a. 18-inch RCP		LF	$30.00	
b. 30-inch RCP	1200	LF	$60.00	$72,000.00
c. 48-inch RCP		LF	$90.00	
d. 60-inch RCP		LF	$120.00	
6. Fencing		LF	$20.00	
7. Riprap	10	CY	$100.00	$1,000.00
8. Stream Restoration		LF	$60.00	
9. Utility Conflicts/Adjustments	1	LS	$20,000.00	$20,000.00
10. Site Restoration	1	LS	$40,000.00	$40,000.00
			Sub-Total	$172,000.00
			Contingency (25 %)	$43,000.00
			Grand Total	$215,000.00

Note: Costs shown above do not include engineering and permitting

Estimated Construction Cost
Private Prop. Proj. No. 1 - Channel Improvements Near Mayfield Circle

Item	Quantity	Unit	Unit Price	Estimated Cost
1. Property Acquisition		LS		
2. Clearing and Grading	1	LS	$5,000.00	$5,000.00
3. Excavation	250	CY	$20.00	$5,000.00
4. Stormwater Structures				
a. Headwalls		EA	$1,500.00	
b. Manholes/Junction Boxes		EA	$2,500.00	
c. Inlets/Catch Basins		EA	$3,000.00	
d. Outlet Structures		EA	$4,500.00	
e. Retrofits		EA	$5,000.00	
f. Spillways		EA	$8,000.00	
5. Storm Drain				
a. 18-inch RCP		LF	$30.00	
b. 30-inch RCP		LF	$60.00	
c. 48-inch RCP		LF	$90.00	
d. 60-inch RCP		LF	$120.00	
6. Fencing		LF	$20.00	
7. Riprap	25	CY	$100.00	$2,500.00
8. Stream Restoration	83.33	LF	$60.00	$5,000.00
9. Utility Conflicts/Adjustments		LS		
10. Site Restoration	1	LS	$10,000.00	$10,000.00
			Sub-Total	$27,500.00
			Contingency (25 %)	$6,875.00
			Grand Total	$34,375.00

Note: Costs shown above do not include engineering and permitting

Estimated Construction Cost
Private Prop. Proj. No. 2 - Broadwell Oaks Drainage Improvements

Item	Quantity	Unit	Unit Price	Estimated Cost
1. Property Acquisition		LS		
2. Clearing and Grading	1	LS	$5,000.00	$5,000.00
3. Excavation		CY	$20.00	
4. Stormwater Structures				
a. Headwalls	2	EA	$1,500.00	$3,000.00
b. Manholes/Junction Boxes	2	EA	$2,500.00	$5,000.00
c. Inlets/Catch Basins	3	EA	$3,000.00	$9,000.00
d. Outlet Structures		EA	$4,500.00	
e. Retrofits		EA	$5,000.00	
f. Spillways		EA	$8,000.00	
5. Storm Drain				
a. 18-inch RCP	400	LF	$30.00	$12,000.00
b. 30-inch RCP		LF	$60.00	
c. 48-inch RCP		LF	$90.00	
d. 60-inch RCP		LF	$120.00	
6. Fencing		LF	$20.00	
7. Riprap		CY	$100.00	
8. Stream Restoration		LF	$60.00	
9. Utility Conflicts/Adjustments		LS		
10. Site Restoration	1	LS	$8,000.00	$8,000.00
			Sub-Total	$42,000.00
			Contingency (25 %)	$10,500.00
			Grand Total	$52,500.00

Note: Costs shown above do not include engineering and permitting

Estimated Construction Cost
Private Property Project No. 3 - Foe Killer Creek Stream Restoration
South of Mayfield Road

Item	Quantity	Unit	Unit Price	Estimated Cost
1. Property Acquisition		LS		
2. Clearing and Grading	1	LS	$30,000.00	$30,000.00
3. Excavation		CY	$20.00	
4. Stormwater Structures				
a. Headwalls		EA	$1,500.00	
b. Manholes/Junction Boxes		EA	$2,500.00	
c. Inlets/Catch Basins		EA	$3,000.00	
d. Outlet Structures		EA	$4,500.00	
e. Retrofits		EA	$5,000.00	
f. Spillways		EA	$8,000.00	
5. Storm Drain				
a. 18-inch RCP		LF	$30.00	
b. 30-inch RCP		LF	$60.00	
c. 48-inch RCP		LF	$90.00	
d. 60-inch RCP		LF	$120.00	
6. Fencing		LF	$20.00	
7. Riprap	800	CY	$100.00	$80,000.00
8. Stream Restoration	1400	LF	$60.00	$84,000.00
9. Utility Conflicts/Adjustments		LS		
10. Site Restoration	1	LS	$45,000.00	$45,000.00
			Sub-Total	$239,000.00
			Contingency (25 %)	$59,750.00
			Grand Total	$298,750.00

Note: Costs shown above do not include engineering and permitting

Estimated Construction Cost
Private Property Project No. 4 - Optional Improvements along Foe Killer Creek

Item	Quantity	Unit	Unit Price	Estimated Cost
1. Property Acquisition		LS		
2. Clearing and Grading	1	LS	$40,000.00	$40,000.00
3. Excavation		CY	$20.00	
4. Stormwater Structures				
a. Headwalls		EA	$1,500.00	
b. Manholes/Junction Boxes		EA	$2,500.00	
c. Inlets/Catch Basins		EA	$3,000.00	
d. Outlet Structures		EA	$4,500.00	
e. Retrofits		EA	$5,000.00	
f. Spillways		EA	$8,000.00	
5. Storm Drain				
a. 18-inch RCP		LF	$30.00	
b. 30-inch RCP		LF	$60.00	
c. 48-inch RCP		LF	$90.00	
d. 60-inch RCP		LF	$120.00	
6. Fencing		LF	$20.00	
7. Riprap	800	CY	$100.00	$80,000.00
8. Stream Restoration	1500	LF	$60.00	$90,000.00
9. Utility Conflicts/Adjustments		LS		
10. Site Restoration	1	LS	$50,000.00	$50,000.00
			Sub-Total	$260,000.00
			Contingency (25 %)	$65,000.00
			Grand Total	$325,000.00

Note: Costs shown above do not include engineering and permitting