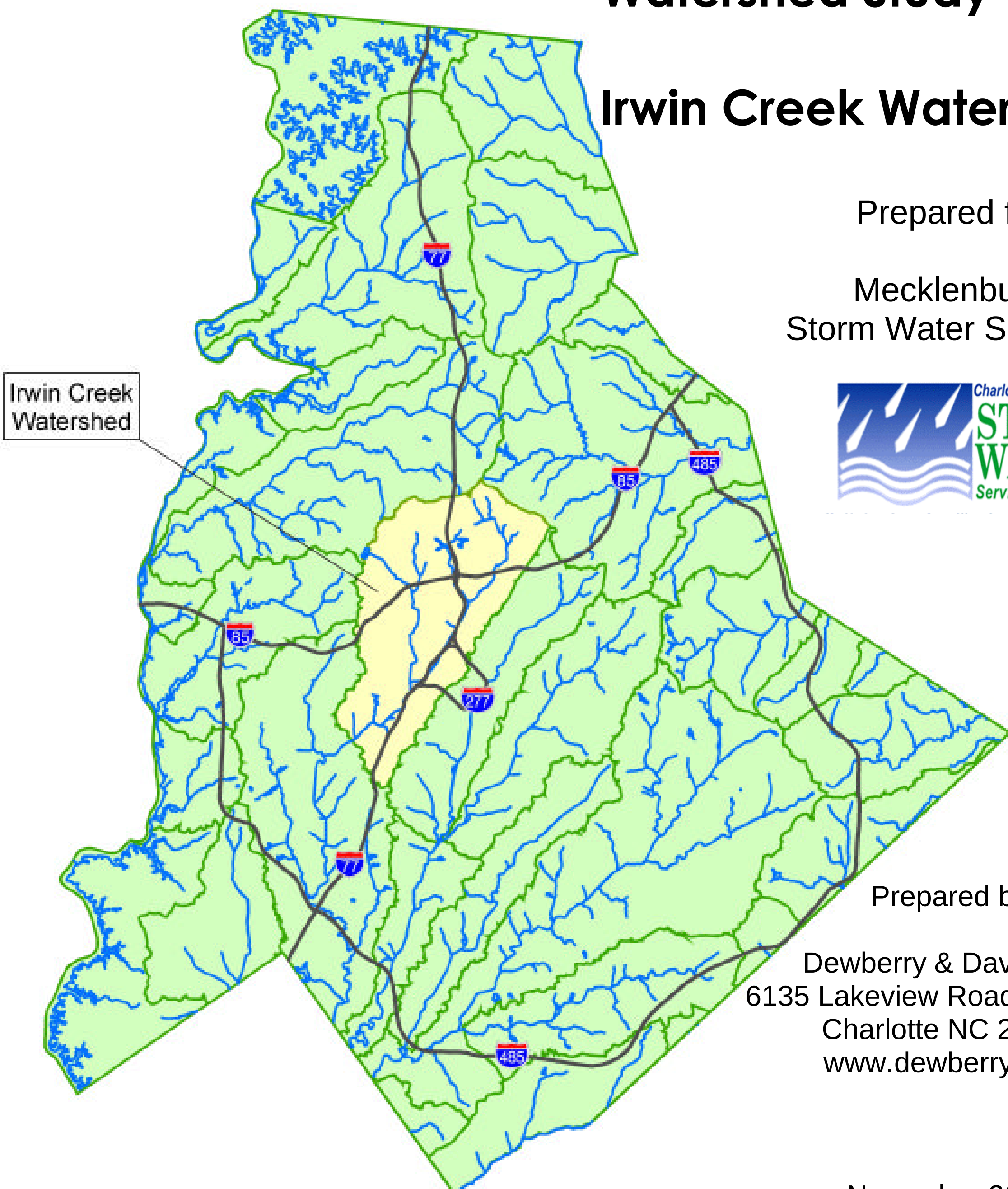
PRELIMINARY ENGINEERING REPORT

Watershed Study No. 8

Irwin Creek Watershed



Prepared for

Mecklenburg
Storm Water Services

Charlotte-Mecklenburg
STORM
WATER
Services

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November 2003

Dewberry

MECKLENBURG COUNTY
STORM WATER SERVICES

PRELIMINARY ENGINEERING REPORT
FOR
WATERSHED STUDY NO. 8

IRWIN CREEK WATERSHED

ACKNOWLEDGEMENT

The project staff of Dewberry would like to express our sincere appreciation to Mecklenburg County Storm Water Services (MCSWS) for its assistance and support during this project.

DISCLAIMER

This watershed-wide study is for planning purposes only. These study results and recommendations are preliminary and should not be used for construction without additional detailed engineering design analysis.

CERTIFICATION

I hereby certify that this Preliminary Engineering Report for Watershed Study No. 8, Irwin Creek Watershed, for Mecklenburg County was prepared by me or under my direct supervision.

Signed, sealed, and dated this ____ day of November 2003.

By: Neal Banerjee

Neal Banerjee, PE
Project Engineer

NORTH CAROLINA PROFESSIONAL SEAL 026974 ENGINEER NEAL L. BANERJEE 11/10/03

(SEAL)

MECKLENBURG COUNTY
STORM WATER SERVICES
PRELIMINARY ENGINEERING REPORT
FOR
WATERSHED STUDY NO. 8

IRWIN CREEK WATERSHED

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GLOSSARY

1% Annual Chance Flood:	The 1% annual chance flood is the flood that has a 1% chance of being equaled or exceeded in any given year, which is referred to as the "100-year flood," in general.
Base Flood Elevation (BFE):	Water surface elevation based on the 1% annual chance flood (100-year flood).
Best Management Practice (BMP):	A structural (e.g. buffer strip) or non-structural (e.g. regulatory) measure that is implemented to improve water quality.
Future Condition Floodplain (FCF):	Floodplain delineated for the 1% chance of flood event in any given year using future land use condition. It is currently defined as Floodplain Land Use Map (FLUM) in Mecklenburg County.
Community Encroachment Floodway	The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the community base flood, without cumulatively increasing the water surface elevation more than 0.1 feet. No structure or fill may be added without special permit.
Existing Condition Floodplain:	Floodplain delineated for the 1% chance of flood event in any given year using current land use condition. It is defined as the same as within the Flood Insurance Rate Map (FIRM).
FEMA	Federal Emergency Management Agency
FEMA Floodway	The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the FEMA base flood, without cumulatively increasing the water surface elevation more than 0.5 feet.
MCSWS	Mecklenburg County Storm Water Services Department
WSE	Water surface elevation
WWTP	Waste water treatment plant

EXECUTIVE SUMMARY

IRWIN CREEK WATERSHED

This Preliminary Engineering Report (PER) summarizes the methods, findings, and recommendations from a flood hazard mitigation and environmental restoration planning study for the Irwin Creek Watershed. The primary focus of this preliminary report was to conduct a review of pertinent stream/watershed information, assess flood damages, and investigate flood hazard mitigation alternatives within the regulated future condition floodplains (FCFs) in the Irwin Creek Watershed. A secondary focus was to provide a broad-level characterization of environmental quality in the Watershed and to offer general recommendations for environmental restoration. Per the context of this study, environmental restoration opportunities were typically only identified in conjunction with flood hazard mitigation improvement alternatives. It is important to note that the conclusions and recommendations provided in this report are based on broad planning level analysis, and thus should not be used for construction without additional detailed engineering analysis.

The Irwin Creek Watershed encompasses a 30 square mile urban area in the west-central portion of Mecklenburg County, North Carolina. The Irwin Creek Watershed contains seven streams that have mapped, future condition floodplains (FCFs, also referred to as FLUM floodplains) - Irwin Creek, Kennedy Branch, Irwin Creek Tributary 1, Stewart Creek, Stewart Creek Tributary 1, Stewart Creek Tributary 2, and Stewart Creek Tributary 3.

Flood Hazard Mitigation

There are 278 structures within the FCF boundaries in the Irwin Creek Watershed. Comparison of flood information with building elevation certificates revealed that 126 of the 278 structures have their lowest finished floor below the predicted water surface elevation (WSE) of the FCF, and thus are considered "flooding" structures. Flood damages for these 126 buildings were estimated using the FEMA Full Riverine Benefit:Cost model (FEMA BC), and totaled to over $15.8 million (2003 dollars). Figure E-1 shows an overall map of the Irwin Creek Watershed and identifies problem areas identified in the study.

Several alternatives were developed to mitigate flood damages for problem areas identified along the study streams. For general project ranking purposes, a benefit:cost (BC) economic analysis was performed to evaluate cost-effectiveness of the alternatives at each problem area. The alternatives were then compared for their economic, technical, and social feasibility, from which a recommended mitigation strategy was developed for each problem area. If no improvement alternatives were identified as being cost effective or technically feasible, no action was recommended (i.e. leave building as-is).

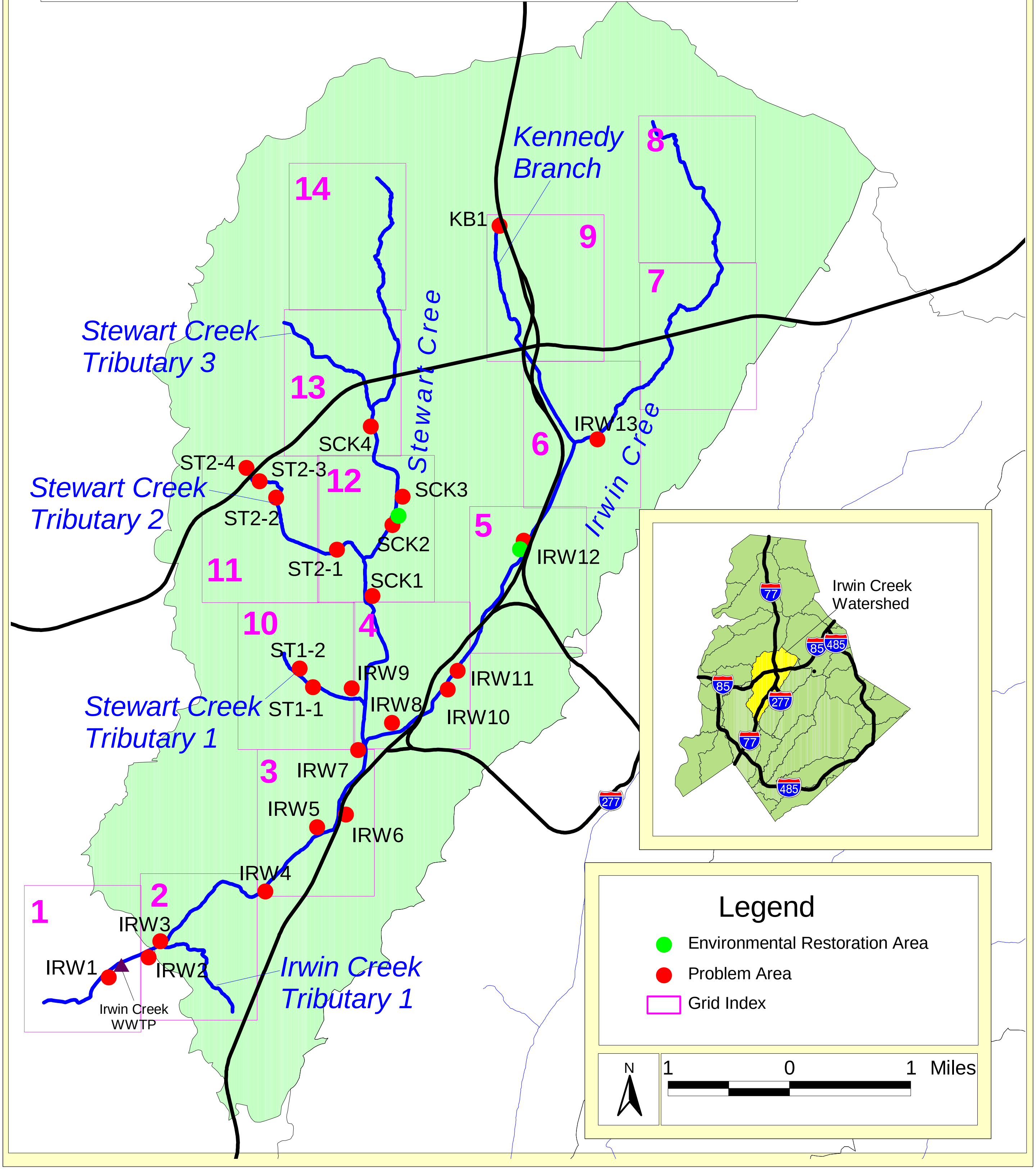
The alternative evaluation indicated that it is cost-effective (or otherwise pertinent) to provide flood protection for 68 of the 126 flooding buildings. The estimated benefits (i.e. damages reduced) and improvement costs are approximately $10.8 million and $7.3 million respectively. This indicates that focusing mitigation efforts on these buildings will provide the most return for mitigation dollars spent. Figures E-2 through E-15 show the recommended mitigation improvements within the Irwin Creek Watershed.

Environmental Characterization

The Irwin Creek Watershed is located in an established, highly urbanized area within the City of Charlotte. Land use is predominately residential (70+/- %), but also includes limited commercial, industrial, vacant, and other uses. The streams in the Watershed have been modified (e.g. straightened, widened, armored, etc.) to accommodate urbanization, and thus do not exhibit natural, healthy stream characteristics. Reference to local water/biological monitoring data indicates overall “good” conditions, however, benthic sample readings were classified as “poor” at several sites. The majority of environmental analysis included in this PER are broad in nature, however, several locations were identified for potential environmental restoration within the Watershed (Figure E-1).

MCSWS and City SWS are presently coordinating a number of planning/design environmental restoration related projects in the Watershed. In addition, investigation of the GIS tax parcel database reveals that the County owns significant portions of vacant land adjacent to the study streams within the Irwin Creek Watershed. This land will likely be used for proposed greenways along the Creek, which in turn will likely incorporate water quality and/or environmental restoration features. However, it is recommended that more detailed analysis be conducted at a smaller scale level to investigate other environmental restoration opportunities.

Figure E-1. Irwin Creek Watershed



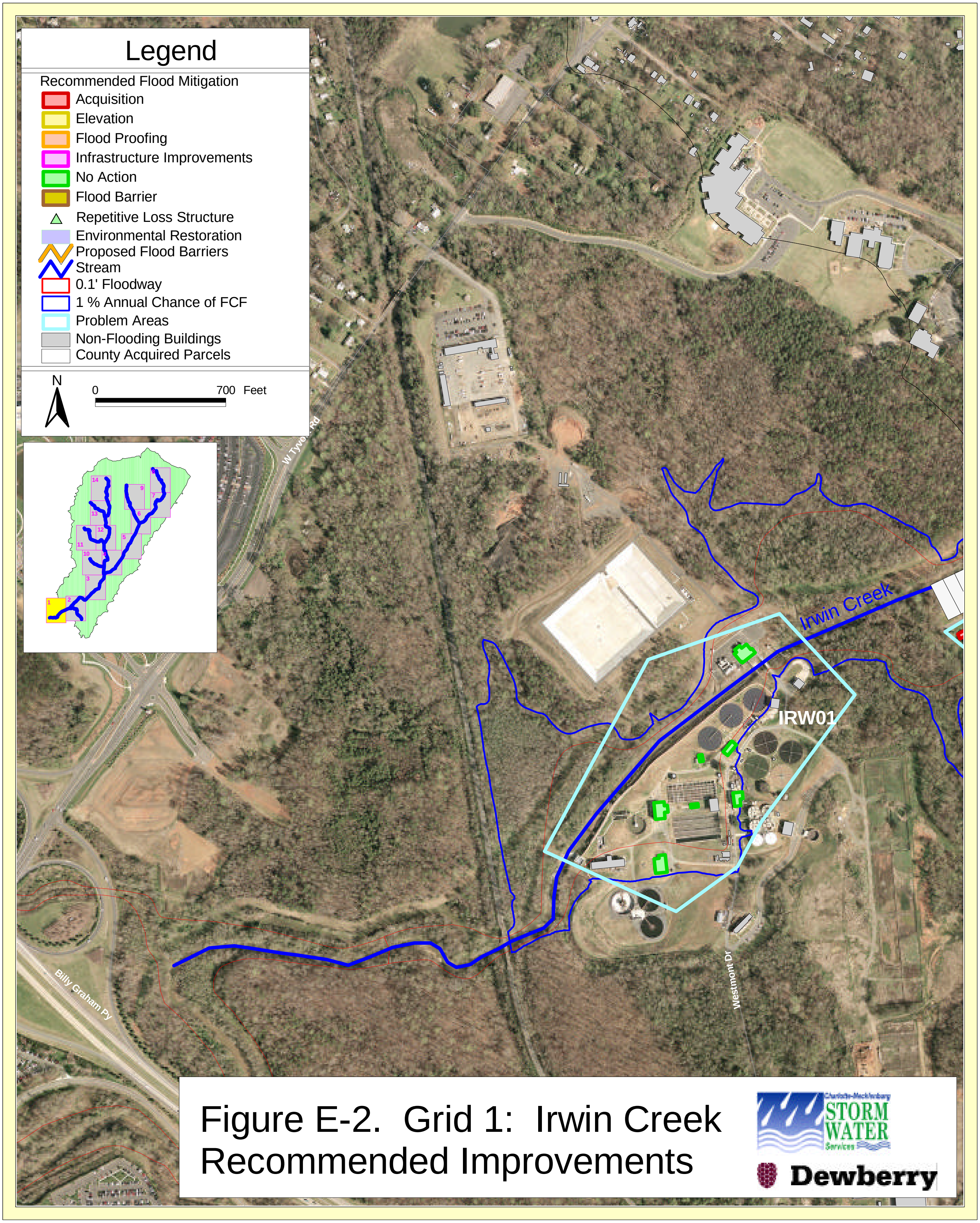


Figure E-2. Grid 1: Irwin Creek Recommended Improvements

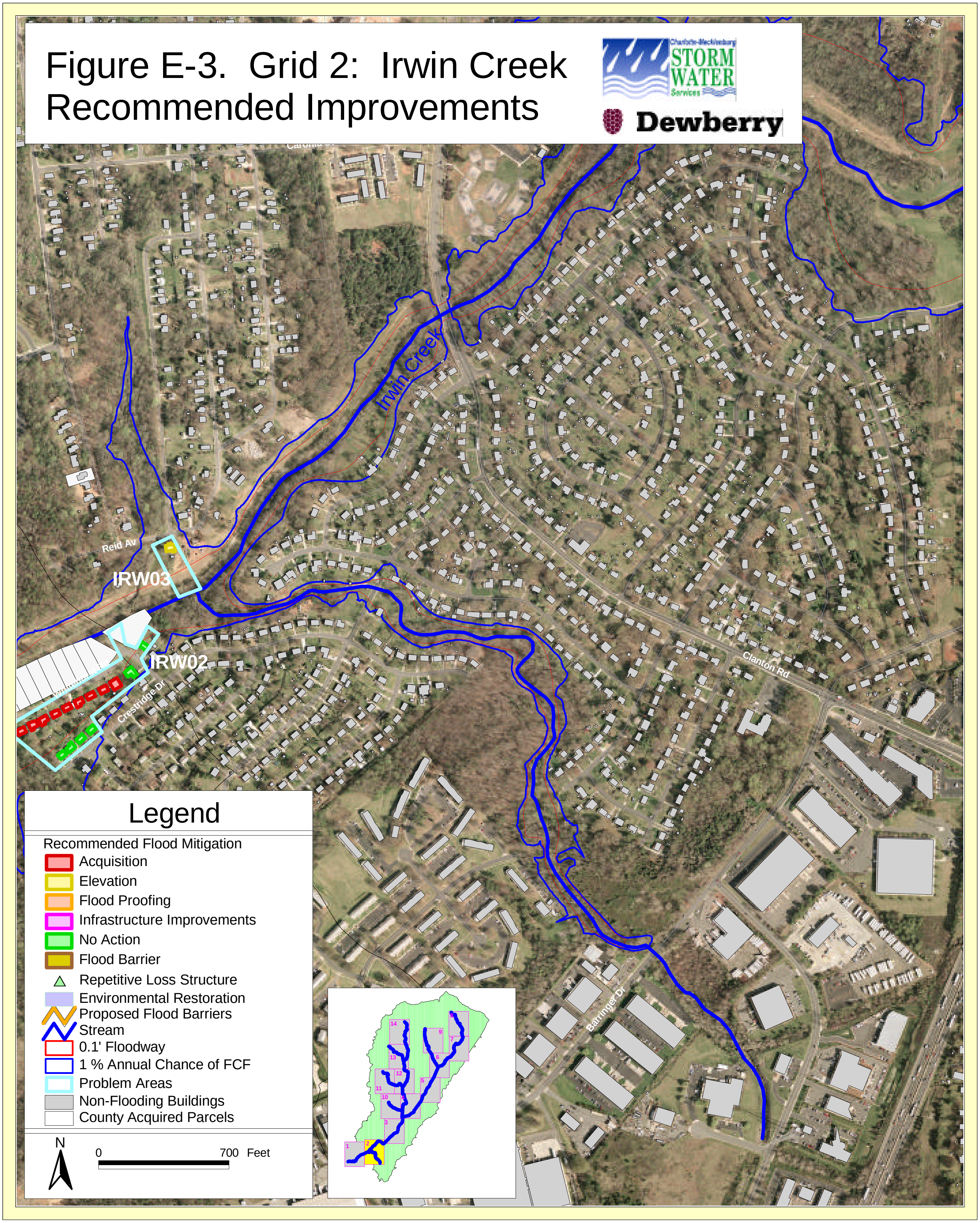


Figure E-3. Grid 2: Irwin Creek Recommended Improvements

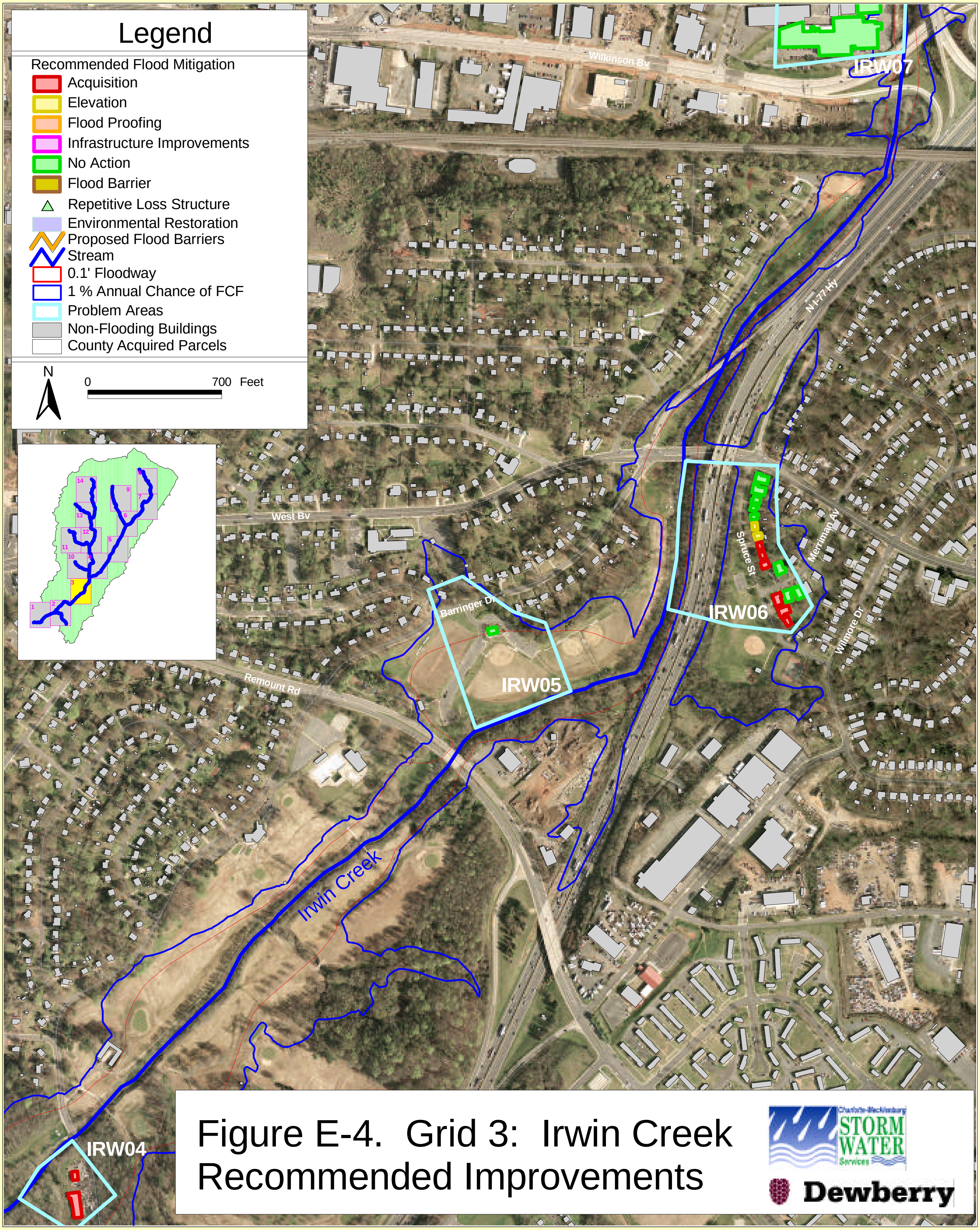


Figure E-4. Grid 3: Irwin Creek Recommended Improvements

Charlotte-Mecklenburg STORM WATER Services

Dewberry

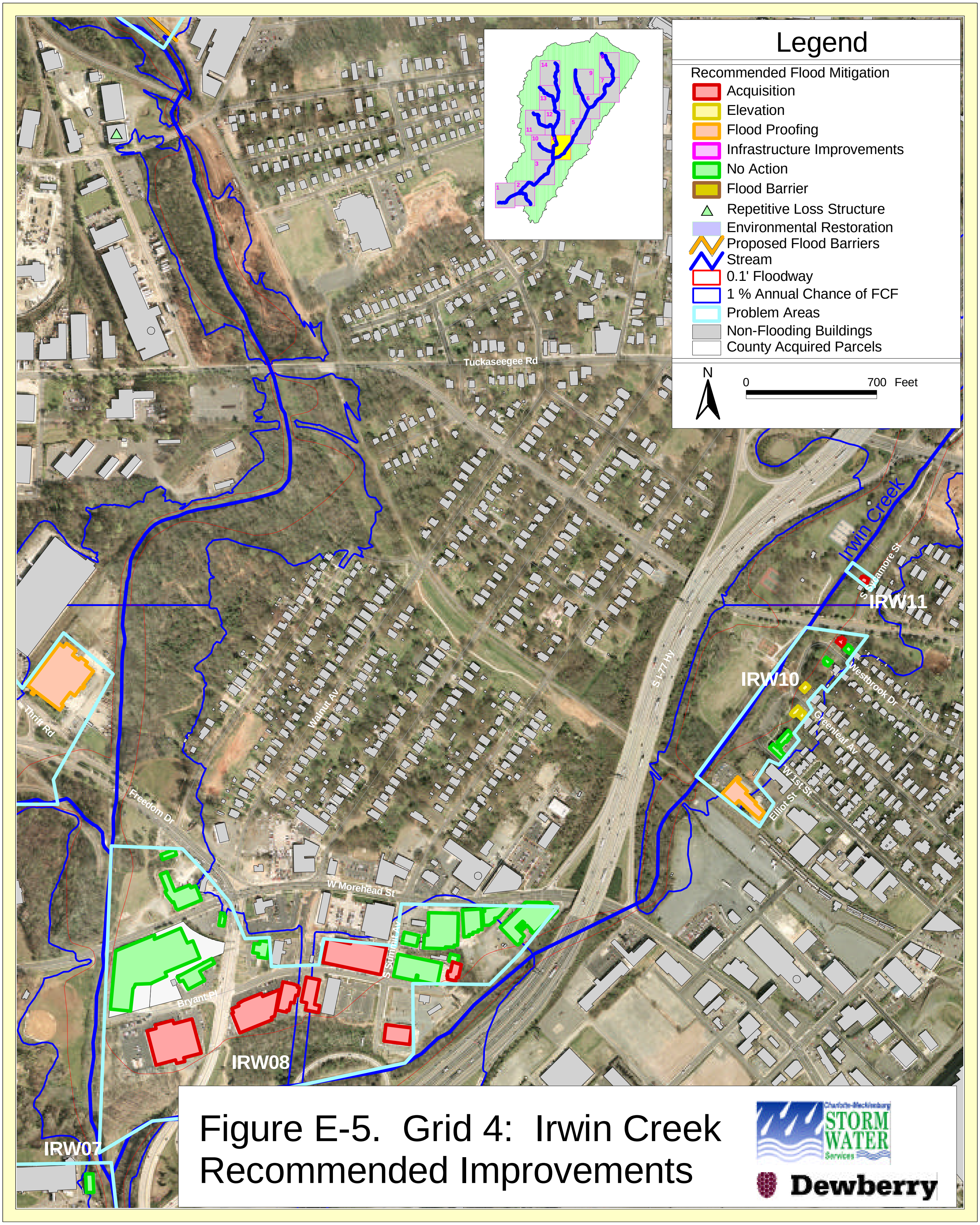


Figure E-5. Grid 4: Irwin Creek Recommended Improvements

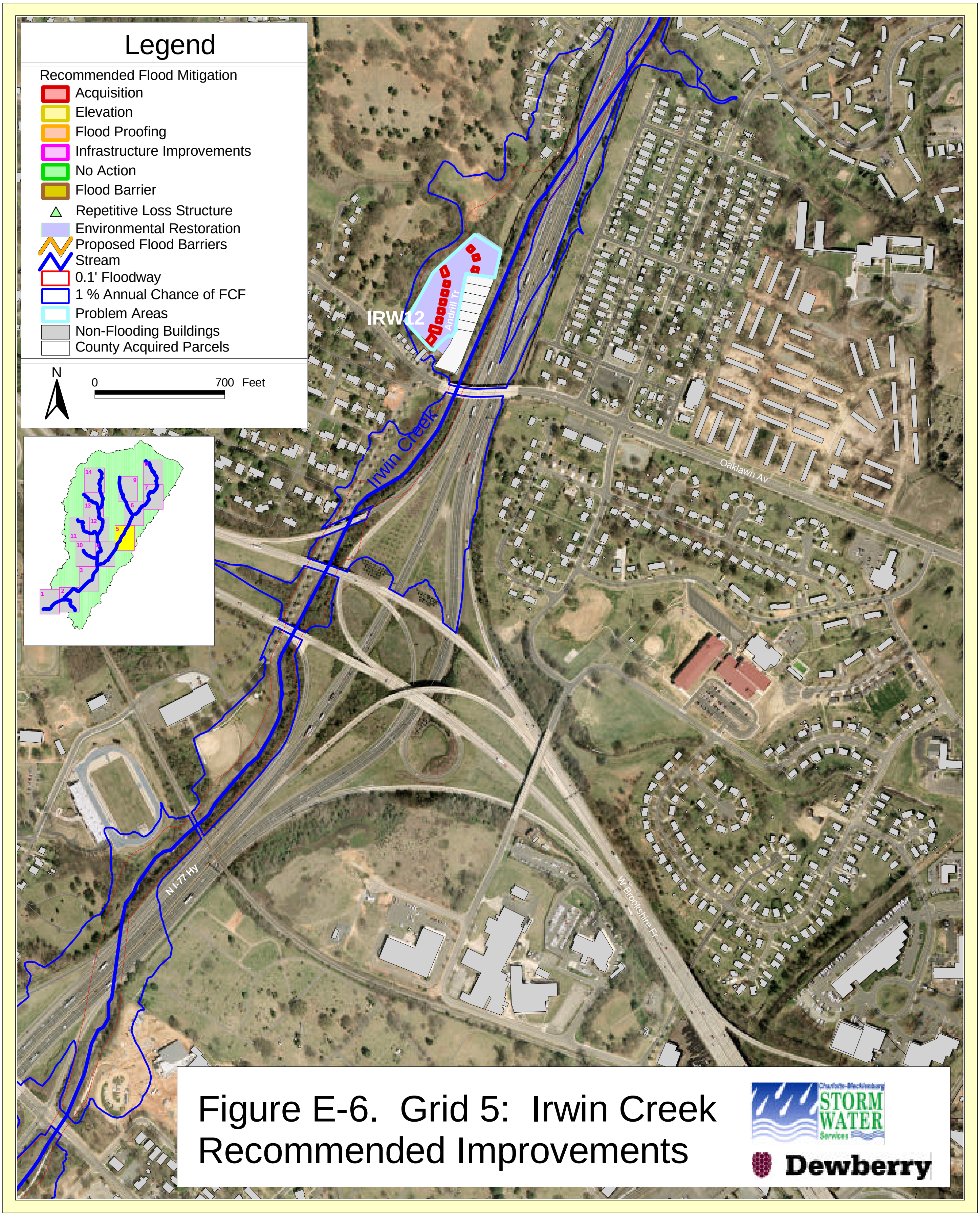


Figure E-6. Grid 5: Irwin Creek Recommended Improvements

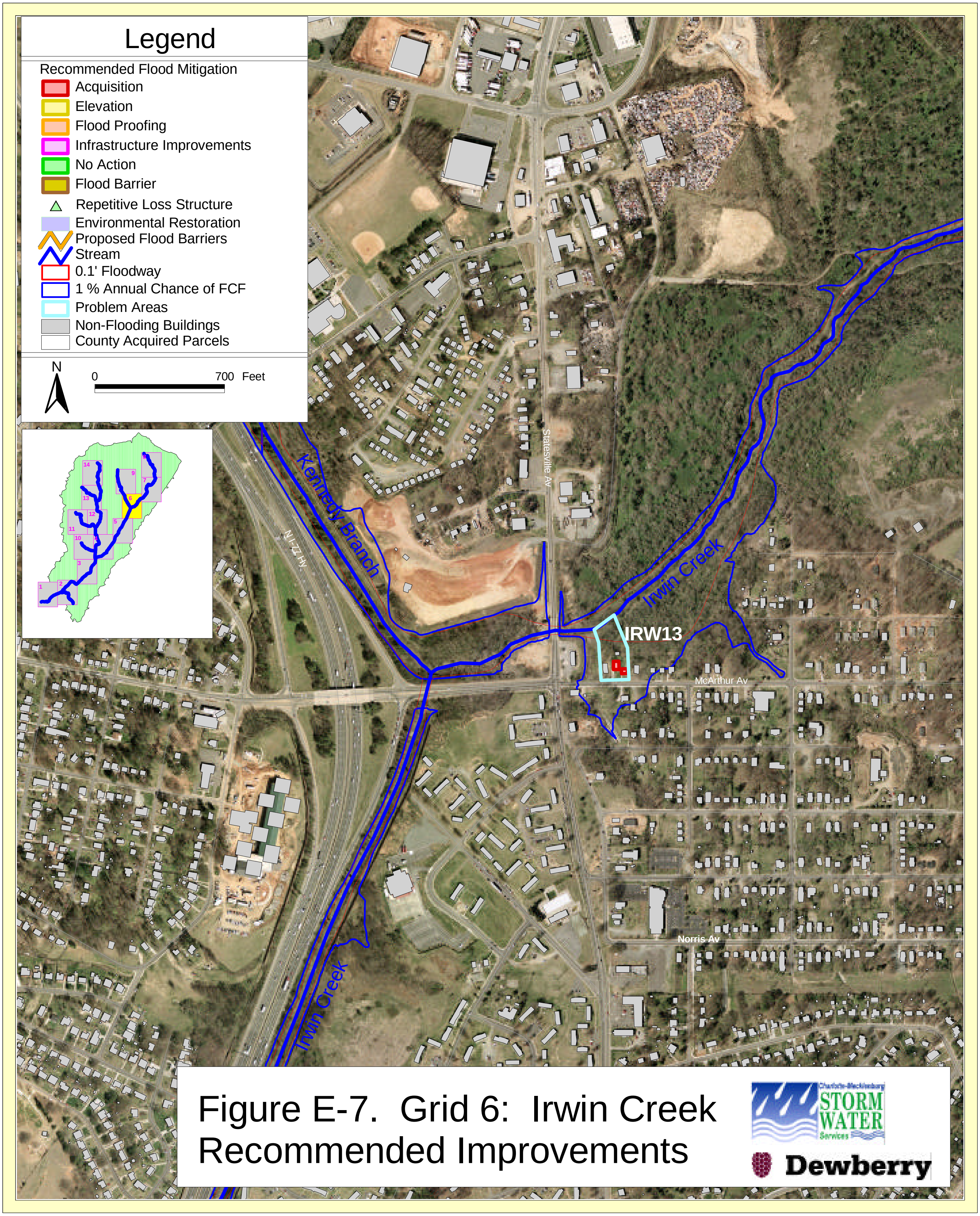


Figure E-7. Grid 6: Irwin Creek Recommended Improvements

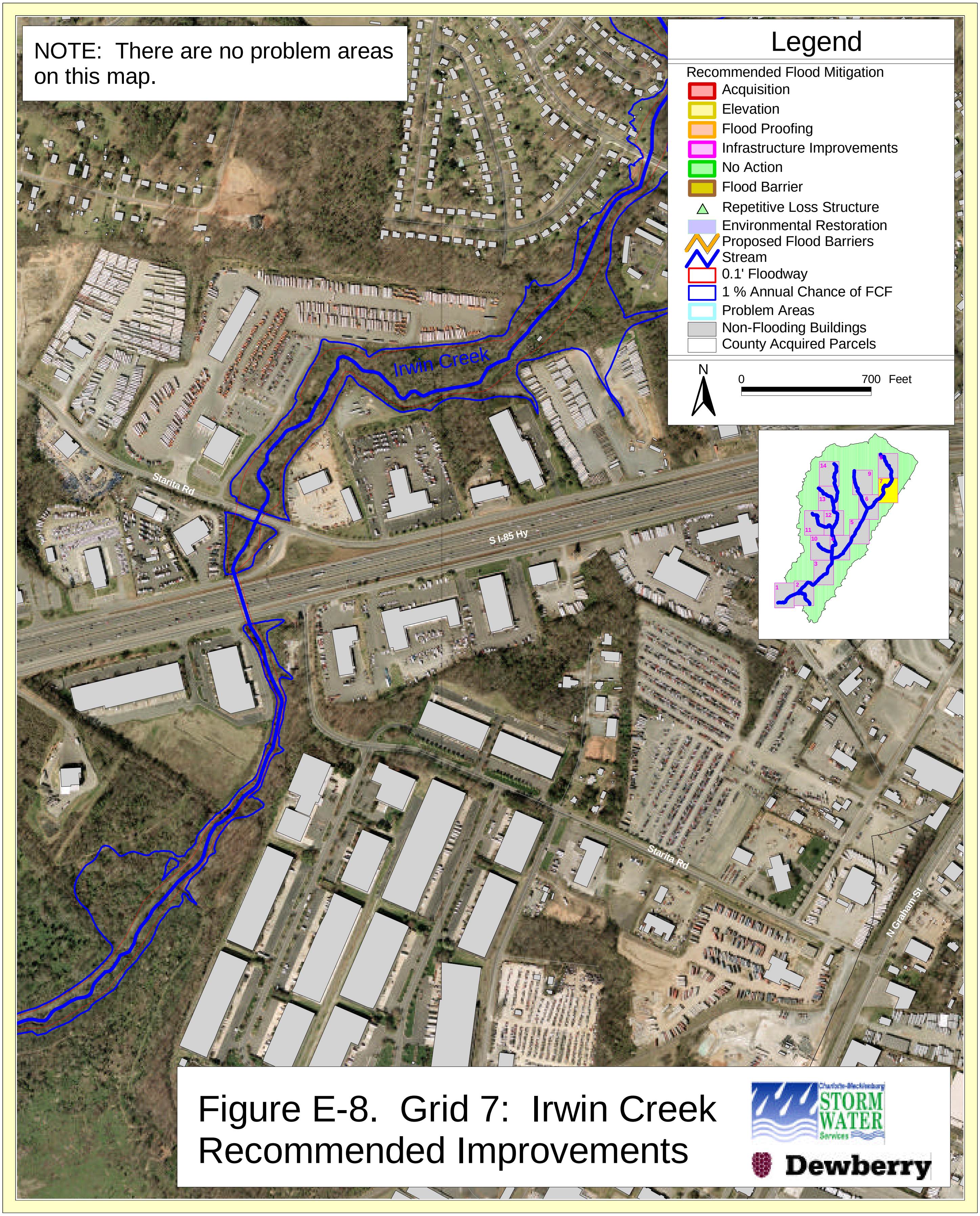


Figure E-8. Grid 7: Irwin Creek Recommended Improvements

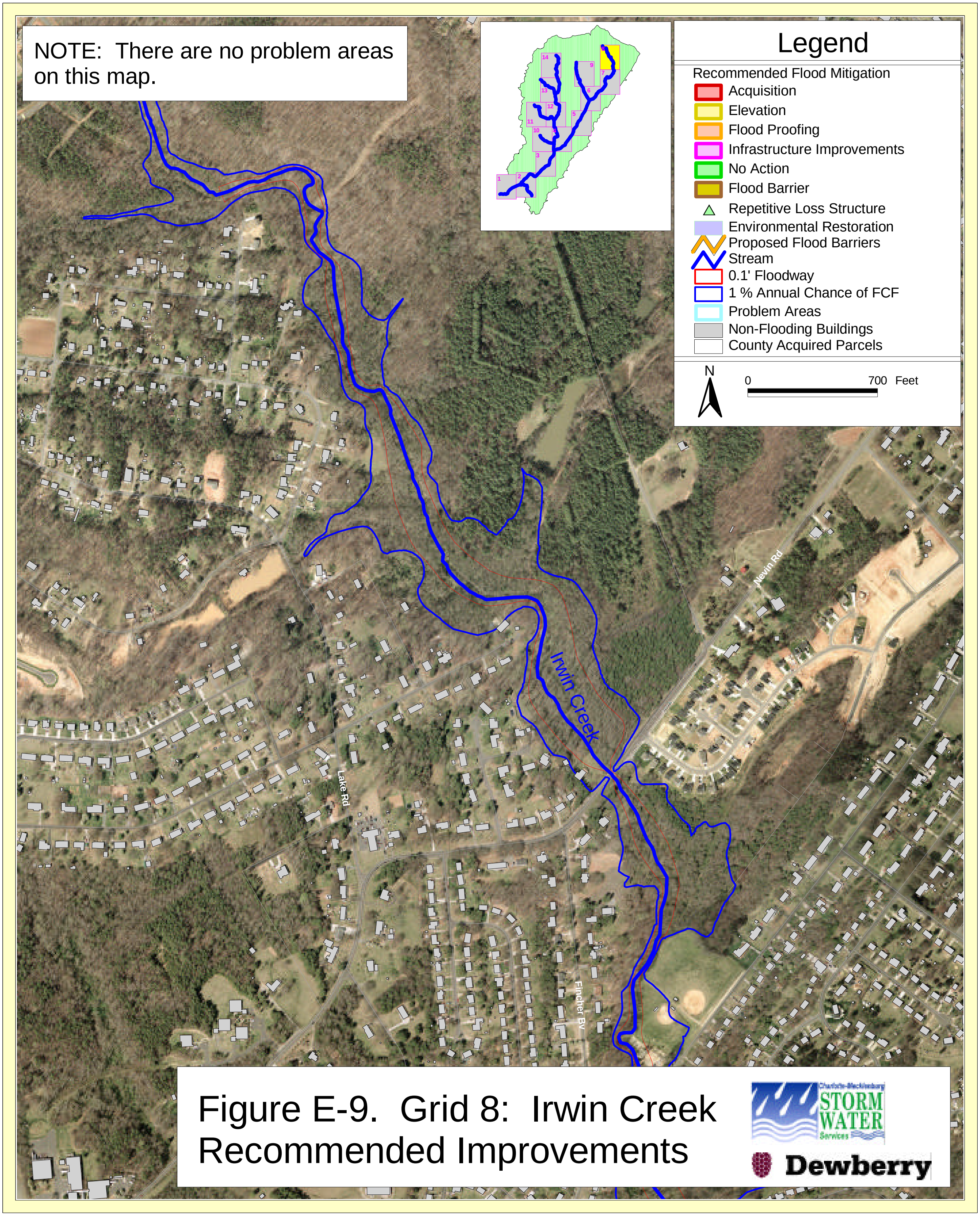
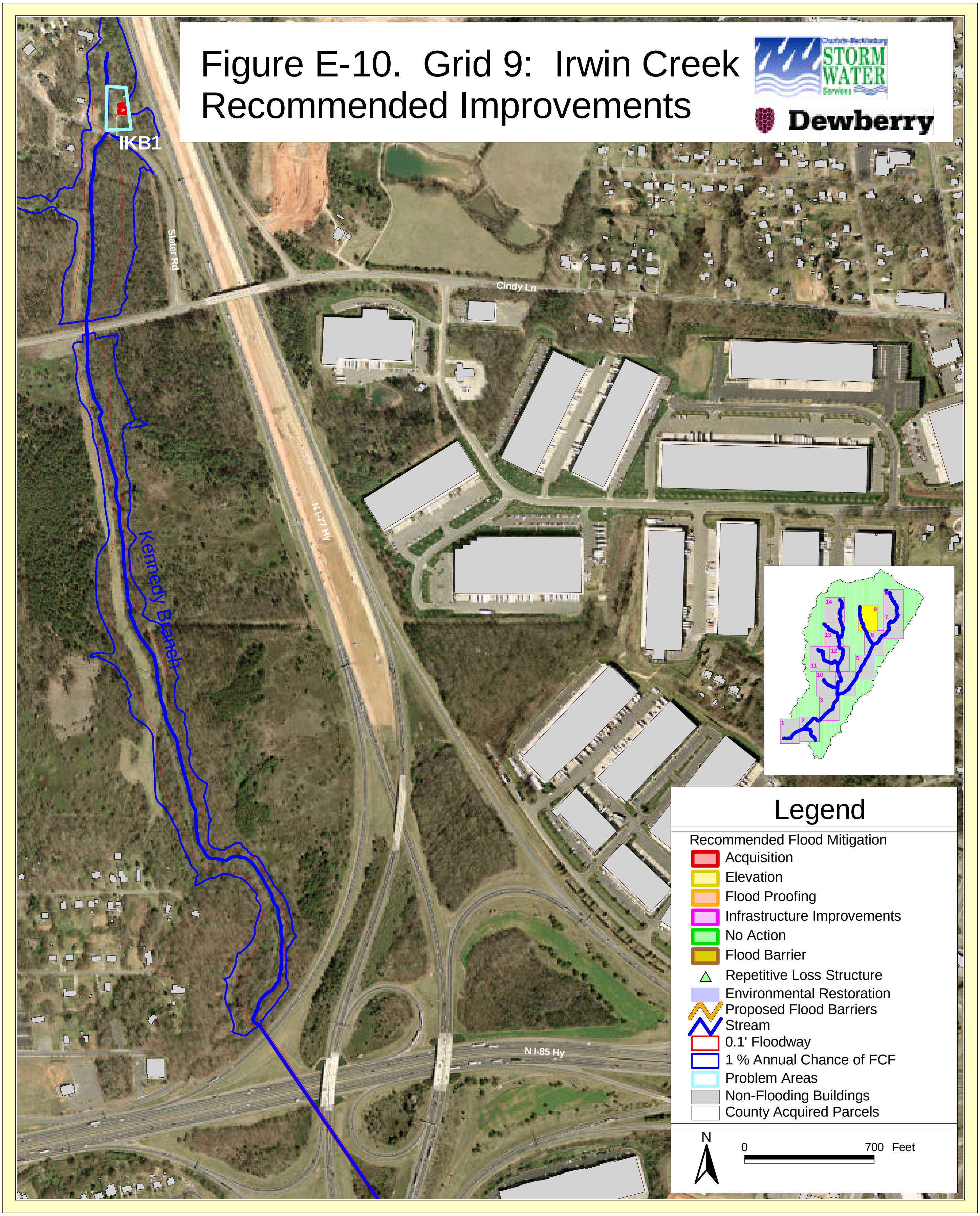


Figure E-9. Grid 8: Irwin Creek Recommended Improvements

Figure E-10. Grid 9: Irwin Creek Recommended Improvements



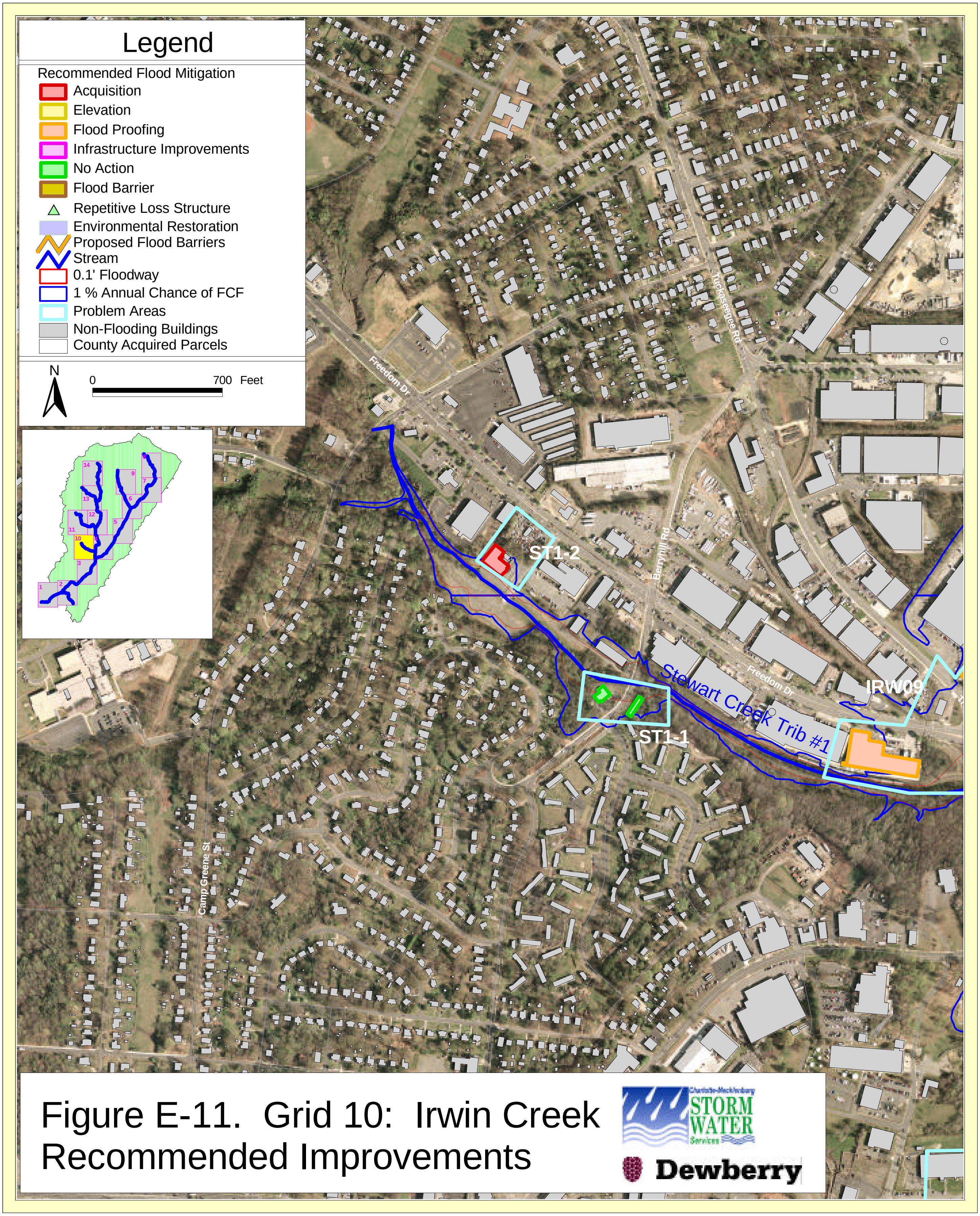


Figure E-11. Grid 10: Irwin Creek Recommended Improvements

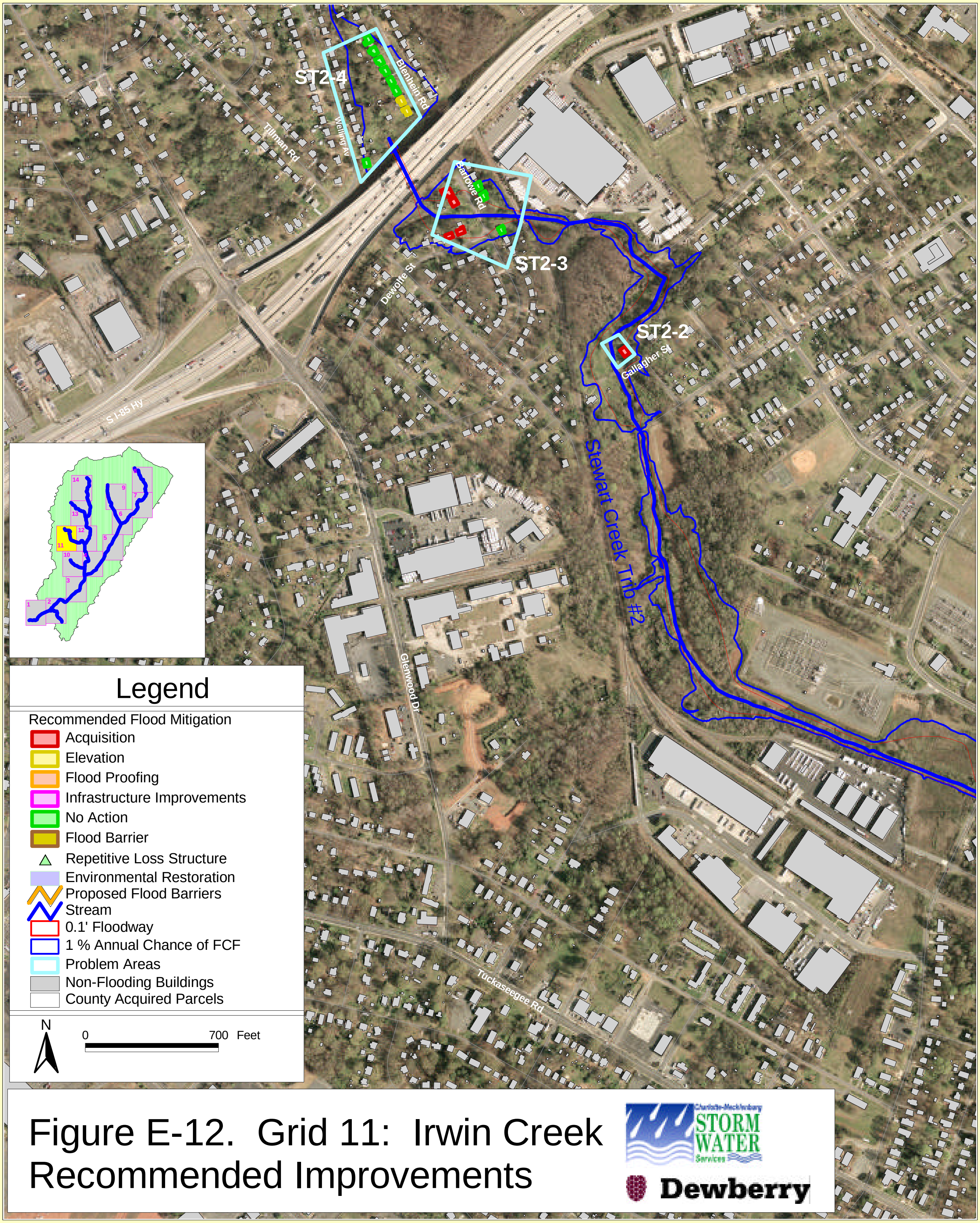


Figure E-12. Grid 11: Irwin Creek Recommended Improvements

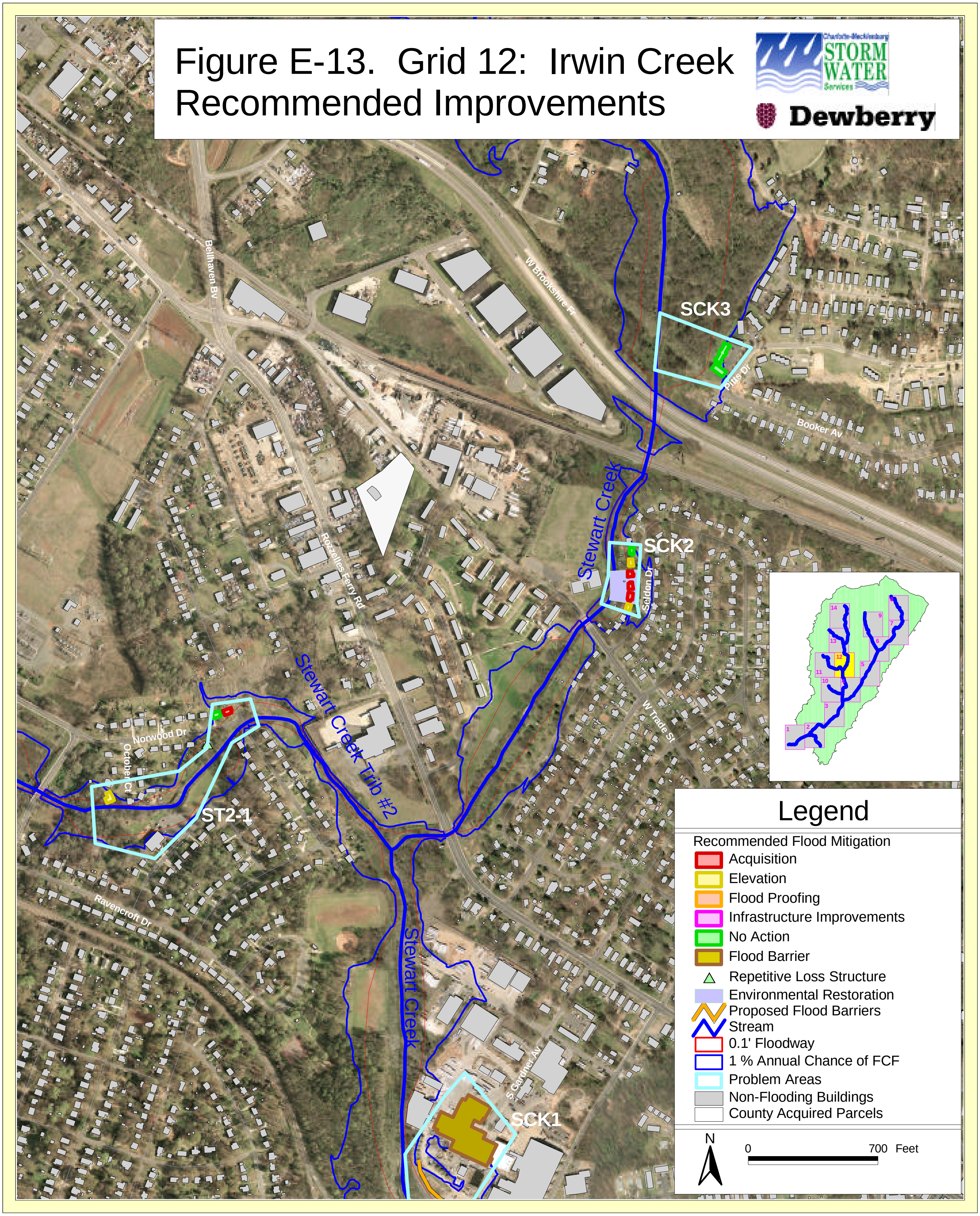
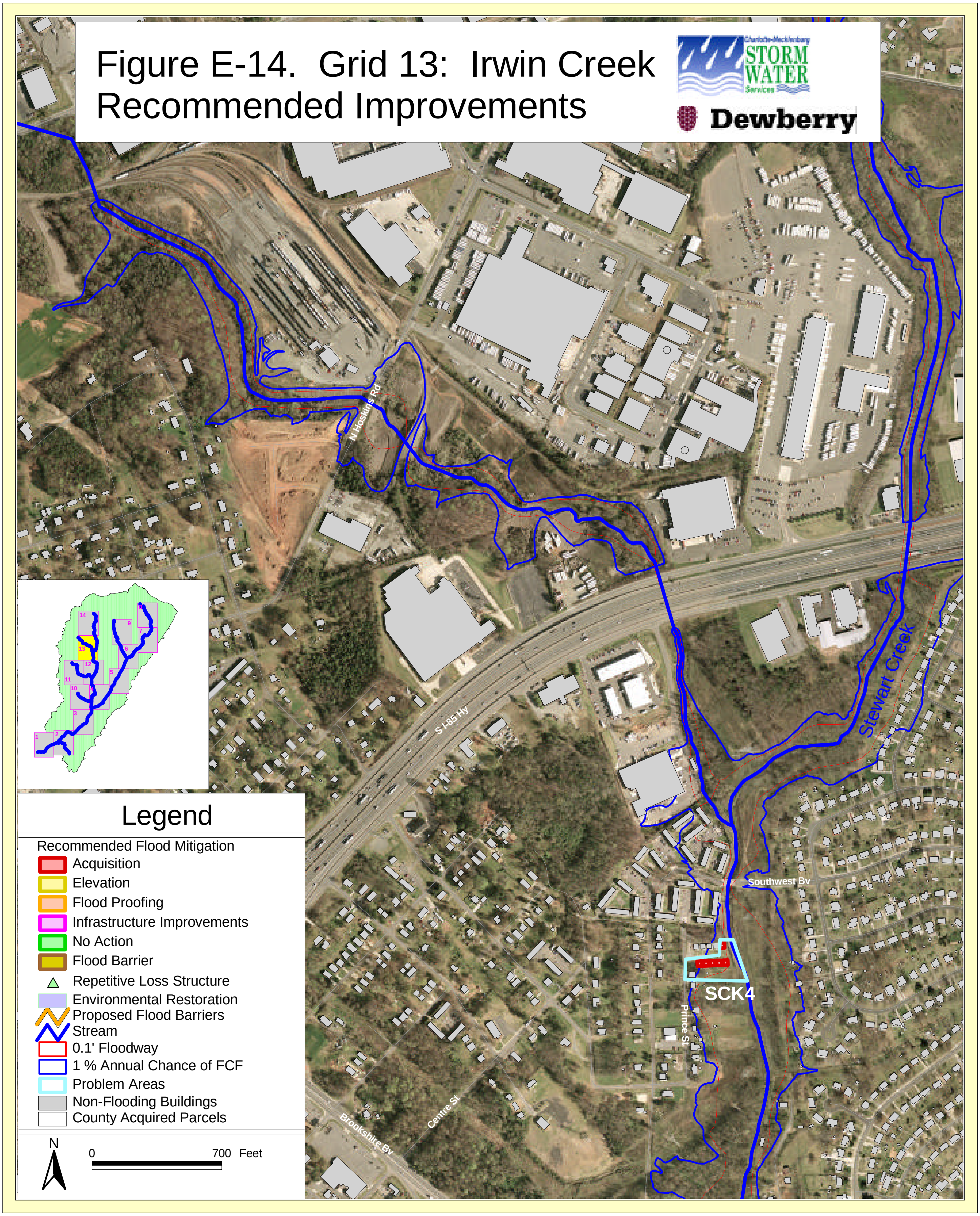


Figure E-13. Grid 12: Irwin Creek
Recommended Improvements
STORM WATER Services
Dewberry
SCK3
SCK2
SCK1
ST2-1
Stewart Creek
Stewart Creek Trib #2
Bellhaven Bv
W Brookshire Fr
Rozzelles Ferry Rd
Booker Av
Seldon Dr
W Trade St
Norwood Dr
October Ct
Ravencroft Dr
S Gardner Av
Legend
Recommended Flood Mitigation
Acquisition
Elevation
Flood Proofing
Infrastructure Improvements
No Action
Flood Barrier
Repetitive Loss Structure
Environmental Restoration
Proposed Flood Barriers
Stream
0.1' Floodway
1 % Annual Chance of FCF
Problem Areas
Non-Flooding Buildings
County Acquired Parcels
N
0
700 Feet

Figure E-14. Grid 13: Irwin Creek Recommended Improvements



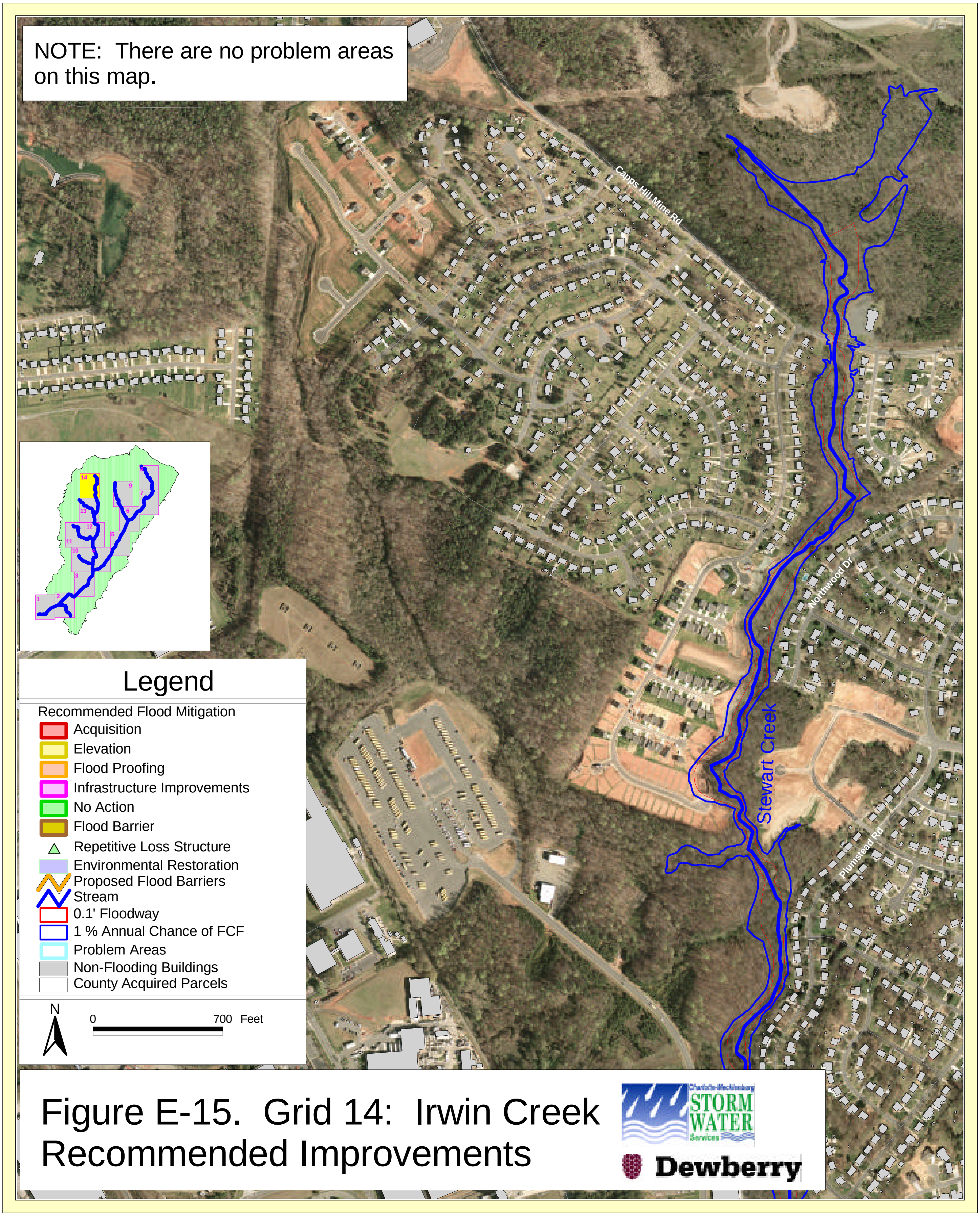


Figure E-15. Grid 14: Irwin Creek Recommended Improvements

1. GENERAL WATERSHED CONDITIONS

1.1. Watershed Characteristics

Irwin Creek Watershed encompasses a 30 square mile urban area in the west-central portion of Mecklenburg County, North Carolina. The Watershed is one of thirty-three major watersheds in the County and drains in a southwestern direction towards the Catawba River. The majority of the Watershed is located within the City of Charlotte municipal limits, with the exception of an approximate 1.5 square mile area at the northern (upstream) end of the Watershed. Irwin Creek Watershed is generally bounded by Graham Street to the northeast, Billy Graham Parkway to the southwest, South Boulevard to the southeast, and Sunset Road to the northwest.

The topography of the Irwin Creek Watershed is generally characterized by relatively steep upland slopes and well-defined drainage features, as are typical of Piedmont areas. Soils in the Watershed are predominately NRCS Hydrologic Group B soils, which have relatively low runoff potential.

The Irwin Creek Watershed contains seven streams that have mapped, future condition floodplains (FCFs, also referred to as FLUM floodplains) - Irwin Creek, Kennedy Branch, an unnamed tributary to Irwin Creek (hereafter referred to as Irwin Creek Tributary 1), Stewart Creek, and three unnamed tributaries to Stewart Creek, hereafter referred to as Stewart Creek Tributaries 1, 2, and 3, respectively. These streams and their associated FCFs were analyzed in this Preliminary Engineering Report (PER) for developing potential flood hazard mitigation and environmental restoration alternatives, and are described below.

Irwin Creek

Irwin Creek flows in a southwestern direction from upstream of Nevin Road to its confluence with Sugar Creek just near the Irwin Creek Waste Water Treatment Plant (WWTP) (upstream of the Billy Graham Parkway) - a distance of approximately 10.9 miles. The Creek runs through/along a variety of undeveloped, commercial, residential, and transportation related land uses, including a 4+ mile stretch adjacent to the Interstate-77 transit corridor.

Figure 1. Irwin Creek – Looking upstream from Clanton Road.

The Irwin Creek main channel exhibits different characteristics along its length, but can be generally described as a straight, relatively wide, trapezoidal channel with steep banks and a relatively shallow normal flow depth. The upper reaches tend to exhibit narrower banks and steeper channel slopes, whereas, the lower reaches have wider banks, milder slopes, and finer bed materials. Sand and silt bed material characterizes a majority of the stream length, however there are numerous sections with significant rock and cobble. The width of the main channel typically ranges from 20 to 70 feet in the upper stream reaches, and transitions to widths in excess of 100 feet in the downstream reaches.

The banks of Irwin Creek vary considerably along the channel ranging from heavily vegetated areas (e.g. between I-85 and I-77) to vertical concrete sides along the I-77. In general, there is only a limited riparian zone along the majority of the Creek length.

Kennedy Branch

The Kennedy Branch study reach is located in the upper portion of the Irwin Creek Watershed. It flows in a southeastern direction from upstream of Cindy Lane to its confluence with Irwin Creek, for a distance of approximately 2.1 miles. The Branch flows along I-77 through undeveloped land, transportation right-of-ways, and limited other land uses. In addition, it crosses I-77 midway along its length through an 1800+ foot culvert.

The Kennedy Branch channel is similar in shape and bed characteristics to the upper portions of Irwin Creek, having an average top width of approximately 35 feet. However, it has been altered significantly to accommodate the I-77 transportation corridor.

Figure 2. Kennedy Branch – Looking upstream from Cindy Lane.

Irwin Creek Tributary 1

The Irwin Creek Tributary 1 study reach is located in the lower portion of the Irwin Creek Watershed. It flows in a northwestern direction from just downstream of Stuart Andrew Boulevard to its confluence with Irwin Creek, for a distance of approximately 1.0 miles. The tributary has a relatively uniform channel and flows through commercial/industrial, undeveloped, and residential land uses. A well established riparian zone lines the tributary for much of its length. The channel bed is comprised primarily of sandy-silty material with cobble and rock.

Figure 3. Irwin Creek Tributary 1 – Looking downstream from Barringer Drive.

Stewart Creek

Stewart Creek is a large tributary of Irwin Creek that accounts for approximately one-third of the Irwin Creek Watershed drainage area.. The Creek starts in the northern portion of the Watershed and flows in a southern direction for approximately 5.4 miles to its confluence with Irwin Creek, just upstream of Wilkinson Boulevard. Unlike Irwin Creek, Stewart Creek is not as heavily impacted by the Interstate system, and flows through/along primarily residential and industrial land uses, as well as scattered undeveloped areas.

Figure 4. Stewart Creek – Looking upstream from Rozzelles Ferry Road.

The Stewart Creek channel is similar in shape and bed material to the upper/middle sections of the Irwin Creek channel, with a top width ranging from 20 feet in the upstream portions to 50+ feet in the lower sections.

Stewart Creek Tributary 1

The Stewart Creek Tributary 1 study reach is located in the lower-middle portion of the Irwin Creek Watershed. It flows in a southeastern direction from Camp Greene Street to its confluence with Stewart Creek, for a distance of approximately 0.9 miles. The Tributary is bordered by commercial/industrial land uses to the north, and residential and undeveloped areas to the south.

Figure 5. Stewart Creek Tributary 1 – Looking downstream from Berryhill Road.

The Stewart Creek Tributary 1 channel is relatively uniform, with an average top width of approximately 40 feet. A well established riparian zone lines the downstream portion of the Tributary (i.e. downstream of Berryhill Road). The channel bed is comprised primarily of sandy-silty material with cobble and rock areas.

Stewart Creek Tributary 2

The Stewart Creek Tributary 2 study reach is located in the west-central portion of the Irwin Creek Watershed. It flows in a southeastern direction from I-85 to its confluence with Stewart Creek (near Rozzelles Ferry Road), for a distance of approximately 1.6 miles. The upstream portion of the Tributary flows through primarily open/undeveloped areas, including a large Duke Power substation property, where it then transitions into more residential land uses.

Figure 6. Stewart Creek Tributary 2 – Looking upstream from Parkway Avenue.

The Stewart Creek Tributary 2 channel is relatively uniform, with an average top width of approximately 40 feet. Scattered riparian zones line the majority of the Tributary. The channel bed is comprised primarily of sandy-silty material with cobble and rock areas.

Stewart Creek Tributary 3

The Stewart Creek Tributary 3 study reach is located in the upper portion of the Irwin Creek Watershed. It flows in a southeastern direction from Lawton Road to its confluence with Stewart Creek, for a distance of approximately 1.1 miles. The Tributary runs through almost all industrial land uses, along the back edge of property lines.

The Stewart Creek Tributary 3 channel is relatively uniform, with an average top width of approximately 35 feet. A limited riparian zone is scattered along the Tributary. The channel bed is comprised primarily of sandy-silty material with cobble and rock areas

Figure 7. Stewart Creek Tributary 3 – Looking upstream from Hoskins Road.

1.2. Development in the Watershed

Identifying existing and future development conditions and activities is an important part of watershed-wide planning. Many of these issues can have a direct or indirect impact in evaluating the feasibility of potential flood mitigation and environmental restoration measures. Examples of pertinent development issues include: land development patterns, land use characteristics, proposed new development, existing proposed utilities, and proposed capital improvement projects (CIPs). These issues are further discussed in the following paragraphs.

The Irwin Creek Watershed is one of the most centralized and urbanized watersheds in Mecklenburg County, thus much of the Watershed is at, or near, built-out land use conditions. However, unlike the other three "central" watersheds (i.e. Upper Little Sugar Creek, Briar Creek, and McMullen Creek), the Irwin Creek Watershed has a noticeably larger presence of industrial and vacant parcels. Thus, there is more new development potential in this Watershed. This is illustrated by the fact that although the majority of development in the Watershed occurred before 1960, there has been an increase in development in the last decade. Mecklenburg County GIS (2002) identifies preliminary plans for new development at ten locations within the Irwin Creek Watershed:

- a 54 lot single family residential development (Fox Glenn) located off Beatties Ford Road in the upper portion of the Watershed
- a 63 lot commercial development (Gables at Druid Hills) located at the corner Statesville Avenue and Kohler Avenue
- a 7 lot single family residential development (General Estates) located off Perkins Road near Far West Drive
- a 120 lot family residential development (Diamond Oak Development) located off Cochrane Drive east of I-77
- a 178 unit multi-family residential public housing development located off Oaklawn Avenue
- a 176 lot single family residential development (Peachtree Hills) located off Crandon Drive at the uppermost portion of the Watershed
- an 8 lot industrial/commercial development located at the intersection of Smith Street and 10th Street
- a 30+ lot single family residential development (Stewarts Glen) located off Hoskins Road along Stewart Creek Tributary 3
- a 19 lot single family residential development (Victory Hollow) located off Nevin Road
- a 48 lot single family residential development (Arbor Glen) located off Clanton Road along Irwin Creek.

Land use in the Irwin Creek Watershed is largely residential (70%), with significant pockets of commercial, office, industrial, and open/vacant land. The majority of residential land uses are medium-high density (i.e. ¼ acre lot size), single-family properties located within established neighborhood districts. Commercial/Industrial land uses are generally concentrated along the major thoroughfares (e.g. South Boulevard, Wilkinson Boulevard, Freedom Drive, Clanton Road, etc.). Open/vacant areas such as parks, undisturbed parcels, and school lands are scattered throughout the Watershed. A summary of development patterns and current land use conditions is provided in Table 1 below.

Table 1. Development in the Irwin Creek Watershed

	Year Developed					Vacant/	
	Before 1961	1961-1970	1971-1980	1981-1990	1991-2000	Unclassified	Total
Parcels	12,888	3,932	1,442	1,789	2,520	5,208	27,779
Percentage	46.4%	14.2%	5.2%	6.4%	9.1%	18.7%	100%

	Land Use as of 2002				
	Single Family	Other Residential	Non-Residential	Vacant/ Unclassified	Total
Parcels	16,667	2,463	3,441	5,208	27,779
Percentage	60.0%	8.9%	12.4%	18.7%	100.0%

Note: Includes entire Irwin Creek Watershed, including all tributaries (29.9 sq. miles)

Being an urbanized area, infrastructure utilities are present throughout the Irwin Creek Watershed. Sanitary sewers are typically the most pertinent utility in relation to stream projects since they often run adjacent to stream channels and may have several crossings. Sanitary sewers are present along Irwin Creek and several tributaries. Major interceptors generally run along the west overbanks of Irwin Creek and Stewart Creek that collect sewage from the smaller system components and transport it to the Irwin Creek Treatment Plant, just upstream of Billy Graham Parkway. The Charlotte-Mecklenburg Utilities (CMU) 5-year capital improvement project map indicates a proposed sanitary sewer relief project for the interceptor along a portion of Irwin Creek, in addition to numerous WWTP plant upgrades and minor system projects.

Storm sewers are another significant consideration in flood mitigation, since they exist throughout the Irwin Creek Watershed, and discharge to the study creeks at numerous locations. City SWS currently has seven active CIP projects, as well as several pending planning/design projects (Figure 8). In addition, MCSWS has a number of existing and recently completed stream restoration CIP projects and planning studies within the Watershed. Several notable recent/existing projects include:

- Four stream restoration projects on Irwin and Stewart creeks (in progress)
- Local watershed plan for Irwin-Sugar Creek basin (in progress)

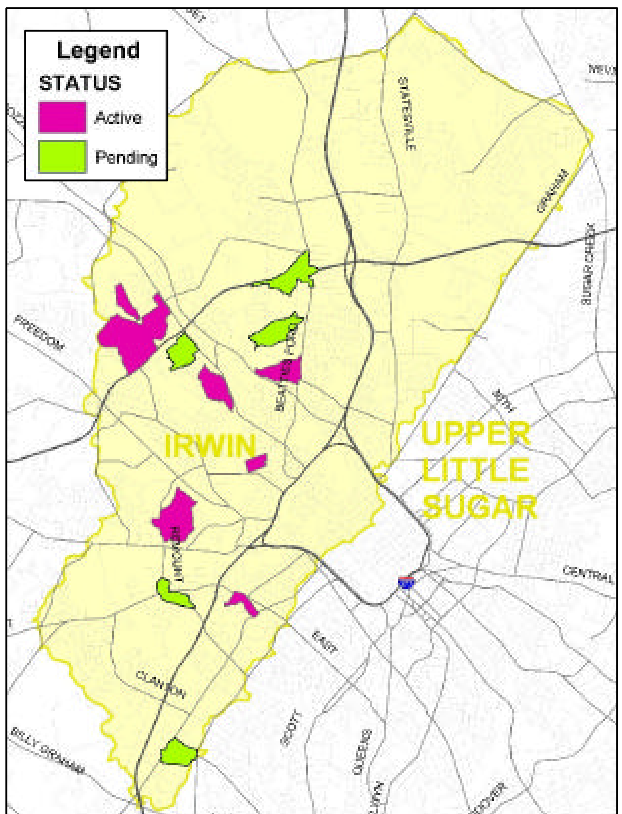


Figure 8. City of Charlotte Storm Water Services Capital Improvement Projects (CIPs)

- Automated flood warning system station near confluence of Irwin and Stewart creeks.

The reader is referred to MCSWS (www.stormwaterservices.com) for more detailed information on existing and future projects in the Irwin Creek Watershed.

Other utilities (water, power, phone, etc.) are scattered throughout the Irwin Creek Watershed, as well. There are two water treatment plants (Vest and Franklin) in the Watershed, which serve Charlotte. Waterlines and gaslines cross the creeks in the watershed along several of the thoroughfares. In addition, Duke Power maintains a substation and several major transmission lines in the northwestern portion of the Watershed. Power lines and utilities poles are also present at many locations.

The existing Mecklenburg County Greenway system includes only one section of greenway in the Irwin Creek Watershed. The existing 1+ mile stretch of greenway runs along Irwin Creek parallel to I-77, and then passes under I-77 to connect with Stewart Creek (near Morehead Street). However, the 1999 Mecklenburg County Greenway Master Plan recommends that the greenway system be expanded as a floodplain management buffer and water quality program to include almost all creeks and streams throughout the County. Future plans within the Irwin Creek Watershed include a 10.2 section of greenway along Irwin Creek, and a 2.3 mile greenway along Edwards Branch. In addition, overland connectors would be used to connect the Irwin Creek greenway to the Mallard Creek greenway. Figure 9 depicts the existing and future greenway systems proposed in the Master Plan for the Irwin Creek Watershed.

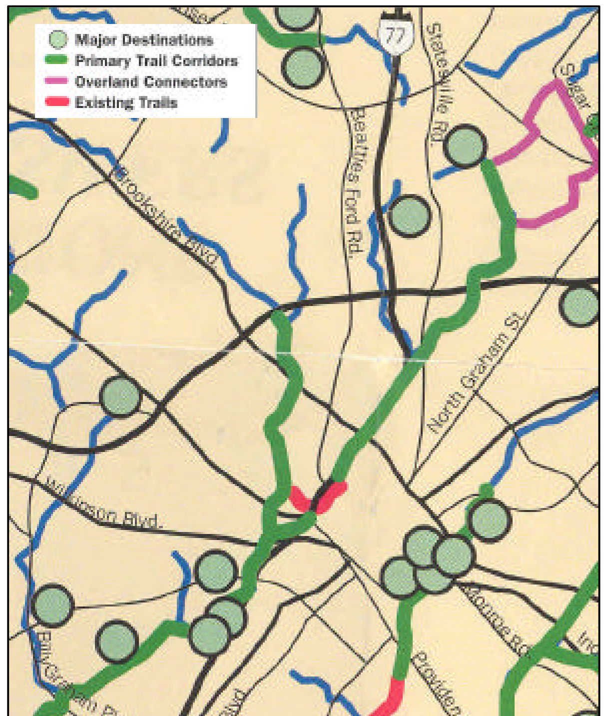


Figure 9 - Proposed Greenway System in Irwin Creek Watershed (from 1999 Greenway Master Plan).

1.3. Aquatic Habitat and Environmental Monitoring

When available, monitoring data can be one of the best sources of information for evaluating site environmental conditions in a watershed. In addition to providing specific information on existing conditions, monitoring data may provide insight to patterns over time. Patterns identified In the monitoring data can be coupled with records of development and/or other activities to help develop a cause-effect relationship between activities in the watershed and environmental stressors (problems) that currently exist, or are likely to develop, based on current watershed patterns. Although a full environmental watershed assessment and data analysis is beyond the scope of this planning project, available monitoring data is identified and summarized below.

Mecklenburg County has a water quality program which maintains a system of approximately 49 water quality monitoring stations throughout the County. There are three basic types of environmental monitoring conducted at the stations:

1) Benthic macroinvertebrate sampling (i.e. taxa richness (EPT method))
2) Fish sampling (i.e. North Carolina Index of Biotic Integrity (NCIBI))
3) Ambient sampling (e.g. dissolved oxygen, nitrates, metals, oils, etc. – reported as composite Water Quality Index (WQI)).

Biological (fish and macroinvertebrate) sampling is used to assess a streams ability to support abundant and diverse populations of aquatic life, and thus, is a direct measure of the aquatic health of a stream. Generally biological sampling protocols are based on the presence or non-presence of indicator species sensitive to pollutants or environmental stressors. A principal advantage of biological sampling is that it is generally less sensitive to short-term environmental changes, and represents a more composite, longer-term view of aquatic health. A limitation of biological sampling is that although it answers the direct question of "how/what" is the aquatic health of the stream, it does not indicate "why" it is such.

Ambient sampling is used to assess the chemical and physical properties of stream flow, and to indirectly assess the aquatic health of a stream. When coupled with biological sampling, ambient data can help answer the question as to "why" the aquatic health of a stream is the status that it is. Ambient sampling is also helpful in evaluating whether the water meets water quality standards (e.g. enough dissolved oxygen, appropriate temperature, etc.), as well as, identifying the presence of potential pollutants that may hinder healthy conditions (e.g. excess metals, oil, etc.). One limitation of ambient sampling is that since it is representative of in-stream conditions at a given point(s) in time, it is highly variable – constituent levels are often sensitive and are affected by changes in environmental conditions (e.g. diurnal and seasonal patterns, wet versus dry weather, etc.). To help assess the data from the many sampled constituents, Mecklenburg County uses a "Water Quality Index" (WQI). The WQI integrates samples from the individual constituent samples to provide a composite or overall rating of the ambient water quality.

Organized monitoring of the stations began in the late 1980's and continues today. The frequency of monitoring at each station is dependent upon the purpose of the station (i.e. project specific or general) and the type of information collected (i.e. chemical versus biological). Ambient chemical water quality data is generally collected every quarter, whereas macroinvertebrate is sampled annually. Fish sampling for the entire County was collected on a "one-time" basis between 1995 and 1999. However, the County has started conducting a new round of fish sampling that is expected to finish in the near future.

Mecklenburg County Water Quality Program (MCWQP) maintains five monitoring stations in the Irwin Creek Watershed - two ambient water quality stations on Irwin Creek, one ambient station on Stewart Creek, and one bio-monitoring station on Stewart Creek. A sixth station (MC22B at Hoskins Road) exists in the GIS information provided by the County, however, there is no sampling data for the site.

Macroinvertebrate Taxa Richness sampling has produced "Fair" or "Poor" rankings for all sites since 1994 with the exception of station MC21A on Stewart Creek, which received a "Fair/Good" rating in May 1996. Fish sampling from 1995, 1996, and 2001 produced rankings ranging from "Poor" to "Fair/Good", with most recent sampling producing a "Fair" rating.

Ambient water quality sampling in the Irwin Creek Watershed have indicated relatively good water quality ratings despite the low macroinvertebrate and fish rankings. Water quality indices have ranged from "Fair/Good" to "Good/Excellent", with many "Good" ratings. Detailed analysis (beyond the scope of this study) is needed to better assess the reason for the conflicting water quality ratings. One possible hypothesis is that although the WQI, which is a composite ambient water quality rating, is good, one or more ambient constituents that are important for healthy aquatic life are at unsuitable levels. Table 2 summarizes the MCWQP monitoring data.

Table 2. MCDEP Water Quality Monitoring Summary											
NC Piedmont Macroinvertebrate Taxa Richness		Jun-94		May-96		Jul-99		Jul-00		May-01	
Site	Location	S_{EPT}	WQ Rating	S_{EPT}	WQ Rating	S_{EPT}	WQ Rating	S_{EPT}	WQ Rating	S_{EPT}	WQ Rating
MC19	Irwin Creek - Statesville Ave	11	Fair	-	-	3	Poor	5	Poor	3	Poor
MC21	Stewart Creek - Morehead Street	2	Poor	-	-	6	Poor	5	Poor	4	Poor
MC21A	Stewart Creek - Capps Hill Mine Rd	-	-	14	Fair/Good	4	Poor	-	-	-	-
MC22	Irwin Creek - West Blvd	3	Poor	-	-	-	-	-	-	-	-
MC22A	Irwin Creek - Westmont Road	-	-	-	-	5	Poor	7	Fair	4	Poor

Fish Bioassessment		Sep-95		May-96		Jul-98		Oct-99		Oct-01	
Site	Location	NCIBI	WQ Rating	NCIBI	WQ Rating	NCIBI	WQ Rating	NCIBI	WQ Rating	NCIBI	WQ Rating
MC19	Irwin Creek - Statesville Ave	44	Fair	-	-	-	-	-	-	42	Fair
MC21	Stewart Creek - Morehead Street	50	Good	-	-	-	-	-	-	44	Fair
MC21A	Stewart Creek - Capps Hill Mine Rd	-	-	42	Fair	36	Poor/Fair	34	Poor	-	-
MC22	Irwin Creek - West Blvd	46	Fair/Good	-	-	-	-	-	-	-	-
MC22A	Irwin Creek - Westmont Road	-	-	-	-	-	-	-	-	-	-

Water Quality Index		Mar-96		May-96		Jun-98		Aug-00		Aug-01	
Site	Location	WQI	WQI Rating	WQI	WQI Rating	WQI	WQI Rating	WQI	WQI Rating	WQI	WQI Rating
MC19	Irwin Creek - Statesville Ave	68.75	Good	68.25	Good	67.38	Good	71.03	Good	66.96	Good
MC21	Stewart Creek - Morehead Street	79.29	Good/Exc.	63.71	Fair/Good	64	Fair/Good	74.98	Good	71.8	Good
MC21A	Stewart Creek - Capps Hill Mine Rd	66.93	Good	65.26	Good	67.92	Good	-	-	-	-
MC22	Irwin Creek - West Blvd	-	-	-	-	-	-	78.98	Good/Exc.	81.22	Good/Exc.
MC22A	Irwin Creek - Westmont Road	-	-	-	-	-	-	-	-	-	-

In additional to the MCWQP monitoring stations, there is one USGS flow station and five rain gages within the Irwin Creek Watershed. A list of these stations and gages are provided below for general reference.

Table 3. USGS Stations and Mecklenburg County Rain Gages		
Station/Gage ID	Type	Location
02146211	USGS (flow)	Irwin Creek at Statesville Avenue
0214620760	County (rainfall)	Irwin Creek at Starita Road
351642080533445	County (rainfall)	CMUD at Hwy 16
351331080525945	County (rainfall)	Fire Station #10 at Remount Rd.
351503080510145	County (rainfall)	Oaklawn Elementary School
351741080475045	County (rainfall)	Derita Elementary School

1.4. Rosgen Stream Morphology Assessment

Stream classification is a process where subject streams are analyzed and are grouped into discrete categorizes based on similar characteristics. Classification is beneficial and often used in stream restoration projects since it provides a consistent baseline for organizing, comparing, and managing streams. In addition, classification can offer insight on existing behavior and future trends of the stream.

There are several types of stream classification systems that categorize streams using different parameters (e.g. channel stability, sediment transport, etc.). This study utilized the Rosgen Stream Classification System, which is a hierarchical classification system (Levels I – IV) based on increasingly detailed morphological information. For the purposes of watershed-wide planning, the Level I (i.e. the most generalized classification) classification is appropriate. Detailed planning and/or design generally merit a Level II assessment or above.

A Rosgen Level I Assessment was conducted on the study streams within the Irwin Creek Watershed to obtain a course geomorphic characterization for each study stream. The Rosgen Assessment qualitatively classifies a stream based on broad-scale quantitative assessments of basin relief, landform, and valley morphology characteristics. For this Level I analysis, topographic data, aerial photos, and HEC-RAS models were used to calculate stream sinuosity (i.e. a measure of how much a stream meanders) and channel slope for each study stream. These calculated values are presented below in the table below.

Table 4. Rosgen Level 1 Assessment: Geomorphic Characterization

	Channel Length (mi)	Valley Length (mi)	Channel Sinuosity	Channel Slope (percent)
Irwin Creek	10.9	10.2	1.1	0.25
Kennedy Branch	2.1	2.0	1.1	0.64
Irwin Creek Tributary 1	1.0	0.9	1.1	0.68
Stewart Creek	5.4	5.2	1.0	0.35
Stewart Creek Tributary 1	0.9	0.8	1.1	0.57
Stewart Creek Tributary 2	1.6	1.5	1.1	0.63
Stewart Creek Tributary 3	1.1	1.1	1.0	0.74

The information presented above and several previous more detailed studies indicate that the main stem of Irwin Creek can be classified as a Type E channel (although less steep and sinuous). Type E channels are generally characterized by slight entrenchment, low width to depth ratios, and relatively high sinuosity within a broad valley. A natural Type E stream is generally considered to be very efficient and stable, although in the case of Irwin Creek there are many exceptions to this generalization.

The tributaries to Irwin Creek are generally more steeply sloped than the main stem, and thus may be classified as Type G channels (again, less steep and sinuous). Type G channels are generally characterized by a low sinuosity, mild slopes, and a low bankfull width/depth ratio. These conditions often lend to undesirable high bank erosion rates, and channel instability. This is consistent with the fact that the creek banks have been armored along numerous sections with riprap to reduce bank erosion.

It is important to note that the urban development of Charlotte has significantly altered the natural stream system (i.e. straightening, widening, armoring, etc), which has diminished the influence that the general geomorphic information (used in a Level 1 analysis) has on channel morphology. In addition, stream morphology can vary considerably between different reaches, especially in urban areas. These factors can complicate classifying streams, since the calculated numbers may not fit perfectly into any one distinct category (as was the case for the study streams). In this situation, judgment and/or further study is used to approximate the "best fit".

1.5. Bank Stability Problem Identification

Channel bank stability is an important issue in urban floodplain/storm water management, since it can have a significant impact on the quality of a stream for both localized areas and as a whole. Unstable channels with eroding banks destroy valuable property, expose and/or weaken existing infrastructure (e.g. utilities), and lessen the efficiency of ponds and reservoirs. In addition, the increased sedimentation can cause significant water quality problems. Sediment in streams negatively impacts aquatic life by burying and suffocating aquatic habitat, and providing a host for harmful bacteria and other pollutants to attach.

Channel instability problems typically fall into two general categories: isolated areas of bank erosion and long-term equilibrium adjustments to changes in the watershed and stream system. The former may be caused by rapid inflow from tributaries, unstable banks, or encroachment of development. The latter is related to larger scale changes in the land use of the watershed and flows in the stream, which manifest in the form of changes to the channel bottom level.

MCSWS and others have identified a number of bank stability problems in the Watershed. However, many of these issues have been or are being addressed. Cursory bank stability assessment for this study did identify both localized scour and the presence of mid-channel sand bars (which indicate long-term equilibrium adjustments) at several locations. However, since most visible channel bank areas near road crossings have been armored, no major problems were identified. Other problem areas may exist at areas not visible from road crossings.

2. BENEFIT:COST ECONOMIC ANALYSIS

2.1. Benefit:Cost Analysis Overview

The benefit:cost (B:C) analysis is an economic based analysis that is commonly used in mitigation projects to evaluate the cost-effectiveness of one or more proposed improvement alternatives. The B:C analysis compares the benefits (in dollars) obtained by a proposed improvement versus the cost to implement the improvement.

In the context of flood hazard mitigation, the benefits are primarily comprised of the estimated flood damages that are avoided by implementing an improvement. For example, if a proposed improvement project (e.g. elevating a building above the floodplain) protects (i.e. eliminates flood damages) a floodprone building that incurs an average of $1,000/yr in flood damages, the $1,000/yr is considered the benefit. The cost equals the cost to implement (and maintain) the alternative.

The results of the B:C analysis is typically expressed in a simple ratio of the benefits over the costs – referred to as the B:C ratio. A B:C ratio of greater than 1.0 implies that the benefit of implementing a proposed project is greater than the cost to implement the project. Thus, the given alternative is considered an economically feasible solution. Subsequently, a B:C ratio of less than 1.0 indicates that the costs associated with a proposed alternative are more than its benefits, so the alternative is not cost-effective. It should be noted that the B:C ratio is based solely on economic considerations, whereas in reality, there are often many other considerations that cannot be directly quantified (for both benefits and costs). Examples of other considerations include: water quality benefit, aesthetic benefit, public safety issues, political environment, disruptions in traffic patterns, and others. For this reason, it can be acceptable to implement an alternative with a benefit/cost ratio of less than 1.0. In this study, per direction of MCSWS, buildings in the community encroachment (0.1 foot) floodway were in almost all cases recommended for acquisition (regardless of their B:C ratio) due to potential public safety issues and regulatory requirements.

2.2. Flood Damage Assessment Model

The FEMA "Riverine Flood, Full Data Module (Version 5.2.3, 1999)" Benefit:Cost model, hereafter referred to as FEMA BC, was used for estimating flood damages in this study. The FEMA BC is an EXCEL spreadsheet-based program that has built-in functions to compute probability based damages, given user-entered information, such as economic and physical building information, and flood information. As noted in the previous section, the estimated damages represent the benefit in the B:C analysis. To increase efficiency and accuracy in inputting data into the FEMA BC model, a custom import application was developed in Visual Basic for Applications (VBA). This import application took data that had been compiled into tables, and automatically created FEMA BC models. Appendix A presents the import tables used to create the FEMA BC models. As indicated previously, the damage estimates presented in this report are for planning and general ranking purposes only. A more detailed B:C analysis should be performed before further mitigation action is taken.

2.3. Building Data

The amount of damage incurred by a flooded building is a function of the economic and physical characteristics of the building. A brief description of the building parameters used by the FEMA BC program for the flood damage assessment is provided below. The reader is referred to the FEMA BC User's Guide for a more detailed description.

Building Type: The building type provides physical style information (i.e. number of stories, presence of basements, etc.) for a building. FEMA BC categorizes building types into six general building types. Each building type has a unique, built-in, flood depth to damage relationship that the program uses to estimate the damages to a given building (e.g. a house with a basement incurs damage at a higher rate than an identical house without a basement).

Building Value: The building value refers to the economic value of the building. It is required by FEMA BC since flood damages are a function of the economic value of the building. Building values were estimated from Mecklenburg County tax parcel data and were assumed to equal 125% of the "improvement value" (i.e. TOT_IMP_VA field). This assumption is consistent with the six previous watershed-wide studies completed in 2001.

Content Value: Content value is the estimated value of the contents in a building. Damages to building contents often represent a significant portion of total flood damage for a given structure. In large-scale studies such as this, the content value is often expressed as a percentage of the building value (e.g. contents in a residence are worth 25% of building value). For this study, flooded buildings were grouped into five categories based on their use (i.e. residential, commercial, etc.). Content to building value percentages were then developed for each category and used in the FEMA BC model. It should be noted that this methodology differs from that used in the previous six watershed studies completed in 2001, which used a content to building value of 25% for all structures.

Floor Elevation: Floor elevation refers to the elevation of the lowest finished floor. The model uses this to determine the elevation at which flood damage commences. Floor elevations were obtained from surveyed elevation certificates obtained from Mecklenburg County. Elevation certificates were surveyed/created for buildings not having existing ones.

Displacement Cost: The displacement cost represents the cost that is incurred when occupants of a building are displaced and thus must live/operate in a temporary location while damage is being repaired. Flat displacement costs of $5,250/month for single-family residential buildings and $12,000/month for multi-family residential buildings were used in this study. These estimates were based on per diem information provided by the NC Department of Emergency Management. Non-residential buildings were assumed to have a $0 displacement cost. Costs related to being displaced were assumed to be accounted for in lost revenue estimates discussed below. It should be noted that this methodology differs from that used in the previous six watershed studies completed in 2001, which used a single flat displacement cost ($5,250/month) for all structures.

Business Loss Cost: The business loss cost is an estimate of the amount of loss revenue incurred by a business when normal operations are disturbed (or halted) due to a flood. Business costs are highly building specific and difficult to estimate. However, for the purposes of the watershed-wide planning study losses of $10,000, $18,800, and $37,500 per month were used for general commercial, warehouse, and offices, respectively. Residential properties were given a business loss of $0. These estimates were developed from economic information obtained the Charlotte Chamber of Commerce and internet business sites. It should be noted that this methodology differs from that used in the previous six watershed studies completed in 2001, which did not account for business loss cost.

2.4. Hydraulic Data

Hydraulic data specifies the frequency and magnitude of flooding at a given building. It is used in conjunction with physical building data to assess flood depths and subsequent flood damages for a given building. FEMA BC requires water surface elevations (WSEs) from four storm events: 10%, 2%, 1%, and 0.2% annual chance flood events, which are typically defined as 10-, 50-, 100-, and 500-year storm events, respectively.

This study used future condition WSEs in the FEMA BC program for each of the storm events. The 100-yr WSEs used in this study were previously developed in HEC-RAS (Version 2.2) for the County by Watershed Concepts. Since the County's HEC-RAS models did not have future condition WSEs for the other storm events (i.e. 10-, 50-, and 500-yr), they were created separately. First, future condition flows were developed by applying the previously developed built-out land use conditions to the 10-, 50-, and 500-yr HEC-1 hydrology models. The future condition WSEs were then calculated by running the future condition flows through the HEC-RAS models. WSEs were calculated at each floodprone building by applying a station to each building and then interpolating the HEC-RAS output to obtain a WSE for the station of the building.

2.5. Modeling Process

The FEMA BC model utilizes the above information to produce an estimated annual cost of flood damage. This expected annual damage cost takes into account damages from all frequency storms inputted into the model, and is calculated in a multiple-step process. First, raw damages for building, contents, displacement, and business losses are computed. Building and content damages are estimated by comparing flood depths associated with each storm event with built-in (or user specified) depth-damage functions (DDFs). Building and content DDFs used in this study are given in Appendix C. Displacement and business costs are estimated by using built-in (or user specified) curves to assess the amount of time the structure is unusable for a given flood depth, and then multiplying this "downtime" by monthly displacement/business loss costs. Next, a probability-based curve is developed from user-entered discharges and WSEs that accounts for probability of each storm event. Lastly, the raw damage functions (DDFs) are compared with the probability curve of to calculate the average annual damage. A detailed description of flood damage assessment statistics is beyond the context of this report. The reader is referred to the FEMA BC Users Guide for more information.

The flood damage assessment portion of this study was conducted on buildings located in the 100-yr Future Condition Floodplain (FCF), with finished floor elevations below the predicted 100-yr future condition WSE. It should be noted that since the FEMA BC includes the 500-yr storm event (i.e. the 0.2% chance event), computed damages include damages from storms larger than the 100-yr. However, improvement alternatives were design based on the 100-yr storm event.

2.6. Economic Analysis

Once the floodprone buildings in a study area are identified and their flood related damages assessed, the next step in a benefit:cost analysis is to identify potential mitigation alternatives and then develop a cost to implement these alternatives. The cost to implement a given improvement alternative represents the "cost" portion of the B:C ratio. Before the a B:C ratio is calculated, all benefits and costs must be in the same time reference (e.g. present lump sum cost, annual cost, etc.). As noted above, the FEMA BC calculates damages (i.e. benefits) as an average annual cost. Conversely, cost estimates for improvement alternatives are typically developed as a present worth lump sum (or a combination lump sum and annual cost), as they were in this project. For clarity, all benefits and costs were standardized to present value lump sump terms. The annualized benefits calculated in the FEMA BC were transformed to present value lump sum using standard engineering economic equations with a 50-yr project life and a 7% interest rate.

The final step in the B:C analysis is to make a mitigation recommendation. B:C ratios are calculated for all the proposed improvement alternatives, from which alternatives that are cost-effective (i.e. B:C > 1.0) are identified. Any additional, non-quantitative factors are then considered in conjunction with the B:C ratios, to identify a recommended action for the building or group of buildings. If the B:C ratio is less than 1.0 for all improvement alternatives and there are no significant non-quantitative benefits (i.e. water quality, public recreation, etc.), then a "no-action" option is recommended.

2.7. Improvements

A number of flood damage mitigation improvement alternatives were considered for each flooded building or group of flooded buildings. General options for improvement alternatives included: property acquisition, structure elevation, flood proofing, construction of floodwalls/levees, channel improvements, infrastructure improvements, detention, and a no action option.

Costs and subsequent B:C ratios (as described above) were developed for each improvement alternative that was deemed as a feasible alternative. Section 3 summarizes the improvements and the economic analysis results for the alternatives. More detailed information on the improvements investigated in this study and the economic analysis results are presented in Sections 3.5.1 and 3.5.2, respectively.

3. FLOOD HAZARD MITIGATION

3.1. Storm Water Service Requests

Mecklenburg County and the City of Charlotte maintain a joint City/County storm water service request hotline where residents can call and request service for storm water related issues/problems. Requests can be made for any storm water related issues (e.g. pipe repair, inoperable structure, yard flooding, etc.), and are thus typically associated with localized issues (which are not addressed in this study), rather than stream overbank flooding. However, presenting this information can be useful for identifying chronic problems.

Information provided by MCSWS indicates that there has been one recent storm water service request. The request is for a property along Stewart Creek immediately upstream of the confluence between Stewart Creek and Stewart Creek Tributary 1, however, the request was not for a building that was identified as flooding in the 100-yr FCF (i.e. included in the B:C analysis). The address of the outstanding request is provided below for general reference:

- 7001 Queensberry Drive

3.2. Repetitive Loss Structures

A repetitive loss structure is defined as any structure that has had two or more flood-related insurance claims during a 10-year period. Repetitive loss structures are of special interest in local mitigation planning since they are being targeted by FEMA for mitigation assistance, and thus are generally the most eligible for federal funding.

Information provided by MCSWS indicates that there are two (2) repetitive loss properties within the Irwin Creek Watershed. A total of five (5) claims amounting to approximately $105,177 have been paid to these properties between 1980 and 1998. Similar to the storm water service requests, repetitive loss structure claims may be the result of localized issues as well as, stream overbank flooding. Both of the repetitive loss structures had finished floor elevations that are higher than the water surface elevation in the 100-yr FCF, and thus were not included in this study. The addresses of the repetitive loss structures are provided below.

- 816 Norwood Drive
- 640 State Street

3.3. Permanent Storm Water Easements

Based on GIS database information obtained from City SWS, there are nine (9) permanent storm water easements within the Irwin Creek Watershed that provide access to any of the seven study streams. The addresses are:

- vacant property off Barringer Drive (PID 14520102)
- 3620 Crestridge Drive
- 3626 Crestridge Drive
- 1847 Evergreen Drive
- 329 Irwin Avenue
- 516 Norwood Drive
- 831 Norwood Drive
- 1215 Rollingwood Drive
- 832 Seldon Drive.

3.4. Roadway Overtopping Problem Locations

Roadway overtopping refers to the situation where the calculated WSE in a stream is above the top of the roadway surface or other stream crossing. Although this study focused on the mitigation of floodprone buildings, overtopping depths were identified at each road crossing, since overtopping can represent a significant hazard during large storm events. For example, motor vehicles can be swept away in as little as 24 inches of flood flow depths over a road.

Roadway culverts/bridges are typically designed to pass a certain frequency storm event without overtopping, based on their level of service. For example a residential road is often designed to be protected from a 10-yr and smaller storm events, whereas an interstate may be designed to be protected from a 100-yr and smaller storm events. Storms larger than the design frequency are "allowed" to overtop the road, and thus not considered to be a problem. However, it is considered a problem if a storm event equal to or smaller than the design frequency overtops the roadway (ex. a 2-yr or 10-yr event overtops a residential roadway).

Roadway overtopping depths were identified within the Irwin Creek Watershed by comparing results of the HEC-RAS models to roadway geometry. Evaluating the level of service and an appropriate "designed" capacity for road crossings was beyond the scope of this study, therefore roadway overtopping "problems" were not specifically identified. However, since public roads are designed for a 10-yr event or greater, any roadway which is overtopped in the 10-yr event can be considered as problematic. Overtopping depths for the future condition 10-, 50-, and 100-yr storms at all study crossings (including roadways and private crossings), are presented in Table 5 below. Crossings are listed from upstream to downstream.

Table 5. Roadway Overtopping Depths

Irwin Creek	Crossing Structure Type/Size	FC 100-yr WSE (FT. NAVD)	FC 10-yr Overtopping Depth (FT)	FC 50-yr Overtopping Depth (FT)	FC 100-yr Overtopping Depth (FT)
Nevin Road	1-10'x13' CMPA	727.09	0.48	2.13	2.64
Unnamed Access Road	Bridge	712.67	4.71	6.54	7.44
Dalecrest Drive	1-10'x8' Box	707.94	-0.20	1.72	2.29
Starita Road	4-9'x9' Box	700.52	-10.24	-5.95	-4.24
I-85	3-10'x11' Box	697.01	-12.90	-9.76	-8.57
Unnamed Access Road	Bridge	676.56	1.67	2.81	3.08
Statesville Avenue	Bridge	668.61	-8.94	-7.57	-7.15
LaSalle Street	4-12'x13' Box	666.64	-14.84	-12.75	-12.13
I-77	4-12'x13' Box	661.04	-7.30	-1.96	-0.99
Oaklawn Avenue	Bridge	659.31	-14.03	-8.60	-7.80
I-77 Off Ramp	Bridge	658.76	-11.97	-6.03	-5.21
I-277	Bridge	658.47	-29.77	-23.61	-22.80
I-277	Bridge	657.99	-28.21	-21.98	-21.17
Railroad	Bridge	656.99	-33.84	-26.70	-25.89
I-77	4-13'x15.2' Box	656.37	-1.60	6.17	7.00
5th Street	4-13'x15.5' Box	655.76	-21.07	-12.69	-11.46
West Trade Street	4-13'x15' Box	653.66	0.61	8.17	9.15
Footbridge	Bridge	653.47	5.85	15.26	16.25
4th Street Ext	4-13.2'x15.4' Box	653.43	-1.40	8.90	9.89
Footbridge	Bridge	653.39	9.33	20.08	21.07
Railroad	Bridge	653.24	-11.17	0.57	1.57

Railroad	3-12.5'x18' Box	652.18	-11.89	-0.76	0.83
West Morehead Street	4-13'x16' Box	649.44	-11.80	-1.84	-0.66
Ramp to I-77	4-13'x16' Box	646.73	0.98	11.22	12.09
Ramp to I-77	4-13'x15' Box	646.54	-19.95	-9.23	-8.37
Ramp to I-77	4-13'x15' Box	644.23	2.05	11.82	12.42
I-277	4-16'x15' Box	643.87	-6.52	3.81	4.36
Ramp from Wilkinson	Bridge	641.52	-8.59	0.41	0.97
Norfolk Southern Railroad	1-44'x28' CMPA	635.93	-11.77	-7.16	-5.98
I-77 to West Boulevard	Bridge	634.1	-8.93	-4.95	-3.95
West Boulevard	Bridge	633.03	-0.21	3.64	4.65
Remount Road	Bridge	630.84	-3.58	-0.29	1.47
Unnamed Access Road	Bridge	627.39	3.28	5.55	6.47
Unnamed Access Road	Bridge	625.07	5.46	7.13	7.91
Unnamed Access Road	Bridge	623.89	6.50	7.99	8.79
Barringer Drive	Bridge	623.6	2.68	4.23	5.28
Clanton Road	Bridge	619.14	-8.09	-5.66	-4.57
Westmont Drive	Bridge	613.56	5.16	7.58	9.10
Norfolk Southern Railroad	Bridge	610.88	-41.72	-39.12	-37.13
Irwin Creek Tributary 1	**Crossing Structure Type/Size**	**FC 100-yr WSE (FT. NAVD)**	**FC 10-yr Overtopping Depth (FT)**	**FC 50-yr Overtopping Depth (FT)**	**FC 100-yr Overtopping Depth (FT)**
Unnamed Access Road	Bridge	640.68	2.98	4.63	4.46
Fieldcrest Road	1-16'x8' Box	628.48	2.03	3.64	4.11
Kennedy Branch					
Slater Road	1-11'x12' Box	732.46	-0.44	1.17	1.91
Cindy Lane	2-9'x9' Box	731.22	-12.38	-9.91	-8.96
I-85 Access Ramps	3-9.5'x6.3' RCPE	708.81	-14.13	-11.35	-9.7
Footbridge	Bridge	674.22	-11.67	-8.66	-7.67
Stewart Creek					
Capps Hill Mine Road	1-9' RCP	727.3	-1.17	1.54	1.99
Hoskins Road	3-12'x8' Box	691.57	-5.02	-2.37	-1.22
I-85 Service Road	2-11'x11' Box	684.31	-8.25	-4.67	-3.47
Southwest Boulevard	Bridge	675.97	-0.33	1.45	1.79
Unnamed Access Road	Bridge	674.55	2.88	5.91	6.43
LaSalle Street	Bridge	673.15	-5.29	-1.62	-1.17
I-277	3-12'x11' Box	670.1	-8.01	-3.83	-2.48
Unnamed Access Road	2-8'x8' Box & 2-12' RCP	667.77	-28.56	-25.24	-24.22
West Trade Street	Bridge	658.28	-6.3	-4.73	-4.31
Rozelles Ferry Road	3-9.5'x14' Box	654.18	-6.78	-4.21	-3.52
Railroad	1-22'x14.5' CMPA & 2-13' RCP	648.11	-14.42	-11.01	-10.13
State Street	1-25.5'x16' CMPA	646.44	-3.34	-0.31	0.48
Tuckaseegee Road	Bridge	641.77	-8.86	-6.38	-5.73
Freedom Drive	4-9'x12' Box	636.29	-3.84	-0.67	0.05
Morehead Street	Bridge	633.54	-1.87	0.64	0.97

Stewart Creek Tributary 1	Crossing Structure Type/Size	FC 100-yr WSE (FT. NAVD)	FC 10-yr Overtopping Depth (FT)	FC 50-yr Overtopping Depth (FT)	FC 100-yr Overtopping Depth (FT)
Unnamed Access Road	Bridge	661.22	3.47	4.44	4.80
Unnamed Access Road	1-4' RCP & 1-5' RCP	658.31	2.15	2.82	3.45
Berryhill Drive	2-8'x6' RCPE	654.79	2.46	4.33	5.02
Railroad	3-5' RCP	639.42	1.53	1.90	2.00
Stewart Creek Tributary 2					
I-85	2-7'x7' Box	707.91	-26.59	-22.86	-21.06
Barlowe Road	Bridge	703.14	1.99	4.22	5.44
Railroad	Bridge	702.66	-9.00	-6.19	-4.65
Railroad	2-15'x8' RCPE	701.44	-14.04	-9.97	-8.27
Lannder Street	1-15'x9.3' RCPE	692.78	2.01	3.23	3.47
Gallagher Street	1-15'x9' RCPE	683.10	2.36	3.33	3.59
Lakewood Avenue	1-15'x9' RCPE	680.68	2.34	3.40	3.64
Parkway Avenue	Bridge	663.24	-15.26	-14.68	-14.24
Coronet Way	1-20'x8.5' Box	658.45	1.50	2.62	2.93
Stewart Creek Tributary 3					
Hoskins Road	2-6' RCP	723.73	1.52	4.83	5.16
Railroad	2-6' RCP	723.72	-8.80	0.77	1.12
I-85	2-7'x7' Box	693.99	-17.88	-15.06	-12.51

For those roadways which do indicate significant overtopping the following general items may wish to be considered for future action:

- Signage of roadway overtopping warning for avoiding road crossing during flood event.
- Coordination with Police Dept. and Fire Dept. for special attention during flood event.
- Routine inspection for bridge/culvert scour and safety conditions, such as a lack of guardrail (or handrail). Guardrail post would give indication of the edge of the structure when inundated during flood flows.

3.5. Flood Mitigation Improvement Analysis

The flood damage assessment, discussed in Section 2, identified a total of 278 floodprone buildings (i.e. buildings whose footprint intersects the 100-yr FCF) within the Irwin Creek Watershed. This figure excludes miscellaneous accessory buildings such as garages, sheds, park shelters, and similar. Further analysis, survey, and comparison with existing County elevation certificates, revealed that 126 (45%) of these 278 buildings have a finished floor elevation below the predicted 100-yr future condition WSE, and thus are expected to incur flood damage. Figure 5 provides a conceptual illustration of the floodprone and flooding buildings.

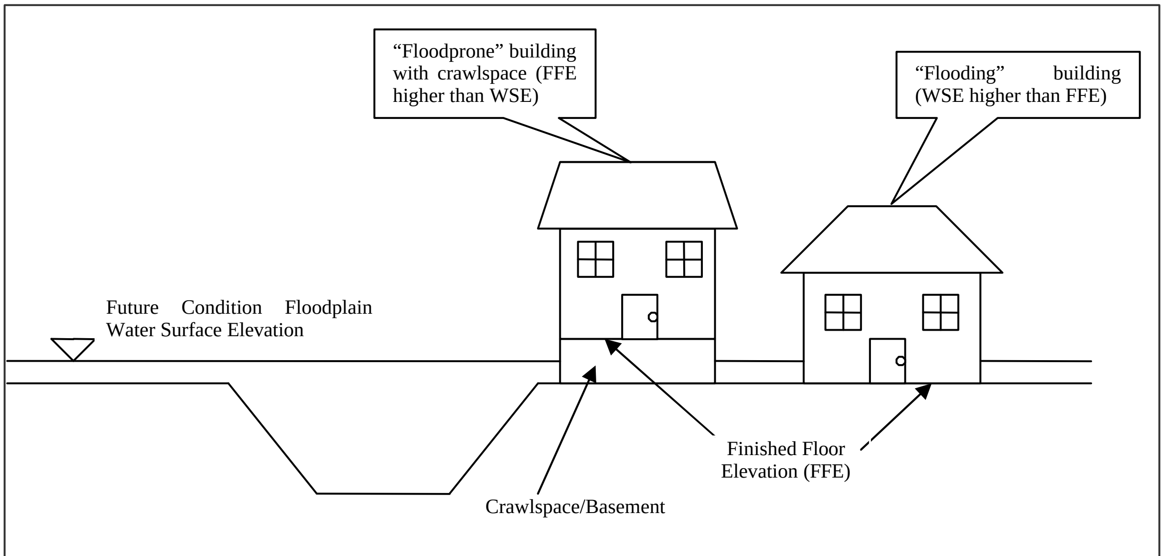


Figure 10. "Floodprone" versus "Flooding" Building Concept Illustration

Since local flood mitigation efforts are often undertaken with the goal of receiving financial assistance from FEMA, additional information was organized to facilitate receiving funding. FEMA considers a number of criteria in evaluating flood mitigation assistance (FMA) and Hazard Mitigation Grant Fund (HMGP) requests. One such criterion – repetitive loss structure information, was previously discussed in this section. Another criterion that is used relates to whether or not floodprone structures were built before Flood Insurance Rate Maps (FIRMs) were available. Buildings constructed prior to available FIRM maps are termed as "pre-FIRM" structures – those built after firm maps are termed "post-FIRM" structures. FIRM maps for Mecklenburg County were first produced in 1978. In addition to FMA and HMGP, pre- and post-FIRM information is also used in the Community Rating System (CRS) evaluation, which can provide additional assistance to municipalities and property owners. Table 6 provides a summary of floodprone building and pre-/post-FIRM information for the study streams in the Irwin Creek Watershed.

Table 6. Flooding Structures Summary

Stream Name	Floodprone Buildings*			Flooding Buildings**		
	Pre-FIRM	Post-FIRM	Sub-Total	Pre-FIRM	Post-FIRM	Sub-Total
Irwin Creek	151	15	166	78	12	90
Irwin Creek Tributary 1	3	0	3	0	0	0
Kennedy Branch	1	1	2	1	0	1
Stewart Creek	65	0	65	12	0	12
Stewart Creek Tributary 1	6	0	6	3	0	3
Stewart Creek Tributary 2	35	1	36	20	0	20
Stewart Creek Tributary 3	0	0	0	0	0	0
WATERSHED TOTALS	261	17	278	114	12	**126**

* Buildings that are within the 100-yr future condition floodplain
** Buildings with a finished floor elevation below the 100-yr future condition water surface elevation

Note: Pre-FIRM structures were constructed before 1978; Post-FIRM structures were constructed in 1978 or later.

Flood mitigation of buildings predicted to incur flood damage is the primary focus of this report. Thus, mitigation improvement alternatives were investigated for these 126 "flooding" buildings, and are discussed in the following sub-sections.

3.5.1. Overview of Mitigation Improvement Alternatives

Several potential improvement alternatives were evaluated to eliminate/reduce flooding damage along the study streams. These alternatives were generally evaluated for flood reduction capability, constructability, social/environmental impact, downstream impact, and economic feasibility. The evaluation was a planning level evaluation only - no design calculations, survey, or detailed analysis were used. The alternatives evaluated included: "no action", property acquisition, structure elevation, flood proofing, construction of levees/floodwalls, infrastructure modification, channel modification, and upstream detention. An overview and preliminary evaluation of each alternative is discussed below.

Alternative 1 – No Action

In any flood mitigation study, where public safety or other concern is not a critical issue, there is the "no action" alternative (i.e. leaving the flooding situation as it is). This is the default alternative that is used when there is no other feasible option, or when the damages associated with periodic flooding do not justify the costs associated with implementing any of the other alternatives (i.e. B:C < 1.0 for all other alternatives). The "no action" option was considered as a feasible alternative, and is further discussed in the evaluation of specific problem areas in the next sub-section.

Alternative 2 – Property Acquisition

Property acquisition is a process in which flood-prone properties are purchased and converted to wetland detention, park area, or some other open space which would allow flood waters to naturally expand. Acquisition is a simple and practical solution since it physically removes the structure from the floodplain, rather than trying to engineer a solution, which always has risk associated with it. In addition, this method provides environmental and aesthetic benefits, and downstream flooding relief.

Another advantage of property acquisition is that Mecklenburg County has significant experience with it for flood mitigation. The County has acquired over 130 floodprone properties for other projects, and thus has gone through the many aspects associated with buyout (i.e. funding, real estate, technical, etc.). The County has used the acquired land for water quality enhancements, stream restoration, and other beneficial uses.

The primary constraints of property acquisition are economic feasibility and social impacts. The cost of acquisition is often high in urban areas, and thus economics may favor other improvement alternatives. In addition, sometimes flood-prone areas have historical, sentimental, or other significance that generates strong public opposition.

For the purposes of this planning study, property acquisition was assumed to consist of property buyout and building demolition. The cost associated with property buyout, for each parcel, was obtained from the County tax database (2002). A unit cost for demolition of $0.25 per cubic foot of building was added to the market value to estimate total property acquisition costs. Property acquisition was considered as a feasible alternative at appropriate locations, and is further discussed in the evaluation of specific problem areas in the next sub-section.

Alternative 3 – Structure Elevation

Structure elevation is a mitigation alternative in which a floodprone structure is physically elevated above the predicted flood elevations. Standard practice is to elevate a structure to one foot (1-ft) above the 100-yr WSE (i.e. 1-ft freeboard). This is typically accomplished on existing structures by extending foundation walls, or using piles, columns, or fill to elevate the structure.

One benefit of structure elevation is that there is minimal change in natural of flood flows. Although, it is possible to elevate almost any structure, it is most appropriate for smaller structures (e.g. residential buildings), especially those with crawlspaces or basements. A limitation of elevation is that although the living area of the structure is protected during a flood event, the surrounding area is inundated, and thus evacuation of the structure may be necessary.

Structure elevation costs were estimated from unit costs provided in FEMA Publication 259 (2001). The original unit costs were adjusted to reflect current economic conditions (i.e. ENR Construction Index) and geographic conditions (i.e. locality adjustment). Adjusted unit costs ranged from $14 to $39 per square foot, depending on building conditions (i.e. wood vs. brick, built on crawl space vs. slab, etc.). A 20% contingency was applied to all unit costs to derive final elevation costs. Structure elevation was considered as a feasible alternative at appropriate locations, and is further discussed in the evaluation of specific problem areas in the next sub-section.

Alternative 4 – Flood Proofing

Flood proofing can refer to several flood damage reduction techniques, however, in this context flood proofing refers to watertight reconstruction of buildings, or “dry” flood proofing. Watertight construction can include sealing building walls with waterproof substances and using flood shields or doors to protect building openings from floodwaters. Flood proofing is generally only applicable for flood depths less than 3 feet, as depths greater than 3 feet generally require structural reinforcement due to the increased hydrostatic and uplift forces caused by the floodwaters (USACE, 1993).

Similar to structure elevation, flood proofing can be implemented on most types of structures, however, it is most appropriate for masonry buildings built with slab-on-grade construction (e.g. warehouses, industrial/commercial buildings, etc.). Generally, these types of structures are sturdy and are more capable of withstanding greater forces associated with floodwaters. In addition, flood-proofing construction, such as watertight doors and flood shields are generally less aesthetically obtrusive on industrial buildings.

The costs associated with flood proofing are a function of the number/type of openings a building has, construction materials, and properties of the buildings utilities. Since this information is very building specific, a flat cost of $50,000 per structure was assumed for this project. This estimate is based on previous flood proofing experience in Mecklenburg County. A 20% contingency was applied to the flat rate to estimate final costs for flood proofing. Flood proofing was considered as a feasible alternative at appropriate locations, and is further discussed in the evaluation of specific problem areas in the next sub-section.

Alternative 5 – Construction of Levees/Floodwalls

Floodwalls and levees are constructed to create a physical barrier between floodwaters and low-lying structures. The primary difference between a levee and a floodwall is that a levee is an earthen embankment with sloped sides, whereas, a floodwall is a concrete or brick wall with vertical sides. Unlike the alternatives mentioned above, floodwalls and levees usually provide protection on a general area, rather than on individual structures.

Floodwalls are often preferred in urban settings because they are thinner, occupy less space, and generally require less maintenance than levees. The primary drawback of floodwalls and levees is that they can greatly constrict the natural flow of water. This constriction can subsequently increase stream velocities, remove natural storage, and increase upstream and downstream water surface elevations. High velocities can increase erosion potential, as well as have adverse environmental effects. The removal of natural storage and the increase in downstream water surface elevations can create increased flooding conditions downstream. In addition, levees also impede the path of natural drainage to a creek, thus requiring an additional drainage system to be constructed.

Costs for constructing levees and floodwalls are highly project dependent, since there are many site specific factors in design (i.e. soils, conflicts with utilities, local permitting, etc.). For purposes of this planning study, costs for levees/floodwalls were estimated from unit costs provided in FEMA Publication 259 (2001). The original unit costs were adjusted to reflect current economic conditions (i.e. ENR Construction Index) and geographic conditions (i.e. locality adjustment). Adjusted unit costs ranged from $31 to $370 per linear foot, depending on the height and type of structure (i.e. levee vs. floodwall). A 30% contingency was applied to all unit costs to estimate final construction costs. Construction of levees/floodwalls was considered as a feasible alternative at appropriate locations, and is further discussed in the evaluation of specific problem areas in the next sub-section.

Alternative 6 – Infrastructure Modification

Infrastructure modification refers to making adjustments to bridges, culvert, and/or roadways to protect floodprone structures and/or to eliminate roadway overtopping. Inadequately sized bridges/roadways are often are a cause of many urban drainage problems. When hydraulic capacity of a bridge/roadway is exceeded, flood waters can build up behind the abutments and cause upstream flooding. The potential effectiveness of increasing the capacity of bridges/roadways can be seen by examining the flood profile. The flood profile displays the difference in the water surface elevation between the downstream and upstream sides. If the profile shows a large difference in upstream and downstream water surface elevations, increasing the size of the pipe or culvert will reduce the backwater effect. However, if there is little difference in the water surface elevations, the significance of enlarging the pipe or culvert will have little effect. It is important to consider the potential downstream impact for any infrastructure modification in order to ensure that increasing flow capacity in one location will not create or worsen flood hazards downstream.

Costs for infrastructure modification are highly project dependent, since they depend on the type and magnitude of improvements being made (e.g. upsizing culverts, raising roadways, adding bridges, etc.). Due to the wide variety of modifications, costs were developed using general estimating procedures and state bid tables. Infrastructure modification was considered as a feasible alternative at appropriate locations, and is further discussed in the evaluation of specific problem areas in the next sub-section.

Alternative 7 – Channel Modification

Modifications to an existing channel can provide a means of reducing flooding, and can include: widening channel banks, clearing of channel sections, lowering channel inverts and cutting back side slopes. The basic mechanism for these improvements is increasing channel conveyance, thus allowing more water flow through the channel boundaries. Channel improvements are generally more applicable to controlling higher frequency, smaller magnitude storms, rather than providing protection against larger magnitude storms, as is the case in this study. This is because flow in the higher magnitude storms is generally spread out in the floodplain area, rather than contained within the channel. In addition, improvements to the channel in highly urban areas are more complex, due to the numerous roadway decks, small work area, and the presence of a stream junction.

Channel modification for flood control has become less popular in recent years due to adverse environmental and aesthetic effects that modification can cause. Examples of adverse effects include an increase in flow velocities, erosion potential, sedimentation, habitat degradation, and downstream flooding. Channel modification for flood control is indeed contradictory to many of the recent efforts of Mecklenburg County to restore previously modified streams to a more natural, healthy state (e.g. Freedom Park Stream Restoration Project). Due to these factors, channel modification will not be further evaluated in this report.

Alternative 8 – Upstream Detention

Upstream detention is another option for mitigating floodprone areas. Unlike the previous alternatives which involve modifications directly in the floodprone area, detention is generally implemented upstream of the problem location, where there may or may not be any flooding problems. The basic idea of a detention facility is to reduce peak flood flows (and thus reduce peak WSEs) by temporarily storing the flood flows, and releasing them at a designed rate. The impact of detention is typically an attenuation or "flattening" of the flood hydrograph. Similar to channel improvements, detention is often used for smaller magnitude storms, and in new land development. Detention can be used for large magnitude floods, but the amount of land required for holding the larger volume of floodwater is often a limiting factor, especially in highly urban areas such as the study watershed. Detention ponds can have adverse environmental effects as well as bring opposition from the public. Due to these factors, detention will not be further evaluated in this report.

3.5.2. Problem Area Evaluation

As previously noted in this section (Table 6), there were a total of 126 buildings identified within the Irwin Creek Watershed for which potential mitigation alternatives were investigated. For clarity in analysis and presentation, the identified buildings were categorized into flood problem areas based on study stream, geographic proximity, and cause/magnitude of flooding. A total of 90 buildings along Irwin Creek were grouped into 13 individual flood problem areas (IRW01 – IRW13). One (1) flooding building along Kennedy Branch was placed into one flood problem area (IKB1). Twelve (12) buildings along Stewart Creek were grouped into four flood problem areas (SCK1 – SCK4). Three (3) flooding buildings along Stewart Creek Tributary 1 were grouped into two flood problem areas (ST1-1 – ST1-2). Twenty (20) buildings along Stewart Creek Tributary 2 were grouped into four flood problem areas (ST2-1 – ST2-4). No flooding buildings were identified on Irwin Creek Tributary 1 and Stewart Creek Tributary 3.

B:C ratios were calculated for each building and for each problem area as a whole. In general, alternatives that produced a B:C ratio greater than 1.0 were considered for recommendation. It is common in benefit-cost analyses to recommend the alternative that produces the highest B:C. However, per direction from MCSWS, this study gave a greater emphasis on acquisition. As indicated in Section 2.1, building structures that were located within the community encroachment (0.1 foot) floodway were in almost all cases recommended for acquisition (regardless of B:C ratio). In addition, for buildings in the floodplain fringe, acquisition was generally recommended over other mitigation alternatives, as long as it had a B:C greater than or equal to 1.0. For example, if mitigation of a residential structure produced a B:C ratio of 1.3 for acquisition and 2.5 for elevation, generally acquisition would be recommended. If all alternatives produced a B:C ratio of less than 1.0, the "no-action" option was recommended.

Results of the mitigation improvement alternative analysis for the individual flood problem areas are summarized below. Figure E-1 is an overall map that shows locations of the problem areas. Figures E-2 through E-15 illustrate the specific location of recommended improvements for each problem area. All E-figures are located in the Executive Summary. In addition, a summary of the B:C analysis, which includes addresses and parcel identification numbers for each individual structure, is presented in Appendix B.

IRW01– Irwin Creek WWTP (Figure E-2)

Problem area IRW1 includes seven (7) office/warehouse buildings in the Irwin Creek WWTP complex, along Irwin Creek. Flooding depths in the future conditions 100-yr storm range from 1.0 ft to 10.0 ft, with an average depth of 4.0 ft. Four of the seven buildings lie within the community encroachment (0.1 foot) floodway. Dewberry staff met with Charlotte-Mecklenburg Utilities (CMU) in November 2002 to discuss flood hazard and flood control for the Irwin WWTP. CMU indicated that the plant was flooded during the 1996 – 1997 storms and subsequently undertook flood mitigation measures. The mitigation measures included construction of a floodwall (crest elevation 614.3) on one side and flood proofing for several buildings on the opposite side of Irwin Creek. A copy of the meeting minutes is provided in Appendix D. Since the FCF WSE is approximately 611.8, at this location, the existing flood mitigation measure were assessed as adequate, and no further mitigation was deemed necessary. Thus, the recommendation for IRW01 is "no action."

Table 7. Problem Area IRW01 Mitigation Summary

	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	4	0.7	0.8	$0*	No Action	-	-	-	-
Non-Floodway	3	2.0	2.8	$0*	No Action	-	-	-	-
Totals	7	4.0	10.0	$0*	No Action	-	-	-	-

*Buildings protected by existing levee and flood proofing measures.

IRW02– Whitehurst Road/Crestridge Drive (Figure E-3)

Problem area IRW02 includes fifteen (15) houses on Whitehurst Road and Crestridge Drive, along a 900 foot reach of Irwin Creek. This area has been targeted by MCSWS for flood hazard mitigation and environmental restoration in recent years. The County acquired nine properties along Whitehurst Road and one property on Abeline Road in 2001, as part of the Whitehurst buyout project. In addition, MCSWS is currently working with the Wetlands Restoration Program (WRP) on a stream restoration/enhancement project that extends from the IRW02 problem area downstream to a railroad crossing below the Irwin Creek WWTP.

The 15 buildings that are still predicted to flood are set back from the Creek and are not included in the buyout/restoration projects. Flooding depths in the future conditions 100-yr storm range from 0.3 ft to 4.6 ft, with an average depth of 2.3 ft. Nine of the eleven houses on Whitehurst Road are located in the community encroachment (0.1 foot) floodway, while the four houses on Crestridge Drive are within the floodplain fringe. Three alternatives were evaluated for IRW02 – no action, property acquisition, and structure elevation. Only one house (Parcel ID 14521210) had a B:C ratio greater than 1.0 for property acquisition. However, eight other houses, with acquisition B:C ratios ranging from 0.2 to 0.9, were also recommended for acquisition since they are located in the located in the 0.1 foot floodway. For the remaining six houses, B:C values for elevation ranged from 0.2 to 0.9 – with four of the houses having values of 0.9. Since the elevation B:C ratios for these four houses are very close to 1.0, the County may wish to perform more detailed benefit:cost analysis on these buildings. However, to be consistent with the methodology used in this study, the recommendation for IRW02 is property acquisition for nine residential houses and "no action" for the remaining six houses.

Table 8. Problem Area IRW02 Mitigation Summary									
	Total # of Buildings Flooding	**Average Flood Depth**	**Max Flood Depth**	**Total Flood Damage**	**Recommended Mitigation**	**Buildings Protected by Mitigation**	**Benefit From Mitigation**	**Total Mitigation Cost**	**Overall B:C Ratio for Mitigation**
Floodway	9	2.8	4.6	$351,091	Acquisition*	9	$351,091	$575,729	0.6
Non-Floodway	6	1.6	3.1	$103,947	No Action	0	-	-	-
Totals	15	2.3	4.6	$455,038	Acquisition/ No Action	9	$351,091	$575,729	0.6

* 8 of the 9 houses have a B:C ratio less than 1.0

IRW03– Reid Avenue (Figure E-3)

Problem area IRW03 includes one (1) residential house on Reid Avenue that is located within the floodplain fringe of Irwin Creek. The future conditions 100-yr storm flood depth is 2.9 ft. Three alternatives were evaluated for IRW03 – no action, property acquisition, and structure elevation. The B:C ratios for property acquisition and structure elevation for this structure are 0.8 and 1.6, respectively. Therefore, the recommendation for IRW03 is structure elevation for one house.

Table 9. Problem Area IRW03 Mitigation Summary									
	Total # of Buildings Flooding	**Average Flood Depth**	**Max Flood Depth**	**Total Flood Damage**	**Recommended Mitigation**	**Buildings Protected by Mitigation**	**Benefit From Mitigation**	**Total Mitigation Cost**	**Overall B:C Ratio for Mitigation**
Floodway	0	-	-	-	-	-	-	-	-
Non-Floodway	1	2.9	2.9	$36,586	Elevation	1	$36,586	$23,239	1.6
Totals	1	2.9	2.9	$36,586	Elevation	1	$36,586	$23,239	1.6

IRW04– Barringer Drive

Problem area IRW04 includes two (2) commercial/warehouse buildings on Barringer Drive, along Irwin Creek. The buildings are on the same property (Parcel ID 14508120) and are both located within the community encroachment (0.1 foot) floodway. Flooding depths in the future conditions 100-yr storm range from 3.1 ft to 3.5 ft, with an average depth of 3.3 ft. Three alternatives were evaluated for IRW04 – no action, property acquisition, and structure elevation. The two buildings have B:C ratios ranging from 0.4 to 0.9. Although neither structure has a cost-effective B:C ratio, they are recommended for acquisition, since they are in the 0.1 foot floodway. The recommendation for IRW04 is acquisition for two buildings.

Table 10. Problem Area IRW04 Mitigation Summary									
	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	2	3.3	3.5	$139,857	Acquisition*	2	$139,857	$210,735	0.7
Non-Floodway	0	-	-	-	-	-	-	-	-
Totals	2	3.3	3.5	$139,857	Acquisition*	2	$139,857	$210,735	0.7

* both buildings have a B:C ratio less than 1.0

IRW05– Revolution Park (Figure E-4)

Problem area IRW05 includes concession/restroom building in Revolution Park (off of Barringer Drive), along Irwin Creek and is located inside the community encroachment (0.1 foot) floodway. The future conditions 100-yr storm flood depth is 5.7 ft. Three alternatives were evaluated for IRW05 – no action, property acquisition, and structure elevation. Mecklenburg County already owns this building, so acquisition would likely be very in-expensive. However, this building serves the public and is not permanently inhabited, thus serious danger/damage is not expected. Therefore, the recommendation for IRW05 is "no action".

Table 11. Problem Area IRW05 Mitigation Summary									
	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	1	5.7	5.7	$221,585	No Action	0	-	-	-
Non-Floodway	0	-	-	-	-	-	-	-	-
Totals	1	5.7	5.7	$221,585	No Action	-	-	-	-

IRW06– Spruce Street/Merriman Avenue (Figure E-4)

Problem area IRW06 includes sixteen (16) residential houses on Spruce Street and Merriman Avenue, along Irwin Creek. Flooding depths in the future conditions 100-yr storm range from 0.2 ft to 6.0 ft, with an average depth of 2.8 ft. None of the houses are located in the community encroachment (0.1 foot) floodway. Three alternatives were evaluated for IRW06 – no action, property acquisition, and structure elevation. The majority of flooding in this problem area is caused by backwater from West Boulevard and/or I-77, however infrastructure improvements were not considered feasible since West Boulevard would likely need to be raised, and other modifications would be necessary to I-77. A floodwall option was also initially considered, but it was dismissed due to access issues, multiple potential flooding sources (i.e. there is a significant tributary south of the problem area), and interior drainage issues. Six houses have B:C ratios ranging from 1.0 to 2.1 for property acquisition. Two other houses (Parcel ID's 11904214 and 11904215) have B:C ratios for structure elevation of 1.3 and 1.5. The remaining eight houses have B:C ratios less than 1.0 for each of the evaluated alternatives. The recommendation for IRW06 is property acquisition for six houses, structure elevation for two houses, and "no action" for eight houses.

Table 12. Problem Area IRW06 Mitigation Summary									
	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	-
Non-Floodway	16	2.8	6.0	$576,637	Acquisition/ Elevation/ No Action	8	$445,667	$323,841	1.4
Totals	16	2.8	6.0	$576,637	Acquisition/ Elevation/ No Action	8	$445,667	$323,841	1.4

IRW07– West Wilkinson Boulevard (Figure E-4)

Problem area IRW07 includes three (3) warehouse buildings on the Radiator Specialty Co. property on West Wilkinson Boulevard, along Irwin Creek near the confluence with Stewart Creek. None of the buildings are located in the community encroachment (0.1 foot) floodway. Flooding depths in the future conditions 100-yr storm range from 0.7 ft to 6.4 ft, with an average depth of 2.9 ft. Four alternatives were evaluated for IRW07 – no action, property acquisition, structure elevation, and flood proofing. Two of the smaller accessory buildings are predicted to experience relatively minor flooding (i.e. < 1.5 ft) in the 100-yr FC storm event, while the main building (over 66,000 sq. ft.) is predicted to incur the substantial flooding. It should be noted that the third building is a multi-level building and thus the damage estimate is likely to be high, since in reality only a portion of the building floods. B:C ratios for all investigated alternatives were less than 1.0. It is also important to note that currently, this property is being considered for re-development plans that involve significant changes to the existing site as well as modification and/or removal of the existing buildings. Thus, any flood mitigation action considered by the County should incorporate/consider these potential re-development plans.

Given the low B:C ratios and potential plans for re-development, the recommendation for IRW07 is “no action” for three buildings.

Table 13. Problem Area IRW07 Mitigation Summary									
	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	-
Non-Floodway	3	2.9	6.4	$913,444	No Action	0	-	-	-
Totals	3	2.9	6.4	$913,444	No Action	0	-	-	-

IRW08 – Morehead Street/Summit Avenue/Bryant Street/Freedom Drive (Figure E-5)

Problem area IRW08 includes twenty (20) flooded buildings – primarily warehouse and office buildings off of Morehead Street and Bryant Street, along Irwin Creek. The problem area is in the vicinity of the confluence of Stewart Creek with Irwin Creek. One building (a night club) in this group, 935 S. Summit Avenue lies within the community encroachment (0.1 foot) floodway, while the others are in the floodplain fringe. Flooding depths in the future conditions 100-yr storm range from 0.4 ft to 12.7 ft, with an average depth of 6.8 ft. Five alternatives were evaluated for IRW08 – no action, property acquisition, structure elevation, floodwall, and flood proofing.

A previous study was conducted in 2001 (Dames & Moore, 2001) which investigated potential flood hazard mitigation measures for the IRW08 problem area. The previous study recommended "no action" since there was no single, cost effective alternative to mitigate the flooding for all of the buildings in this area. However, since this study considers B:C ratios for individual buildings, as well as the problem area as a whole, various alternatives were developed and investigated. Based on the analysis in the previous study and subsequent investigation, it appears a floodwall could provide flood protection for the twenty buildings. However, the construction of a floodwall would require significant roadway modifications to West Morehead Street and two stretches on Freedom Drive. It is also anticipated that additional complications may be encountered during the design/construction of a floodwall. Because of the additional costs associated with building a floodwall, the B:C ratio is 0.4.

Six buildings have property acquisition B:C ratios ranging from 1.2 to 1.8. These six buildings are all located off of Bryant Street. The building in the floodway produced an acquisition B:C of only 0.6, however, it is also recommended for acquisition since it is in the floodway and is predicted to experience severe flooding (10.4 feet of flooding) in the 100-yr event. There are two primary explanations for why this structure did not produce a cost-effective B:C ratio (even with the high flood depths). First, the County hydraulic models indicate that the predicted water surface elevations in this area vary dramatically between the lower and higher frequency storm events. In this case, the building is not predicted to flood in the 10-year storm event (which is often an indicator of whether flood mitigation will be cost effective), but is predicted to experience severe flooding in the larger storm events. The second reason is that the structure has a relatively low assessed value compared to the overall value of the property. Since building damages are largely calculated as a function of building value, the estimated damages do not exceed the overall property cost.

The remaining thirteen buildings have B:C ratios less than 1.0 for each of the evaluated alternatives. The recommendation for IRW08 is property acquisition for six warehouse buildings and a night club, and "no action" for the other fourteen buildings.

It should be noted that the County purchased the large warehouse building on the southeast corner of West Morehead Street and Bryant Street (Parcel IDs 06701304 and 06701305) in December 2002 (after the commencement of this study). The analysis used in this study produced B:C ratios of less than 1.0 for all investigated improvements, however, the B:C for acquisition was very close to 1.0 (i.e. 0.9). In addition, it should also be noted that the Charlotte-Mecklenburg Planning Commission has produced a future land use plan for this area, referred to as the "Gateway District" of the West Morehead Corridor plan (2001). The recommendations of this study appear to be consistent with the current district plan, however, it is recommended that the district plan be consulted prior to any flood hazard mitigation actions.

Table 14. Problem Area IRW08 Mitigation Summary

	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	1	10.4	10.4	$317,528	Acquisition*	1	$317,528	$576,600	0.6
Non-Floodway	19	6.6	12.7	$7,652,610	Acquisition/ No-Action	6	$4,567,398	$3,205,986	1.4
Totals	20	6.8	12.7	$7,970,137	Acquisition*/ No-Action	7	$4,884,926	3,782,586	1.3

* building in floodway has a B:C ratio less than 1.0

IRW09– Thrift Road/Freedom Drive (Figure E-5)

Problem area IRW09 includes two (2) brick warehouse buildings on Thrift Road and Freedom. The buildings are located just upstream of the confluence between Stewart Creek and Stewart Creek

Tributary 1, however the buildings are flooded due to backwater from Irwin Creek. Both buildings are located in the floodplain fringe. Flooding depths in the future conditions 100-yr storm range from 0.1 ft to 2.6 ft, with an average depth of 1.4 ft. Four alternatives were evaluated for IRW09 – no action, property acquisition, structure elevation, and flood proofing. The two buildings have B:C ratios of 1.5 and 2.2 for flood proofing. B:C ratios for the other evaluated alternatives were between 0.0 and 0.1. The recommendation for IRW09 is flood proofing of 2 buildings.

Table 15. Problem Area IRW09 Mitigation Summary

	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	-
Non-Floodway	2	1.4	2.6	$220,564	Flood Proofing	2	$220,564	$120,000	1.8
Totals	2	1.4	2.6	$220,564	Flood Proofing	2	$220,564	$120,000	1.8

IRW10– Westbrook Drive/Greenleaf Avenue/Elliott Street (Figure E-5)

Problem area IRW10 includes six single family residential houses on Westbrook Drive and Greenleaf Avenue, two condominium buildings on 1st Street, and one office/warehouse building on Elliott Street, along a 920 foot reach of Irwin Creek. All nine (9) structures are located within the floodplain fringe. Flooding depths in the future conditions 100-yr storm range from 0.2 ft to 8.1 ft, with an average depth of 2.7 ft. Three alternatives were evaluated for IRW10 – no action, property acquisition, and structure elevation. Infrastructure improvements to the two railroad crossings downstream of this problem area were initially considered, however, these options were dismissed due to the expected inhibitive cost of two new railroad bridges.

The house with the predicted 8.1 flood depth (Parcel ID 07321302) is recommended for acquisition, even though it has an acquisition B:C ratio less than 1.0 (i.e. 0.7). Acquisition is recommended due to the dangerous flood depths and the fact that elevating the house would likely not be practical. Similar to the explanation provided in IRW08, this house likely did not produce a cost-effective B:C ratio (even with the high flood depths) due the fact it does not flood in the 10-yr storm event. Three houses have B:C ratios for structure elevation ranging from 1.1 to 1.6. The office/warehouse had a B:C ratio of 1.8 for flood proofing. The other three buildings have B:C ratios ranging from 0.1 to 0.7 for the evaluated alternatives. The recommendation for IRW10 is acquisition of one residential house, structure elevation for three residential houses, flood proofing for one office/warehouse, and “no action” for the other four buildings.

Table 16. Problem Area IRW10 Mitigation Summary

	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	-
Non-Floodway	9	2.7	8.1	$484,530	Acquisition*/Elevation / Flood Proofing/ No Action	5	$231,259	$179,870	1.3
Totals	9	2.7	8.1	$484,530	Acquisition*/Elevation / Flood Proofing/ No Action	5	$231,259	$179,870	1.3

* one building has a B:C ratio less than 1.0

IRW11– Sycamore Street (Figure E-5)

Problem area IRW11 includes one (1) residential house on Sycamore Street, along Irwin Creek which lies within the community encroachment (0.1 foot) floodway. The future conditions 100-yr storm flooding depth is 6.5 ft. Three alternatives were evaluated for IRW11 – no action, property acquisition, and structure elevation. Although the building is predicted to experience significant flooding in the 100-yr event, the building mitigation improvements do not appear to be cost effective. The B:C ratios for acquisition and elevation are 0.7 and 0.9, respectively. The primary reasons for the low estimated damages are a low building value (since the damage is a function of building value) and the fact that the house does not flood in the 10-year event (which is often an indicator of whether or not flood mitigation will be cost-effective). However, since the building is in the 0.1 foot floodway, the recommendation for IRW11 is acquisition for one building.

Table 17. Problem Area IRW11 Mitigation Summary

	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	1	6.5	6.5	$38,835	Acquisition*	1	$38,835	$54,806	0.7
Non-Floodway	0	-	-	-	-	-	-	-	-
Totals	1	6.5	6.5	$38,835	Acquisition*	1	$38,835	$54,806	0.7

* building has a B:C ratio less than 1.0

IRW12– Andrill Terrace (Figure E-6)

Problem area IRW12 includes eleven (11) residential homes on Andrill Terrace, upstream of the Oaklawn Avenue crossing on Irwin Creek. All of these homes area located in the community encroachment (0.1 foot) floodway. This area has been targeted by MCSWS for flood hazard mitigation in recent years, as the County acquired seven properties along Andrill Terrace in 2001 as part of a buyout project.

The eleven buildings that are still predicted to flood are set back from the Creek and were not included in the buyout project. Flooding depths in the future conditions 100-yr storm range from 5.3 ft to 7.6 ft, with an average depth of 6.7 ft. Three alternatives were evaluated for IRW12 – no action, property acquisition, and structure elevation. Due to the relatively high flood depths, property acquisition is the best option. B:C ratios for the eleven homes range from 1.4 to 4.6 for property acquisition. Similar to what the County has done for other buyout project areas (e.g. Whitehurt, Westfield, etc.) the vacant land resulting from acquisition and the previous buyout project could be used for streamside water quality enhancements, such as pocket wetlands, vegetative buffers, and/or storm water best management practices (BMPs). The recommendation for IRW12 is property acquisition for eleven homes and further investigation of water quality enhancements.

Table 18. Problem Area IRW12 Mitigation Summary									
	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	11	6.7	7.6	$1,162,009	Acquisition/Water Quality Enhancements	11	$1,162,009	$397,962	2.9
Non-Floodway	0	-	-	-	-	-	-	-	-
Totals	11	6.7	7.6	$1,162,009	Acquisition/Water Quality Enhancements	11	$1,162,009	$397,962	2.9

IRW13– McArthur Avenue (Figure E-7)

Problem area IRW13 includes two (2) residential homes on McArthur, along Irwin Creek just upstream of the confluence between Irwin Creek and Kennedy Branch. No buildings in this group are located in the community encroachment (0.1 foot) floodway. Both properties are owned by the City of Charlotte. Flooding depths in the future conditions 100-yr storm range from 2.2 ft to 4.0 ft, with an average depth of 3.1 ft. Three alternatives were evaluated for IRW13 – no action, property acquisition, and structure elevation. B:C ratios for property acquisition range from 2.3 to 17.5. The overall B:C ratio for the problem area with respect to property acquisition is 5.7. The recommendation for IRW13 is property acquisition for two residential homes.

Table 19. Problem Area IRW13 Mitigation Summary									
	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	
Non-Floodway	2	2.7	3.3	$625,864	Acquisition	2	$625,864	$109,514	5.7
Totals	2	2.7	3.3	$625,864	Acquisition	2	$625,864	$109,514	5.7

KB1– Slater Road (Figure E-10)

Problem area KB1 includes one (1) house off of Slater Road, along Kennedy Branch which is outside the community encroachment (0.1 foot) floodway. The flooding depth in the future condition 100-yr storm is 0.6 ft. Three alternatives were evaluated for KB1 – no action, property acquisition, and structure elevation. The B:C ratios for acquisition and elevation are 0.2 and 0.5, respectively. Since neither alternative is cost effective, the recommendation for the KB1 problem area is “no action” for one house.

Table 20. Problem Area KB1 Mitigation Summary									
	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	
Non-Floodway	1	0.6	0.6	$9,730	No Action	0	-	-	-
Totals	1	0.6	0.6	$9,730	No Action	0	-	-	-

SCK1– Gardener Avenue (Figure E-13)

Problem area SCK1 includes one (1) warehouse building on Gardener Avenue, along Stewart Creek which is outside the community encroachment (0.1 foot) floodway. The flooding depth in the future conditions 100-yr storm range is 0.3 ft. Six different alternatives were evaluated for SCK1 – no action, property acquisition, structure elevation, levee, culvert improvement, and flood proofing. B:C ratios for the warehouse ranged from 0.1 to 3.0. The B:C ratios were greater than 1.0 for the levee, culvert improvement, and flood proofing, with the levee producing the highest value. The levee option would entail constructing an approximate 430 foot long, 3 foot high earthen berm that would essentially "close off" a backwater area of Irwin Creek. Given the topography and the location of the building with respect to the floodplain, a levee would appear to be a feasible cost effective solution. The recommendation for the SCK1 problem area is a levee.

Table 21. Problem Area SCK1 Mitigation Summary									
	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	
Non-Floodway	1	0.3	0.3	$96,191	Levee	1	$96,191	$51,541	1.9
Totals	1	0.3	0.3	$96,191	Levee	1	$96,191	$51,541	1.9

SCK2– Seldon Drive (Figure E-13)

Problem area SCK2 includes six (6) residential houses on Seldon Drive, along Stewart Creek. All the homes are located outside the community encroachment (0.1 foot) floodway. Flooding depths in the future condition 100-yr storm range from 0.9 ft to 2.6 ft, with an average depth of 1.7 ft. Four alternatives were evaluated for SCK2 – no action, property acquisition, structure elevation, and floodwall. The floodwall has the highest B:C ratio of the evaluated alternatives – 1.8 for the problem area. However, construction of a floodwall in this area will impact a significant amount of private backyard property and would likely have to be built in the 0.1 foot floodway. It would also be difficult to account for lost floodplain storage in order to not increase WSEs in the area since there is a large Salvation Army building is located on the other side of the Creek. Due to the apparent constraints, the floodwall option is not recommended.

Three of the houses have property acquisition B:C ratios ranging from 1.0 to 1.8. An additional two houses have structure elevation B:C ratios ranging from 1.0 to 1.7. The sixth house (Parcel ID 06905113) has B:C ratios less than 1.0 for the evaluated alternatives. The houses with cost effective acquisition B:C ratios are on contiguous properties that are located in a natural topographic depression.

Thus, these properties may also be good candidates for water quality enhancements such as vegetative buffers, pocket wetlands, and/or other storm water BMPs (e.g. level spreaders, bioretention areas, etc.). The recommendation for SCK2 is property acquisition for three houses and subsequent investigation of water quality enhancements on the acquired properties, structure elevation for two houses, and "no action" for the remaining house.

Table 22. Problem Area SCK2 Mitigation Summary

	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	
Non-Floodway	6	1.7	2.6	$221,198	Acquisition/ Water Quality Enhancements/ Elevation/ No Action	5	$208,502	$152,430	1.4
Totals	6	1.7	2.6	$221,198	Acquisition/ Water Quality Enhancements/ Elevation/ No Action	5	$208,502	$152,430	1.4

SCK3– Pitts Drive (Figure E-13)

Problem area SCK3 includes two (2) apartment buildings on Pitts Drive, along Stewart Creek. Both buildings are outside the community encroachment (0.1 foot) floodway. Flooding depths in the future condition 100-yr storm range from 0.7 ft to 1.3 ft, with an average depth of 1.0 ft. Four alternatives were evaluated for SCK3 – no action, property acquisition, structure elevation, and a floodwall. B:C ratios for the evaluated mitigation alternatives ranged from 0.1 to 0.8. Since none of the alternatives are cost effective, the recommendation for SCK3 is "no action" for two apartment buildings.

Table 23. Problem Area SCK3 Mitigation Summary

	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	
Non-Floodway	2	1.0	1.3	$39,139	No Action	0	-	-	-
Totals	2	1.0	1.3	$39,139	No Action	0	-	-	-

SCK4 – Prince Street (Figure E-14)

Problem area SCK4 includes three (3) residential housing units (on the same parcel) on Prince Street, along Stewart Creek. All of these units are outside the community encroachment (0.1 foot) floodway. Flooding depths in the future condition 100-yr storm range from less than 3.1 ft to 3.9 ft, with an average depth of 3.5 ft. Three alternatives were evaluated for SCK4 – no action, property acquisition, and structure elevation. The three buildings all have B:C ratios greater than 1.0 for property acquisition. The acquisition costs used to develop the B:C ratios included 10 housing units, since they are on the same parcel (10 units total) as the three "flooding" structures. Thus the recommendation for SCK4 is property acquisition for all housing units on parcel PID 06907102.

Table 24. Problem Area SCK4 Mitigation Summary									
	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	
Non-Floodway	3	3.5	3.9	$268,218	Acquisition	3	$268,218	$237,150	1.1
Totals	3	3.5	3.9	$268,218	Acquisition	3	$268,218	$237,150	1.1

ST1-1– Berryhill Road (Figure E-11)

Problem area ST1-1 includes one (1) apartment building and one commercial building on Berryhill Road, along Stewart Creek Tributary 1. Both of these buildings are outside the community encroachment (0.1 foot) floodway. Flooding depths in the future condition 100-yr storm range from 0.3 ft to 2.2 ft, with an average of 1.5 ft. Three alternatives were evaluated for ST1-1 – no action, property acquisition, and structure elevation. Both buildings have B:C ratios less than 1.0. The recommendation for the ST1-1 problem area is “no action” for the two buildings.

Table 25. Problem Area ST1-1 Mitigation Summary									
	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	
Non-Floodway	2	1.3	2.2	$82,349	No Action	0	-	-	-
Totals	2	1.3	2.2	$82,349	No Action	0	-	-	-

ST1-2 – Freedom Drive (Figure E-11)

Problem area ST1-2 includes one (1) commercial (nightclub) building on Freedom Drive, located in the floodplain fringe of Stewart Creek Tributary 1. The flooding depth in the future condition 100-yr storm is 1.8 ft. Three alternatives were evaluated for ST1-2 – no action, property acquisition, and structure elevation. The B:C ratios for property acquisition and structure elevation are 1.9 and 3.0, respectively. Although the building is not inundated by high flood depths, it is predicted to in the 10-year storm – resulting in a high estimated damage. Given the County’s preference for acquisition, the recommendation for ST1-2 is property acquisition for one commercial building.

Table 26. Problem Area ST1-2 Mitigation Summary									
	Total # of Buildings Flooding	**Average Flood Depth**	**Max Flood Depth**	**Total Flood Damage**	**Recommended Mitigation**	**Buildings Protected by Mitigation**	**Benefit From Mitigation**	**Total Mitigation Cost**	**Overall B:C Ratio for Mitigation**
Floodway	0	-	-	-	-	-	-	-	
Non-Floodway	1	1.8	1.8	$1,346,042	Acquisition	1	$1,346,042	$695,660	1.9
Totals	1	1.8	1.8	$1,346,042	Acquisition	1	$1,346,042	$695,660	1.9

ST2-1 – Norwood Drive/October Court (Figure E-12)

Problem area ST2-1 includes three (3) residential houses on Norwood Drive and October Court, along Stewart Creek Tributary 2. All of these homes are located outside of the community encroachment (0.1 foot) floodway. Flooding depths in the future conditions 100-yr storm range from 0.6 ft to 2.8 ft, with an average depth of 1.4 ft. Three alternatives were evaluated for ST2-1 – no action, property acquisition, and structure elevation. One house on Norwood Drive (Parcel ID 06511111) has B:C ratios of 8.0 and 10.1 for acquisition and elevation, respectively. The house on October Court (Parcel ID 07113127) has a B:C ratio of 1.1 for structure elevation. The third house has B:C ratios less than 1.0 for each alternative. The recommendation for the ST2-1 problem area is acquisition for one house, elevation for one house, and "no action" for the third house.

Table 27. Problem Area ST2-1 Mitigation Summary									
	Total # of Buildings Flooding	**Average Flood Depth**	**Max Flood Depth**	**Total Flood Damage**	**Recommended Mitigation**	**Buildings Protected by Mitigation**	**Benefit From Mitigation**	**Total Mitigation Cost**	**Overall B:C Ratio for Mitigation**
Floodway	0	-	-	-	-	-	-	-	
Non-Floodway	3	1.4	2.8	$384,820	Acquisition/ Elevation/ No Action	2	$374,925	$60,573	6.2
Totals	3	1.4	2.8	$384,820	Acquisition/ Elevation/ No Action	2	$374,925	$60,573	6.2

ST2-2– Gallagher Street (Figure E-12)

Problem area ST2-2 includes one (1) residential house on Gallagher St, along Stewart Creek Tributary 2. This home is located within the community encroachment (0.1 foot) floodway. The flooding depth in the future conditions 100-yr storm is 1.5 ft. Three alternatives were evaluated for ST2-2 – no action, property acquisition, and structure elevation. The B:C ratios for property acquisition and structure elevation are 1.2 and 3.1, respectively. Since the B:C ratio for acquisition is greater than 1.0, the recommendation for the ST2-2 problem area is property acquisition for one residential house.

Table 28. Problem Area ST2-2 Mitigation Summary

	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	1	1.5	1.5	$66,547	Acquisition	1	$66,547	$57,040	1.2
Non-Floodway	0	-	-	-	-	-	-	-	-
Totals	1	1.5	1.5	$66,547	Acquisition	1	$66,547	$57,040	1.2

ST2-3– Barlowe Road/Dewolfe Street (Figure E-12)

Problem area ST2-3 includes seven (7) residential houses on Barlowe Road and Dewolfe Street, along Stewart Creek Tributary 2. Both houses on Dewolfe Street and one house on Barlowe Road (4015 Barlowe Road) are located within the community encroachment (0.1 foot) floodway. Flooding depths in the future conditions 100-yr storm range from 0.9 ft to 4.3 ft, with an average depth of 2.3 ft. Four alternatives were evaluated for ST2-3 – no action, property acquisition, structure elevation, and infrastructure improvements. Two of the houses on Barlowe Road have B:C ratios for acquisition of 2.1 and 2.4. Although the acquisition B:C ratios for the houses on Dewolfe Street were less than 1.0 (0.3 and 0.6), they are recommended for acquisition, since they are in the 0.1 foot floodway. The other three houses have B:C ratios less than 1.0 for each of the evaluated alternatives. A culvert improvement was considered at the railroad crossing approximately 500 feet downstream of Barlowe Road. While the culvert improvement would mitigate flooding for four of the houses, the three houses with the more severe flooding would still be flooded during the future conditions 100-yr storm. Thus, the infrastructure improvements option was discarded. The recommendation for ST2-3 is acquisition for four houses and "no action" for the remaining three houses.

Table 29. Problem Area ST2-3 Mitigation Summary

	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	3	2.5	4.3	$156,859	Acquisition*/ No Action	3	$156,859	$141,714	1.1
Non-Floodway	4	2.1	4.2	$153,174	Acquisition/ No Action	1	$110,737	$53,052	2.1
Totals	7	2.3	4.3	$310,034	Acquisition*/ No Action	2	$267,596	$194,766	1.4

* two buildings have a B:C ratio less than 1.0

ST2-4– Blenhein Road

Problem area ST2-4 includes nine (9) residential houses on Blenhein Road, along Stewart Creek Tributary 2 (just upstream of I-85). All of these homes are located outside of the community encroachment (0.1 foot) floodway. Flooding depths in the future conditions 100-yr storm range from 0.4 ft to 4.0 ft, with an average depth of 2.1 ft. Three alternatives were evaluated for ST2-4 – no action, property acquisition, and structure elevation. Initially a levee/floodwall option and infrastructure improvements were considered, but they were dismissed due to "no rise" requirements and anticipated costs. Two of the houses on Blenhein Road, immediately upstream of I-85 have B:C ratios of 1.2 and 1.5 for structure elevation. The remaining seven houses have B:C ratios less than 1.0 of each of the evaluated alternatives. The recommendation for ST2-4 is elevation for two houses and "no action" for the remaining seven houses.

Table 30. Problem Area ST2-4 Mitigation Summary

	Total # of Buildings Flooding	Average Flood Depth	Max Flood Depth	Total Flood Damage	Recommended Mitigation	Buildings Protected by Mitigation	Benefit From Mitigation	Total Mitigation Cost	Overall B:C Ratio for Mitigation
Floodway	0	-	-	-	-	-	-	-	-
Non-Floodway	9	2.1	4.0	$200,635	Elevation/ No Action	2	$69,583	$55,074	1.3
Totals	9	2.1	4.0	$200,635	Elevation/ No Action	2	$69,583	$55,074	1.3

4. CONCLUSIONS AND RECOMMENDATIONS

Irwin Creek Watershed encompasses a 30 square mile urban area in the west-central portion of Mecklenburg County, North Carolina. The Irwin Creek Watershed contains seven streams that have mapped, future condition floodplains (FCFs, also referred to as FLUM floodplains) - Irwin Creek, Kennedy Branch, Irwin Creek Tributary 1, Stewart Creek, Stewart Creek Tributary 1, Stewart Creek Tributary 2, and Stewart Creek Tributary 3.

Flood Hazard Mitigation

There are 278 structures within the FCF boundaries in the Irwin Creek Watershed. Comparison of flood information with building elevation certificates revealed that 126 of the 278 structures have their lowest finished floor below the predicted water surface elevation (WSE) of the FCF, and thus are considered “flooding” structures. Flood damages for these 126 buildings were estimated using the FEMA Full Riverine Benefit:Cost model (FEMA BC), and totaled to over $15.8 million (2003 dollars). Figure E-1 shows an overall map of the Irwin Creek Watershed and identifies problem areas identified in the study.

Several alternatives were developed to mitigate flood damages for problem areas identified along the study streams. A benefit:cost (BC) economic analysis was performed to evaluate cost-effectiveness of the alternatives at each problem area. The alternatives were then compared for their economic, technical, and social feasibility, from which a recommended mitigation strategy was developed for each problem area. If no improvement alternatives were identified as being cost effective or technically feasible, no action was recommended (i.e. leave building as-is).

The alternative evaluation indicated that it is cost-effective (or otherwise pertinent) to provide flood protection for 68 of the 126 flooding buildings. The estimated benefits (i.e. damages reduced) and improvement costs are approximately $10.8 million and $7.3 million respectively. This indicates that focusing mitigation efforts on these buildings will provide the most return for mitigation dollars spent. Figures E-2 through E-15 show the recommended mitigation improvements within the Irwin Creek Watershed.

Environmental Characterization

The Irwin Creek Watershed is located in an established, highly urbanized area within the City of Charlotte. Land use is predominately residential (70+/- %), but also includes limited commercial, industrial, vacant, and other uses. The streams in the Watershed have been modified (e.g. straightened, widened, armored, etc.) to accommodate urbanization, and thus do not exhibit natural, healthy stream characteristics. Reference to local water/biological monitoring data indicates overall “good” conditions, however, benthic sample readings were classified as “poor” at several sites. The majority of environmental analysis included in this PER are broad in nature, however, several locations were identified for potential environmental restoration within the Watershed (Figure E-1).

MCSWS and City SWS are presently coordinating a number of planning/design environmental restoration related projects in the Watershed. In addition, investigation of the GIS tax parcel database reveals that the County owns significant portions of vacant land adjacent to the study streams within the Irwin Creek Watershed. This land will likely be used for proposed greenways along the Creek, which in turn will likely incorporate water quality and/or environmental restoration features. However, it is recommended that more detailed analysis be conducted at a smaller scale level to investigate other environmental restoration opportunities.

5. REFERENCES

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APPENDIX A

IRWIN CREEK WATERSHED FEMA BC IMPORT SPREADSHEET
UPDATED 11/07/03

UNQBLD_ID	STRM_NAME	STRM_STA	BANK	PID	SITUS1	SITUS2	OWNER_NAME	CNTVAL_PCT	BLDG_USE	STYLE_TYPE	BLDG_TYPE	FFE_88	YEAR_BUILT	HIST_FLAG	HEATD_AREA	BLDG_VAL	ESCRIP	Q010yr	Q050yr	Q100yr	Q500yr	WSE010yr	WSE050yr	WSE100yr	WSE500yr	PLCMNTCS	STREVNCS	MANUAL	IFLDWAY0	IFLDWAY0	COMMNTS
5	KENNEDY BRANCH	10628.705	L	04112513	2115 SLATER RD	CHARLOTTE, NC	JACKSON RICHARD MELVIN JR	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	731.8	1946	N	1076	$38,310	bright gr	632	1021	1166	1439	730.2	731.7	732.4	734.8	$5,250	$0	N	N	Y	
48	STEWART CREEK	16165.423	R	06907102	816 PRINCE ST	CHARLOTTE, NC	KERR THOMAS F CO	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	671.47	1964	N	650	$22,094		1974	3125	3447	4420	672.1	674.6	675.1	677.2	$5,250	$0	Y	N	N	
50	STEWART CREEK	16077.432	R	06907102	800 PRINCE ST	CHARLOTTE, NC	KERR THOMAS F CO	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	671.17	1964	N	650	$22,094		1974	3125	3447	4420	672.0	674.6	675.1	677.2	$5,250	$0	Y	N	N	
51	STEWART CREEK	16062.171	R	06907102	800 PRINCE ST	CHARLOTTE, NC	KERR THOMAS F CO	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	671.97	1964	N	2600	$88,374		1974	3125	3447	4420	672.0	674.6	675.1	677.2	$5,250	$0	Y	N	N	
70	IRWIN CREEK	38358.038	L	07719404	1206 MCARTHUR AV	CHARLOTTE, NC	CITY OF CHARLOTTE	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	667.16	1982	N	1470	$76,010	Brick w/v	2841	3647	3890	5160	667.7	669.0	669.4	671.6	$5,250	$0	Y	N	N	
77	IRWIN CREEK	38375.846	L	07719405	1200 MCARTHUR AV	CHARLOTTE, NC	COLEMAN TOMMIE LEE	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	666.16	1956	N	768	$17,980	White sid	2841	3647	3890	5160	667.8	669.1	669.4	671.6	$5,250	$0	N	N	N	
114	STEWART CREEK TRIB 2	8208	L	06302210	4139 BLENHEIN RD	CHARLOTTE, NC	GODFREY JAMES CARL	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	707.2	1953	N	1042	$47,010	brick w/	816	1038	1111	1212	702.4	706.1	707.9	713.1	$5,250	$0	N	N	N	
116	STEWART CREEK TRIB 2	8208	L	06302209	4133 BLENHEIN RD	CHARLOTTE, NC	JOHNSON RAY REALTY INC	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	705.9	1953	N	996	$47,950	brick w/	816	1038	1111	1212	702.4	706.1	707.9	713.1	$5,250	$0	N	N	N	
119	STEWART CREEK TRIB 2	8208	L	06302208	4129 BLENHEIN RD	CHARLOTTE, NC	REAVIS RUTH	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	705.6	1953	N	1044	$45,700	brick w/	816	1038	1111	1212	702.4	706.1	707.9	713.1	$5,250	$0	N	N	N	
121	STEWART CREEK TRIB 2	8208	L	06302207	4125 BLENHEIN RD	CHARLOTTE, NC	MONTGOMERY ANTONIO	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	706.72	1953	N	1040	$46,340		816	1038	1111	1212	702.4	706.1	707.9	713.1	$5,250	$0	N	N	N	
123	STEWART CREEK TRIB 2	8208	L	06302206	4121 BLENHEIN RD	CHARLOTTE, NC	NETTLE JAMES P	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	705.1	1953	N	1062	$45,370	brick w/	816	1038	1111	1212	702.4	706.1	707.9	713.1	$5,250	$0	N	N	N	
125	STEWART CREEK TRIB 2	8208	L	06302205	4117 BLENHEIN RD	CHARLOTTE, NC	MARTIN GEORGE I	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	705.2	1955	N	1040	$42,960	brick w/	816	1038	1111	1212	702.4	706.1	707.9	713.1	$5,250	$0	N	N	N	
127	STEWART CREEK TRIB 2	8208	L	06302204	4115 BLENHEIN RD	CHARLOTTE, NC	HOLLAND HOWARD JAMES SR	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	704.9	1953	N	975	$37,320	brick w/	816	1038	1111	1212	702.4	706.1	707.9	713.1	$5,250	$0	N	N	N	
130	STEWART CREEK TRIB 2	8208	L	06302203	4109 BLENHEIN RD	CHARLOTTE, NC	WINCHESTER ISIAH &WF	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	703.9	1953	N	1000	$46,250	brick w/	816	1038	1111	1212	702.4	706.1	707.9	713.1	$5,250	$0	N	N	N	
138	STEWART CREEK TRIB 2	8208	R	06302229	4116 WELLING AV	CHARLOTTE, NC	TURNER SARAH FRANCIS	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	707.5	1955	N	950	$37,180	white w/	816	1038	1111	1212	702.4	706.1	707.9	713.1	$5,250	$0	N	N	N	
141	STEWART CREEK TRIB 2	7500.01	L	06514304	4016 BARLOWE RD	CHARLOTTE, NC	LONG JAMES MCKINLEY	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	702	1954	N	888	$34,930	brick w/	1881	2701	3000	3807	698.8	701.4	702.9	707.4	$5,250	$0	N	N	N	
143	STEWART CREEK TRIB 2	7625.263	L	06514109	4017 BARLOWE RD	CHARLOTTE, NC	KEATON DANNY O	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	699	1954	N	1044	$43,740	brick w/	816	1038	1111	1212	699.7	702.0	703.2	707.5	$5,250	$0	N	N	N	
144	STEWART CREEK TRIB 2	7495.953	L	06514305	4012 BARLOWE RD	CHARLOTTE, NC	WEBSTER EDWARD WALKER	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	701	1954	N	950	$33,700	No Acce	1881	2701	3000	3807	698.7	701.4	702.8	707.4	$5,250	$0	N	N	N	Elev cert no elevation, assumed FFE as LAG + 1 from 1997 topo
145	STEWART CREEK TRIB 2	7637.021	L	06514108	4015 BARLOWE RD	CHARLOTTE, NC	BAILEY JAMES A	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	698.9	1954	N	1040	$39,360	brick w/	816	1038	1111	1212	699.8	702.0	703.2	707.5	$5,250	$0	N	N	Y	
149	STEWART CREEK TRIB 2	7477.822	R	06514307	3946 BARLOWE RD	CHARLOTTE, NC	EAST EIGHTH STREET PARTNE	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	701.3	1954	N	888	$33,960	brick w/	1881	2701	3000	3807	698.4	701.2	702.7	707.4	$5,250	$0	N	N	N	
150	STEWART CREEK TRIB 2	7668.885	R	06514107	606 DEWOLFE ST	CHARLOTTE, NC	PALMER BERNARD GLEN	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	700.8	1954	N	1040	$42,310	brick w/	816	1038	1111	1212	699.8	702.0	703.2	707.5	$5,250	$0	N	N	Y	
152	STEWART CREEK TRIB 2	7733.76	R	06514106	612 DEWOLFE ST	CHARLOTTE, NC	BUIE GRACE	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	702.3	1954	N	888	$31,660	brick w/	816	1038	1111	1212	699.9	702.0	703.2	707.5	$5,250	$0	N	N	Y	
159	STEWART CREEK	12357.345	L	06906201	2730 PITTS DR	CHARLOTTE, NC	PITT COURT ASSOCIATES	0.25	APARTMENTS	1 Story, w/o Basem	1	669.5	1968	N	2544	$17,121		1974	3125	3447	4420	664.7	668.8	670.2	674.3	$12,000	$0	Y	N	N	
160	STEWART CREEK TRIB 2	5910.789	L	06513105	530 GALLAGHER ST	CHARLOTTE, NC	WHITE STEPHEN RANDOLPH	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	681.87	1941	N	1200	$48,440	Grey sid	1881	2701	3000	3807	682.1	683.1	683.4	684.0	$5,250	$0	N	N	Y	
161	STEWART CREEK	12243.123	L	06906201	2740 PITTS DR	CHARLOTTE, NC	PITTS COURT ASSOCIATES	0.25	APARTMENTS	2 Story, w/o Basem	2	668.8	1968	N	3504	$23,582		1974	3125	3447	4420	664.6	668.8	670.1	674.3	$12,000	$0	Y	N	N	
198	STEWART CREEK	11215.393	L	06905113	800 SELDON DR	CHARLOTTE, NC	DAVIS NUNTIA	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	659.06	1948	N	816	$30,640	Peach w	1974	3125	3447	4420	657.8	659.5	659.9	661.9	$5,250	$0	N	N	N	
207	STEWART CREEK	11143.562	L	06905112	808 SELDON DR	CHARLOTTE, NC	SCOTT PEGGY HART	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	658.06	1948	N	872	$31,850	Green w	1974	3125	3447	4420	657.5	659.2	659.7	661.8	$5,250	$0	N	N	N	
213	STEWART CREEK	11086.069	L	06905111	814 SELDON DR	CHARLOTTE, NC	HILL MELVIN	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	656.86	1948	N	816	$31,240	White w/	1974	3125	3447	4420	657.3	659.0	659.4	661.7	$5,250	$0	N	N	N	
218	STEWART CREEK	11028.237	L	06905110	820 SELDON DR	CHARLOTTE, NC	NELSON JOEL	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	657.16	1948	N	768	$32,780	Blue w/w	1974	3125	3447	4420	657.1	658.8	659.2	661.6	$5,250	$0	N	N	N	
220	STEWART CREEK	10980.062	L	06905109	826 SELDON DR	CHARLOTTE, NC	GRIFFIN JAMES	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	656.76	1948	N	792	$34,520	Tan sidir	1974	3125	3447	4420	657.0	658.6	659.0	661.5	$5,250	$0	N	N	N	
228	STEWART CREEK	10937.592	L	06905108	832 SELDON DR	CHARLOTTE, NC	CUNNINGHAM WILLIE C	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	657.96	1948	N	786	$30,150	Yellow w	1974	3125	3447	4420	656.8	658.4	658.9	661.4	$5,250	$0	N	N	N	
252	IRWIN CREEK	32817.7	R	07509312	1058 ANDRILL TR	CHARLOTTE, NC	FRALEY CLARENCE EUGENE JR	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	653.06	1959	N	650	$19,830	Brick w/g	2841	3647	3890	5160	653.7	658.7	659.5	662.4	$5,250	$0	N	Y	Y	
255	IRWIN CREEK	32783.497	R	07509313	1052 ANDRILL TR	CHARLOTTE, NC	FRALEY CLARENCE EUGENE JR	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	652.56	1959	N	650	$19,830	Brick w/y	2841	3647	3890	5160	653.7	658.7	659.5	662.4	$5,250	$0	N	Y	Y	
259	IRWIN CREEK	32656.702	R	07509311	1043 ANDRILL TR	CHARLOTTE, NC	FRALEY CLARENCE EUGENE JR	0.25	DUPLEX/TRIPLEX	1.0 STORY	1	652.26	1959	N	1300	$22,780	Brick w/y	2841	3647	3890	5160	653.6	658.7	659.5	662.4	$5,250	$0	N	N	Y	
261	IRWIN CREEK	32714.12	R	07509314	1048 ANDRILL TR	CHARLOTTE, NC	CRAWFORD RICKY	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	651.86	1959	N	650	$19,830	Brick w/b	2841	3647	3890	5160	653.6	658.7	659.5	662.4	$5,250	$0	N	Y	Y	
271	IRWIN CREEK	32587.28	R	07509310	1039 ANDRILL TR	CHARLOTTE, NC	FRALEY CLARENCE EUGENE JR	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	652.46	1959	N	650	$19,830	Brick w/c	2841	3647	3890	5160	653.6	658.7	659.5	662.4	$5,250	$0	N	N	Y	
278	IRWIN CREEK	32519.977	R	07509309	1035 ANDRILL TR	CHARLOTTE, NC	SMITH LEVY	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	652.36	1959	N	650	$21,600	Brick w/c	2841	3647	3890	5160	653.5	658.7	659.4	662.4	$5,250	$0	N	N	Y	
281	STEWART CREEK TRIB 2	1198.306	L	06511111	835 NORWOOD DR	CHARLOTTE, NC	LEWIS LORETTA	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	655.66	1960	N	975	$35,360	Brick w/c	1881	2701	3000	3807	657.0	658.2	658.5	659.2	$5,250	$0	N	N	N	
284	STEWART CREEK TRIB 2	1260.775	L	06511110	831 NORWOOD DR	CHARLOTTE, NC	VANDEVERE JOSEPH C JR	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	657.96	1960	N	1014	$36,910	Brick w/g	1881	2701	3000	3807	657.1	658.3	658.6	659.3	$5,250	$0	N	N	N	
286	IRWIN CREEK	32469.326	R	07509308	1033 ANDRILL TR	CHARLOTTE, NC	LUCKY SEVEN INC	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	652.66	1959	N	650	$21,600	Brick w/g	2841	3647	3890	5160	653.5	658.7	659.4	662.4	$5,250	$0	N	N	Y	
292	IRWIN CREEK	32402.247	R	07509307	1027 ANDRILL TR	CHARLOTTE, NC	LUCKY SEVEN INC	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	652.76	1959	N	650	$24,430	Brick w/b	2841	3647	3890	5160	653.4	658.6	659.4	662.3	$5,250	$0	N	N	Y	
299	IRWIN CREEK	32351.24	R	07509306	1023 ANDRILL TR	CHARLOTTE, NC	LOVE FREDERICA E	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	652.46	1959	N	650	$18,770	Brick w/c	2841	3647	3890	5160	653.4	658.6	659.4	662.3	$5,250	$0	N	N	Y	
305	IRWIN CREEK	32308.912	R	07509305	1017 ANDRILL TR	CHARLOTTE, NC	AZIZY HAIM	0.25	DUPLEX/TRIPLEX	1.0 STORY	1	653.26	1959	N	1400	$35,710	Brick w/c	2841	3647	3890	5160	653.4	658.6	659.4	662.3	$5,250	$0	N	N	Y	
314	IRWIN CREEK	32237.427	R	07509304	1011 ANDRILL TR	CHARLOTTE, NC	RAINES JAMES A	0.25	DUPLEX/TRIPLEX	1.0 STORY	1	654.06	1960	N	1364	$35,410	Brick w/c	2841	3647	3890	5160	653.3	658.6	659.4	662.3	$5,250	$0	N	N	Y	
339	STEWART CREEK TRIB 2	2103.924	L	07113127	2922 OCTOBER CT	CHARLOTTE, NC	STEPHENS DALLAS L	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	659.46	1960	N	950	$46,170	Green si	1881	2701	3000	3807	658.8	660.0	660.4	661.3	$5,250	$0	N	N	N	
424	STEWART CREEK	6993.911	L	07111412	GARDENER AVE	CHARLOTTE, NC	CAROLINA PAPER BOARD COR	1	WAREHOUSE	1 Story, w/o Basem	1	647.76	1946	N	39362	$760,080		2458	3505	3799	4766	644.1	647.2	648.1	650.2	$0	$18,800	Y	N	N	
603	STEWART CREEK TRIB 1	3547.42	L	06707359	2301 FREEDOM DR	CHARLOTTE,NC	TYSON FLOYD OKEY	0.75	COMMERCIAL	2 Story, w/o Basem	2	658.5	1974	N	12803	$356,695		1883	2749	3133	4025	659.1	660.0	660.3	661.1	$0	$10,000	Y	N	N	
615	IRWIN CREEK	25976.579	L	07321102	236S SYCAMORE ST	CHARLOTTE, NC	SANDERS ANNIE B	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	4	646.86	1935	N	1032	$37,710	Brick w/w	5521	7396	7840	9727	643.2	652.4	653.4	655.4	$5,250	$0	N	N	Y	
640	IRWIN CREEK	25556.5	L	07321302	1024 WESTBROOK DR	CHARLOTTE, NC	JOHNSON ELIZABETH MRS R	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	4	645.25	1940	N	1206	$43,200	1.5-story	5521	7396	7840	9727	642.0	652.4	653.3	655.4	$5,250	$0	N	N	N	
641	IRWIN CREEK	20900.71	R	07104111	2000 THRIFT ROAD	CHARLOTTE, NC	PIEDMONT PROPERTIES	1	COLD STORAGE/FREEZER	1 Story, w/o Basem	1	641.62	1958	N	60656	$238,970		5521	7396	7840	9727	633.4	643.6	644.2	646.2	$0	$10,000	Y	N	N	
642	IRWIN CREEK	25539.718	L	07321303	1020 WESTBROOK DR	CHARLOTTE, NC	HEARD MARY EMMA	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	4	653.1	1938	N	993	$42,510	brick w/	5521	7396	7840	9727	642.0	652.4	653.3	655.4	$5,250	$0	N	N	N	
650	IRWIN CREEK	25501.578	L	07322125	1025 WESTBROOK DR	CHARLOTTE, NC	THORNBURG NEAL PATRICK	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	650.1	1942	N	975	$35,310	brick w/	5521	7396	7840	9727	642.0	652.4	653.3	655.4	$5,250	$0	N	N	N	
659	IRWIN CREEK	25345.356	L	07322130	GREENLEAF AV	CHARLOTTE, NC	COOPER BAILEY O JR	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	651.8	1993	N	952	$62,080	blue w/ v	5521	7396	7840	9727	642.0	652.4	653.3	655.3	$5,250	$0	N	N	N	
668	STEWART CREEK TRIB 1	2654.867	R	06707352	1552 BERRYHILL RD	CHARLOTTE, NC	JOHNSON ARTIE	0.75	COMMERCIAL	1.0 STORY	1	652.76	1964	N	3100	$93,280	Yellow b	1883	2749	3133	4025	652.5	654.3	655.0	656.3	$0	$10,000	N	N	N	
673	IRWIN CREEK	25162.243	L	07322210	1121 GREENLEAF AV	CHARLOTTE, NC	RAWLINSON MILLER	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	649.95	1900	N	1020	$44,110	Off-white	5521	7396	7840	9727	641.9	652.3	653.3	655.3	$5,250	$0	N	N	N	
674	STEWART CREEK TRIB 1	2486.912	R	06703112	1501 BERRYHILL RD	CHARLOTTE,NC	WESTWOOD ASSOCIATES	0.25	APARTMENTS	1 Story, w/o Basem	1	654.4	1949	N	2860	$60,591		1883	2749	3133	4025	652.2	654.0	654.7	656.1	$12,000	$0	Y	N	N	
677	IRWIN CREEK	25153.15	L	07322209	1117 GREENLEAF AV	CHARLOTTE, NC	LYONS EVETTA	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	650.9	1906	N	700	$29,020	tan w/ br	5521	7396	7840	9727	641.9	652.3	653.3	655.3	$5,250	$0	N	N	N	
689	IRWIN CREEK	25001.276	L	07322C97	922 W. 1ST STREET	CHARLOTTE, NC	OAK PARK @ 3RD WARD	0.25	CONDOS	2.5 Stories or more	2	650.81	1999	N	5850	$722,460		5521	7396	7840	9727	641.8	652.3	653.3	655.3	$12,000	$0	Y	N	N	Bldg 2; Units 33 - 38
695	IRWIN CREEK	20687.736	R	06703106	1921 FREEDOM DR	CHARLOTTE, NC	F & N FAMILY PARTNERSHIP LP	3	LIGHT MANUFACTURING	2.0 STORIES	2	643.96	1955	N	53095	$584,390	Brick wa	5521	7396	7840	9727	633.3	643.5	644.1	646.1	$0	$18,800	N	N	N	
697	IRWIN CREEK	24917.378	L	07322C97	926 W.1ST STREET	CHARLOTTE, NC	OAK PARK @ 3RD WARD	0.25	CONDOS	2.5 Stories or more	2	652.82	1999	N	5850	$722,460		5521	7396	7840	9727	641.8	652.3	653.3	655.3	$12,000	$0	Y	N	N	Bldg 1; Units 27 - 32
737	IRWIN CREEK	24646.008	L	07324219	520 & 528 ELLIOTT ST	CHARLOTTE, NC	TOWER PROPERTIES/CHARLOT	1	WAREHOUSE & OFFICE	1 or 2 Story, w/ Bas	4	651.15	1987	N	22948	$457,124		5521	7396	7840	9727	641.3	652.3	653.2	655.2	$0	$18,800	Y	N	N	
795	IRWIN CREEK	21273.093	R	06703102	1627 FREEDOM DR	CHARLOTTE, NC	GRIFFITH JAMES R	1	WAREHOUSE	1 Story, w/o Basem	1	638.25	1956	N	1288	$13,035		5521	7396	7840	9727	633.9	643.6	644.2	646.2	$0	$18,800	Y	N	N	
806	IRWIN CREEK	21274.223	R	06703102	1616 MOREHEAD ST	CHARLOTTE, NC	GRIFFITH JAMES R	1	WAREHOUSE	1 Story, w/o Basem	1	637.25	1928	N	9841	$99,591		5521	7396	7840	9727	633.9	643.6	644.2	646.2	$0	$18,800	Y	N	N	
826	IRWIN CREEK	23180.674	R	07325403	1213 W. MOREHEAD STREET	CHARLOTTE, NC	TWELVE THIRTEEN COMPANY L	1	WAREHOUSE & OFFICE	1 Story, w/o Basem	1	642.42	1947	N	17420	$207,780		5521	7396	7840	9727	637.5	646.4	647.3	650.8	$0	$18,800	Y	N	N	
827	IRWIN CREEK	23136.805	R	07325405	1233W MOREHEAD ST	CHARLOTTE, NC	JOHNSON J BERNARD	1	WAREHOUSE	2.0 STORIES	2	644	1928	N	5376	$76,820	brick, co	5521	7396	7840	9727	637.4	646.2	647.1	650.5	$0	$18,800	N	N	N	
829	IRWIN CREEK	23085.733	R	07325407	1307W MOREHEAD ST	CHARLOTTE, NC	NOLAN PROPERTIES LLC	1	WAREHOUSE	2.0 STORIES	2	645.5	1934	N	25600	$207,250	brick wa	5521	7396	7840	9727	637.3	646.0	646.9	650.3	$0	$18,800	N	N	N	
832	IRWIN CREEK	22885.631	R	07325409	WEST MOREHEAD ST	CHARLOTTE, NC	M & J EQUITIES LLC	1	WAREHOUSE	1.0 STORY	1	645.9	1962	N	30880	$49,717		5521	7396	7840	9727	636.7	645.9	646.8	650.1	$0	$18,800	Y	N	N	
833	IRWIN CREEK	21349.235	R	06701302	1601W MOREHEAD ST	CHARLOTTE, NC	FOUR STAR PARTNERS	0.75	OFFICE	2.0 STORIES	4	643.89	1951	N	3290	$144,600		5521	7396	7840	9727	633.9	643.6	644.2	646.2	$0	$37,500	N	N	N	
839	IRWIN CREEK	20908.464	R	06701305	1637W MOREHEAD ST	CHARLOTTE, NC	FOUR WALL ASSOCIATES INC	1	WAREHOUSE	1.0 STORY	1	633.95	1939	N	96020	$973,820	White br	5521	7396	7840	9727	633.5	643.6	644.2	646.2	$0	$18,800	N	N	N	
844	IRWIN CREEK	22732.069	R	07325409	811 WEST MOREHEAD ST	CHARLOTTE, NC	M & J EQUITIES LLC	1	WAREHOUSE	1 Story, w/o Basem	1	644.8	1947	N	4800	$7,728		5521	7396	7840	9727	636.3	645.9	646.8	650.1	$0	$18,800	Y	N	N	
851	IRWIN CREEK	21999.425	R	06701207	S SUMMIT AV	CHARLOTTE, NC	GRINNELL WATER WORKS LLC	1	WAREHOUSE	1.0 STORY	1	634.85	1930	N	45824	$492,210	Brick w/t	5521	7396	7840	9727	635.0	645.8	646.7	650.1	$0	$18,800	N	N	N	
854	IRWIN CREEK	21556.893	R	06701202	1518 BRYANT ST	CHARLOTTE, NC	MAYHEW WILLIAM M JR	1	WAREHOUSE	1.0 STORY	1	637.85	1996	N	6000	$256,090	White br	5521	7396	7840	9727	634.0	643.6	644.2	646.2	$0	$18,800	N	N	N	
862	IRWIN CREEK	22839.279	R	07325410	829 S. SUMMIT AVENUE	CHARLOTTE, NC	LARRY D. & NANCY H. WATTS	1	WAREHOUSE	1 Story, w/o Basem	1	640.59	1938	N	1783	$38,548		5521	7396	7840	9727	636.6	645.9	646.8	650.1	$0	$18,800	Y	N	N	
863	IRWIN CREEK	22562.7	R	07325410	829 SUMMIT AV	CHARLOTTE, NC	WATTS LARRY D	0.75	OFFICE	1 Story, w/o Basem	1	639.5	1948	N	16660	$360,189		5521	7396	7840	9727	636.0	645.9	646.7	650.1	$0	$37,500	Y	N	N	
867	IRWIN CREEK	20950.494	R	06701301	1501 FREEDOM DR	CHARLOTTE, NC	BRADSHAW ELDON ROY	1	PREFAB WAREHOUSE	1.0 STORY	1	638.8	1997	N	11700	$331,790	warehou	5521	7396	7840	9727	633.5	643.6	644.2	646.2	$0	$18,800	N	N	N	
869	IRWIN CREEK	22799.537	R	07325410	829 S. SUMMIT AVENUE	CHARLOTTE, NC	LARRY D. & NANCY H. WATTS	1	WAREHOUSE	1 Story, w/o Basem	1	638.02	1938	N	4736	$102,392		5521	7396	7840	9727	636.5	645.9	646.8	650.1	$0	$18,800	Y	N	N	
872	IRWIN CREEK	21785.846	R	06701102	1429 BRYANT ST	CHARLOTTE, NC	CAROLINA INVESTMENT GROU	1	WAREHOUSE & OFFICE	1 Story, w/o Basem	1	633.85	1940	N	11949	$133,948		5521	7396	7840	9727	635.0	645.7	646.5	649.8	$0	$18,800	Y	N	N	
874	IRWIN CREEK	21633.007	R	06701103	1431 BRYANT ST	CHARLOTTE, NC	CANECLIDES DEAN	1	WAREHOUSE	1.0 STORY	1	633.15	1955	N	10468	$193,370	Grey & t	5521	7396	7840	9727	634.2	644.0	644.7	646.9	$0	$18,800	N	N	N	
875	IRWIN CREEK	21510.496	R	06701104	1451 BRYANT ST	CHARLOTTE, NC	GRAYBAR ELECTRIC CO INC	1	WAREHOUSE	1.0 STORY	1	635.15	1959	N	31344	$584,170	Brick wa	5521	7396	7840	9727	634.0	643.6	644.2	646.2	$0	$18,800	N	N	N	
879	IRWIN CREEK	20935.934	R	06701406	1401 FREEDOM DR	CHARLOTTE, NC	FOURTEEN HUNDRED ONE FRE	1	WAREHOUSE	1.0 STORY	1	633.25	1958	N	35907	$684,730	Brick wa	5521	7396	7840	9727	633.5	643.6	644.2	646.2	$0	$18,800	N	N	N	
881	IRWIN CREEK	22305.926	R	07325301	935 S. SUMMIT AVENUE	CHARLOTTE, NC	M & J EQUITIES LLC	0.75	NIGHTCLUB	1 Story, w/o Basem	1	636.31	1948	N	12600	$189,900		5521	7396	7840	9727	635.7	645.9	646.7	650.1	$0	$10,000	Y	N	Y	Updated tax information from POLARIS 11/2003
895	IRWIN CREEK	20459.908	R	06701403	1900 W. WILKINSON BLVD.	CHARLOTTE, NC	APS WILKINSON PROPERTIES L	1	WAREHOUSE	1 Story, w/o Basem	1	643.17	1975	N	4040	$56,520		5750	10417	11500	14243	633.2	643.4	643.9	645.8	$0	$18,800	Y	N	N	
900	IRWIN CREEK	20302.199	R	06701403	1900 W. WILKINSON BLVD.	CHARLOTTE, NC	APS WILKINSON PROPERTIES L	1	WAREHOUSE	1 Story, w/o Basem	1	642.42	1900	N	7335	$102,627		5750	10417	11500	14243	633.1	643.3	643.9	645.8	$0	$18,800	Y	N	N	
901	IRWIN CREEK	20192.065	R	06701403	1900 W. WILKINSON BLVD.	CHARLOTTE, NC	APS WILKINSON PROPERTIES L	1	WAREHOUSE	2 Story, w/o Basem	2	637.43	1900	N	66307	$927,635		5750	10417	11500	14243	633.0	643.3	643.9	645.8	$0	$18,800	Y	N	N	
1012	IRWIN CREEK	17498.241	L	11904210	1201 SPRUCE ST	CHARLOTTE, NC	BROWN HARRIETT ELIZABETH	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	631.5	1956	N	2058	$41,340		5750	10417	11500	14243	627.5	631.0	632.4	635.4	$5,250	$0	Y	N	N	
1016	IRWIN CREEK	17437.708	L	11904210	1209 & 1211 SPRUCE STREET	CHARLOTTE, NC	HARRIETT ELIZABETH BROWN	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	630.78	1956	N	2058	$41,340		5750	10417	11500	14243	627.4	630.9	632.3	635.4	$5,250	$0	Y	N	N	
1018	IRWIN CREEK	17382.546	L	11904211	1215 SPRUCE ST	CHARLOTTE, NC	MCCLAIN GLENNAL	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	631.3	1948	N	1116	$39,960	green sid	5750	10417	11500	14243	627.4	630.9	632.3	635.3	$5,250	$0	N	N	N	
1024	IRWIN CREEK	17317.631	L	11904212	1217 SPRUCE ST	CHARLOTTE, NC	YOUNG MARION	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	631.3	1948	N	846	$19,110	white w/	5750	10417	11500	14243	627.4	630.8	632.2	635.3	$5,250	$0	N	N	N	
1028	IRWIN CREEK	17260.571	L	11904213	1221 SPRUCE ST	CHARLOTTE, NC	PEARSON TED CHARLES &WF	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	631.6	1948	N	772	$28,350	white sid	5750	10417	11500	14243	627.4	630.8	632.2	635.2	$5,250	$0	N	N	N	
1035	IRWIN CREEK	17219.538	L	11904214	1225 SPRUCE ST	CHARLOTTE, NC	WIGGINS HERMAN	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	629.8	1952	N	828	$28,340	ivory w/	5750	10417	11500	14243	627.4	630.8	632.2	635.2	$5,250	$0	N	N	N	
1043	IRWIN CREEK	17176.765	L	11904215	1229 SPRUCE ST	CHARLOTTE, NC	BARNETTE JOHNNY ELMORE &	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	628.9	1952	N	1108	$32,620	ivory w/	5750	10417	11500	14243	627.3	630.7	632.1	635.2	$5,250	$0	N	N	N	
1054	IRWIN CREEK	17124.142	L	11904216	1233 SPRUCE ST	CHARLOTTE, NC	DOUGLAS REGINALD EUGENE	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	628	1952	N	805	$27,490	white sid	5750	10417	11500	14243	627.3	630.7	632.1	635.1	$5,250	$0	N	N	N	
1058	IRWIN CREEK	17081.132	L	11904217	1237 SPRUCE ST	CHARLOTTE, NC	ALDRIDGE JAMES W	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	627.3	1952	N	792	$27,380	yellow w	5750	10417	11500	14243	627.3	630.7	632.1	635.1	$5,250	$0	N	N	N	
1063	IRWIN CREEK	17044.753	L	11904201	1243 SPRUCE ST	CHARLOTTE, NC	HOUSE MARION	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	627.7	1952	N	1006	$30,870	brick w/	5750	10417	11500	14243	627.3	630.7	632.1	635.1	$5,250	$0	N	N	N	
1064	IRWIN CREEK	17037.959	L	11904202	1932 MERRIMAN AV	CHARLOTTE, NC	MACK SHARON PATRICIA BROW	0.25	DUPLEX/TRIPLEX	1.0 STORY	1	631.9	1955	N	2100	$44,810	red brick	5750	10417	11500	14243	627.3	630.7	632.1	635.1	$5,250	$0	N	N	N	
1074	IRWIN CREEK	16943.658	L	11904121	1935 MERRIMAN AV	CHARLOTTE, NC	CAPTAIN BROWN PROPERTIES	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	629.2	1955	N	1918	$46,857		5750	10417	11500	14243	627.3	630.6	632.0	635.0	$5,250	$0	Y	N	N	
1076	IRWIN CREEK	16898.396	L	11904121	1935 MERRIMAN AV	CHARLOTTE, NC	CAPTAIN BROWN PROPERTIES	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	628.6	1955	N	1918	$46,857		5750	10417	11500	14243	627.2	630.6	632.0	635.0	$5,250	$0	Y	N	N	
1079	IRWIN CREEK	16871.235	L	11904121	1943 MERRIMAN AV	CHARLOTTE, NC	CAPTAIN BROWN PROPERTIES	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	627.8	1955	N	1918	$46,857		5750	10417	11500	14243	627.2	630.6	632.0	635.0	$5,250	$0	Y	N	N	
1081	IRWIN CREEK	16845.959	L	11904121	1309 SPRUCE ST	CHARLOTTE, NC	CAPTAIN BROWN PROPERTIES	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	627.7	1955	N	1918	$46,857		5750	10417	11500	14243	627.2	630.6	631.9	635.0	$5,250	$0	Y	N	N	
1084	IRWIN CREEK	16813.121	L	11904122	1315 SPRUCE ST	CHARLOTTE, NC	BLACKMAN GEORGE E	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	4	626	1948	N	1164	$46,150		5750	10417	11500	14243	627.2	630.5	632.0	635.0	$5,250	$0	N	N	N	
1089	IRWIN CREEK	15714.238	R	11904312	2425 BARRINGER DRIVE	CHARLOTTE, NC	MECKLENBURG COUNTY	0.25	CLUB-LODGE	1 Story, w/o Basem	1	626.01	9999	N	1462	$131,653		5750	10417	11500	14243	627.0	630.3	631.7	634.8	$5,250	$0	Y	N	Y	
1341	IRWIN CREEK	12361.45	L	14508120	3000 BARRINGER DR	CHARLOTTE, NC	PATON KENYON	1	WAREHOUSE	1 Story, w/o Basem	1	620.25	1963	N	1202	$21,299		8635	11750	13100	16224	619.9	622.3	623.3	625.4	$0	$18,800	Y	N	Y	
1358	IRWIN CREEK	12304.853	L	14508120	3018 BARRINGER DR	CHARLOTTE, NC	PATON KENYON	0.75	COMMERCIAL	1 Story, w/o Basem	1	619.85	1960	N	5437	$96,344		8635	11750	13100	16224	619.9	622.3	623.3	625.3	$0	$10,000	Y	N	Y	
1534	IRWIN CREEK	6220.46	R	14517919	3501 REID AV	CHARLOTTE, NC	CUNNINGHAM LARRY	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	612.84	1957	N	1260	$38,500	Stone sid	8635	11750	13100	16224	612.3	614.5	615.8	617.6	$5,250	$0	N	N	N	
1620	IRWIN CREEK	5836.606	L	14516102	1212 ABELINE RD	CHARLOTTE, NC	THOMPSON BENNIE JAMES	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	614.3	1958	N	1118	$45,020	brick w/	8635	11750	13100	16224	612.0	614.2	615.6	617.4	$5,250	$0	N	N	N	
1632	IRWIN CREEK	5711.497	L	14521201	4001 WHITEHURST RD	CHARLOTTE, NC	MCKOY ALVIN LEON &WF	0.25	SINGLE FAMILY RESIDENTIAL	1.0 STORY	1	613.94	1960	N	1092	$53,110	Blue bric	8635	11750	13100	16224	611.8	614.1	615.5	617.4	$5,250	$0	N	N	N	
2778	IRWIN CREEK	5632.544	L	14521202	4011 WHITEHURST RD	CHARLOTTE, NC	RUDSILL WILLIE RALPH	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	613.84	1960	N	1680	$56,810		8635	11750	13100	16224	611.6	613.9	615.4	617.3	$5,250	$0	Y	N	Y	
2781	IRWIN CREEK	5579.524	L	14521203	4017 WHITEHURST RD	CHARLOTTE, NC	BARBER NEVONIA THOMPSON	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	613.64	1960	N	1112	$44,540		8635	11750	13100	16224	611.6	613.9	615.4	617.3	$5,250	$0	Y	N	Y	
2785	IRWIN CREEK	5502.542	L	14521204	4023 WHITEHURST RD	CHARLOTTE, NC	HART LOUISE J	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	613.44	1960	N	1105	$45,580		8635	11750	13100	16224	611.4	613.8	615.3	617.2	$5,250	$0	Y	N	Y	
2788	IRWIN CREEK	5451.584	L	14521205	4029 WHITEHURST RD	CHARLOTTE, NC	REED DOYLE	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	612.84	1960	N	1312	$53,120		8635	11750	13100	16224	611.4	613.7	615.2	617.2	$5,250	$0	Y	N	Y	
2792	IRWIN CREEK	5378.557	L	14521206	4035 WHITEHURST RD	CHARLOTTE, NC	GEER BOBBY	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	612.24	1960	N	1050	$43,870		8635	11750	13100	16224	611.3	613.7	615.2	617.1	$5,250	$0	Y	N	Y	
2794	IRWIN CREEK	5308.9	L	14521207	4041 WHITEHURST RD	CHARLOTTE, NC	WILLIAMS MARY FRANCES	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	612.14	1960	N	1112	$44,780		8635	11750	13100	16224	611.3	613.6	615.2	617.1	$5,250	$0	Y	N	Y	
2797	IRWIN CREEK	5236.962	L	14521208	4101 WHITEHURST RD	CHARLOTTE, NC	WITHERS CHARLES A	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	611.94	1960	N	1305	$53,500		8635	11750	13100	16224	611.2	613.6	615.1	617.1	$5,250	$0	Y	N	Y	
2798	IRWIN CREEK	5181.885	L	14521209	4109 WHITEHURST RD	CHARLOTTE, NC	SHIPP MAE RUTH	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	611.44	1960	N	1112	$48,480		8635	11750	13100	16224	611.2	613.6	615.1	617.1	$5,250	$0	Y	N	Y	
2799	IRWIN CREEK	5463.28	L	14521214	4028 WHITEHURST RD	CHARLOTTE, NC	LUCKEY MARY ELIZABETH	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	614.94	1960	N	1078	$44,980		8635	11750	13100	16224	611.4	613.7	615.3	617.2	$5,250	$0	Y	N	N	
2800	IRWIN CREEK	5092.268	L	14521210	4115 WHITEHURST RD	CHARLOTTE, NC	MORROW ROBIN L	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	610.44	1960	N	1105	$44,370		8635	11750	13100	16224	611.1	613.5	615.1	617.0	$5,250	$0	Y	N	Y	
2803	IRWIN CREEK	5382.374	L	14521213	4034 CRESTRIDGE DR	CHARLOTTE, NC	GARDNER FELECIA R	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	613.84	1960	N	1112	$45,610		8635	11750	13100	16224	611.3	613.7	615.2	617.1	$5,250	$0	Y	N	N	
2805	IRWIN CREEK	4007.057	R	14531101	4000 WESTMONT DRIVE	CHARLOTTE, NC	CITY OF CHARLOTTE	1	WAREHOUSE	1 Story, w/o Basem	1	609.97	1985	N	5653	$2,736,110	IRW_W	8635	11750	13100	16224	609.3	611.5	612.5	614.4	$0	$18,800	Y	N	Y	WWTP bldg; protected by floodproofing
2806	IRWIN CREEK	5326.755	L	14521212	4100 CRESTRIDGE DR	CHARLOTTE, NC	JONES DAVID	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	613.24	1960	N	1202	$49,950		8635	11750	13100	16224	611.3	613.6	615.2	617.1	$5,250	$0	Y	N	N	
2808	IRWIN CREEK	5244.644	L	14521211	4108 CRESTRIDGE DR	CHARLOTTE, NC	WELCH JOESPH SR	0.25	SINGLE FAMILY RESIDENTIAL	1 Story, w/o Basem	1	612.04	1960	N	1075	$43,620		8635	11750	13100	16224	611.2	613.6	615.1	617.1	$5,250	$0	Y	N	N	
2813	IRWIN CREEK	3580.678	L	14531101	4000 WESTMONT DRIVE	CHARLOTTE, NC	CITY OF CHARLOTTE	0.75	OFFICE	1 Story, w/o Basem	1	609.49	1994	N	2160	$1,045,462	IRW_W	8635	11750	13100	16224	608.3	610.7	611.7	613.9	$0	$37,500	Y	N	N	WWTP bldg; protected by existing floodwall (TOW=614.3)
2814	IRWIN CREEK	3431.182	L	14531101	4000 WESTMONT DRIVE	CHARLOTTE, NC	CITY OF CHARLOTTE	0.75	OFFICE	1 Story, w/o Basem	1	608.59	1955	N	1134	$548,868	IRW_W	8635	11750	13100	16224	608.2	610.7	611.8	613.9	$0	$37,500	Y	N	Y	WWTP bldg; protected by existing floodwall (TOW=614.3)
2819	IRWIN CREEK	3356.581	L	14531101	4000 WESTMONT DRIVE	CHARLOTTE, NC	CITY OF CHARLOTTE	0.75	OFFICE	1 Story, w/o Basem	1	609	1994	N	3340	$1,616,594	IRW_W	8635	11750	13100	16224	608.2	610.7	611.8	613.9	$0	$37,500	Y	N	N	WWTP bldg; protected by existing floodwall (TOW=614.3)
2821	IRWIN CREEK	3095.366	L	14531101	4000 WESTMONT DRIVE	CHARLOTTE, NC	CITY OF CHARLOTTE	0.75	OFFICE	1 Story, w/o Basem	1	601.81	1990	N	5235	$2,533,794	IRW_W	8635	11750	13100	16224	608.2	610.7	611.8	614.0	$0	$37,500	Y	N	Y	WWTP bldg; protected by existing floodwall (TOW=614.3)
2822	IRWIN CREEK	3224.648	L	14531101	4000 WESTMONT DRIVE	CHARLOTTE, NC	CITY OF CHARLOTTE	0.75	OFFICE	1 Story, w/o Basem	1	605.78	1927	N	437	$211,513	IRW_W	8635	11750	13100	16224	608.2	610.7	611.8	614.0	$0	$37,500	Y	N	Y	WWTP bldg; protected by existing floodwall (TOW=614.3)
2827	IRWIN CREEK	2835.948	L	14531101	4000 WESTMONT DRIVE	CHARLOTTE, NC	CITY OF CHARLOTTE	0.75	OFFICE	1 Story, w/o Basem	1	610.5	1927	N	5098	$2,467,484	IRW_W	8635	11750	13100	16224	607.8	610.4	611.5	613.7	$0	$37,500	Y	N	N	WWTP bldg; protected by existing floodwall (TOW=614.3)

APPENDIX B

Interest Rate 7.0%
Project Life 50

IRWIN CREEK WATERSHED INDIVIDUAL BENEFIT:COST ANALYSIS SPREADSHEET
Mecklenburg County Flood Hazard Mitigation Project
Lower Little Sugar, Briar, Irwin, and McMullen Creek Watersheds

BUILDING INFORMATION				BENEFIT	COSTS					B/C RATIOS							
UNQBLD_ID	PID	SITE ADDRESS	FLD_GRP	FLOOD DAMAGE	ACQUISITION	ELEVATION	FLOOD PROOFING	LEVEE/FLOOD WALL	DRAINAGE IMPRVMNTS	ACQUISITION	ELEVATION	FLOOD PROOFING	LEVEE/FLOOD WALL	DRAINAGE IMPRVMNTS	IN 0.1' FLOODWAY?	NOTES	RECOMMENDED ALTERNATIVE
5	04112513	2115 SLATER RD	IKB1	$9,730	$51,938	$18,245	na	na	na	0.2	0.5	na	na	na	Y	not cost-effective, but in floodway	Acquisition
2805	14531101	4000 WESTMONT DRIVE	IRW01	$0	$3,236,325	$270,530	$60,000	na	na	0.0	0.0	0.0	na	na	Y	WWTP bldg; protected by floodproofing	No Action
2813	14531101	4000 WESTMONT DRIVE	IRW01	$0	$1,236,593	$103,369	$60,000	na	na	0.0	0.0	0.0	na	na	N	WWTP bldg; protected by ex	No Action
2814	14531101	4000 WESTMONT DRIVE	IRW01	$0	$649,212	$55,112	na	na	na	0.0	0.0	na	na	na	Y	WWTP bldg; protected by existing floodwall (TOW=614.3)	No Action
2819	14531101	4000 WESTMONT DRIVE	IRW01	$0	$1,912,139	$162,324	$60,000	na	na	0.0	0.0	0.0	na	na	N	WWTP bldg; protected by ex	No Action
2821	14531101	4000 WESTMONT DRIVE	IRW01	$0	$2,997,022	$292,992	na	na	na	0.0	0.0	na	na	na	Y	WWTP bldg; protected by existing floodwall (TOW=614.3)	No Action
2822	14531101	4000 WESTMONT DRIVE	IRW01	$0	$250,182	$22,214	na	na	na	0.0	0.0	na	na	na	Y	WWTP bldg; protected by existing floodwall (TOW=614.3)	No Action
2827	14531101	4000 WESTMONT DRIVE	IRW01	$0	$2,918,589	$240,177	$60,000	na	na	0.0	0.0	0.0	na	na	N	WWTP bldg; protected by ex	No Action
640	07321302	1024 WESTBROOK DR	IRW10	$53,754	$71,818	$28,756	na	na	na	0.7	1.9	na	na	na	N	high flood depth (>8' above FFE); house has basement so elev not practical	Acquisition
642	07321303	1020 WESTBROOK DR	IRW10	$5,934	$70,489	$34,616	na	na	na	0.1	0.2	na	na	na	N		No Action
650	07322125	1025 WESTBROOK DR	IRW10	$25,531	$78,235	$35,439	na	na	na	0.3	0.7	na	na	na	N		No Action
659	07322130	GREENLEAF AV	IRW10	$18,631	$91,936	$16,850	na	na	na	0.2	1.1	na	na	na	N		Elevation
673	07322210	1121 GREENLEAF AV	IRW10	$28,761	$67,170	$18,813	na	na	na	0.4	1.5	na	na	na	N		Elevation
677	07322209	1117 GREENLEAF AV	IRW10	$19,224	$51,120	$12,390	na	na	na	0.4	1.6	na	na	na	N		Elevation
689	07322C97	922 W. 1ST STREET	IRW10	$159,495	$740,010	$279,958	na	na	na	0.2	0.6	na	na	na	N		No Action
697	07322C97	926 W.1ST STREET	IRW10	$62,310	$740,010	$275,605	na	na	na	0.1	0.2	na	na	na	N		No Action
737	07324219	520 & 528 ELLIOTT ST	IRW10	$110,889	$735,974	$1,098,199	$60,000	na	na	0.2	0.1	1.8	na	na	N		Flood Proofing
615	07321102	236S SYCAMORE ST	IRW11	$38,835	$54,806	$42,068	na	na	na	0.7	0.9	na	na	na	Y	not cost-effective, but in flood	Acquisition
252	07509312	1058 ANDRILL TR	IRW12	$91,540	$32,230	$25,077	na	na	na	2.8	3.7	na	na	na	Y	further investigate water qual	Acquisition
255	07509313	1052 ANDRILL TR	IRW12	$111,110	$32,230	$26,497	na	na	na	3.4	4.2	na	na	na	Y	further investigate water qual	Acquisition
259	07509311	1043 ANDRILL TR	IRW12	$126,153	$33,830	$52,993	na	na	na	3.7	2.4	na	na	na	Y	further investigate water qual	Acquisition
261	07509314	1048 ANDRILL TR	IRW12	$146,730	$32,230	$27,136	na	na	na	4.6	5.4	na	na	na	Y	further investigate water qual	Acquisition
271	07509310	1039 ANDRILL TR	IRW12	$109,426	$32,230	$26,497	na	na	na	3.4	4.1	na	na	na	Y	further investigate water qual	Acquisition
278	07509309	1035 ANDRILL TR	IRW12	$114,436	$34,550	$26,497	na	na	na	3.3	4.3	na	na	na	Y	further investigate water qual	Acquisition
286	07509308	1033 ANDRILL TR	IRW12	$100,497	$34,550	$26,497	na	na	na	2.9	3.8	na	na	na	Y	further investigate water qual	Acquisition
292	07509307	1027 ANDRILL TR	IRW12	$98,620	$37,380	$26,497	na	na	na	2.6	3.7	na	na	na	Y	further investigate water qual	Acquisition
299	07509306	1023 ANDRILL TR	IRW12	$101,035	$31,720	$26,497	na	na	na	3.2	3.8	na	na	na	Y	further investigate water qual	Acquisition
305	07509305	1017 ANDRILL TR	IRW12	$92,603	$48,710	$54,012	na	na	na	1.9	1.7	na	na	na	Y	further investigate water qual	Acquisition
314	07509304	1011 ANDRILL TR	IRW12	$69,859	$48,302	$51,608	na	na	na	1.4	1.4	na	na	na	Y	further investigate water qual	Acquisition
70	07719404	1206 MCARTHUR AV	IRW13	$196,868	$84,940	$52,338	na	na	na	2.3	3.8	na	na	na	N		Acquisition
77	07719405	1200 MCARTHUR AV	IRW13	$428,996	$24,574	$14,165	na	na	na	17.5	30.3	na	na	na	N		Acquisition
1620	14516102	1212 ABELINE RD	IRW02	$12,738	$60,374	$38,973	na	na	na	0.2	0.3	na	na	na	N		No Action
1632	14521201	4001 WHITEHURST RD	IRW02	$16,174	$68,386	$38,880	na	na	na	0.2	0.4	na	na	na	N		No Action
2778	14521202	4011 WHITEHURST RD	IRW02	$16,796	$73,850	$59,815	na	na	na	0.2	0.3	na	na	na	Y	not cost-effective, but in flood	Acquisition
2781	14521203	4017 WHITEHURST RD	IRW02	$16,147	$59,876	$39,592	na	na	na	0.3	0.4	na	na	na	Y	not cost-effective, but in flood	Acquisition
2785	14521204	4023 WHITEHURST RD	IRW02	$17,237	$60,895	$39,342	na	na	na	0.3	0.4	na	na	na	Y	not cost-effective, but in flood	Acquisition
2788	14521205	4029 WHITEHURST RD	IRW02	$25,876	$69,056	$46,712	na	na	na	0.4	0.6	na	na	na	Y	not cost-effective, but in flood	Acquisition
2792	14521206	4035 WHITEHURST RD	IRW02	$33,508	$59,020	$38,165	na	na	na	0.6	0.9	na	na	na	Y	not cost-effective, but in flood	Acquisition
2794	14521207	4041 WHITEHURST RD	IRW02	$34,999	$60,116	$40,419	na	na	na	0.6	0.9	na	na	na	Y	not cost-effective, but in flood	Acquisition
2797	14521208	4101 WHITEHURST RD	IRW02	$42,423	$69,415	$47,434	na	na	na	0.6	0.9	na	na	na	Y	not cost-effective, but in flood	Acquisition
2798	14521209	4109 WHITEHURST RD	IRW02	$55,934	$63,816	$41,246	na	na	na	0.9	1.4	na	na	na	Y	not cost-effective, but in flood	Acquisition
2799	14521214	4028 WHITEHURST RD	IRW02	$6,859	$60,214	$37,579	na	na	na	0.1	0.2	na	na	na	N		No Action
2800	14521210	4115 WHITEHURST RD	IRW02	$108,170	$59,685	$41,809	na	na	na	1.8	2.6	na	na	na	Y		Acquisition
2803	14521213	4034 CRESTRIDGE DR	IRW02	$13,235	$60,946	$38,764	na	na	na	0.2	0.3	na	na	na	N		No Action
2806	14521212	4100 CRESTRIDGE DR	IRW02	$18,935	$65,556	$42,796	na	na	na	0.3	0.4	na	na	na	N		No Action
2808	14521211	4108 CRESTRIDGE DR	IRW02	$36,006	$58,845	$39,074	na	na	na	0.6	0.9	na	na	na	N		No Action
1534	14517919	3501 REID AV	IRW03	$36,586	$44,280	$23,239	na	na	na	0.8	1.6	na	na	na	N		Elevation
1341	14508120	3000 BARRINGER DR	IRW04	$34,888	$38,153	$58,417	na	na	na	0.9	0.6	na	na	na	Y	not cost-effective, but in flood	Acquisition
1358	14508120	3018 BARRINGER DR	IRW04	$104,968	$172,582	$264,238	na	na	na	0.6	0.4	na	na	na	Y	not cost-effective, but in flood	Acquisition

Prepared By:
Neal Banerjee, PE
Dewberry
November 2003

UNQBLD_ID	PID	SITE ADDRESS	FLD_GRP	FLOOD DAMAGE	ACQUISITION	ELEVATION	FLOOD PROOFING	LEVEE/FLOOD WALL	DRAINAGE IMPRVMNTS	ACQUISITION	ELEVATION	FLOOD PROOFING	LEVEE/FLOOD WALL	DRAINAGE IMPRVMNTS	IN 0.1' FLOODWAY?	NOTES	RECOMMENDED ALTERNATIVE
1089	11904312	2425 BARRINGER DRIVE	IRW05	$221,585	$4,386	$74,316	na	na	na	50.5	3.0	na	na	na	Y	Park consession/restrooms	No Action
1012	11904210	1201 SPRUCE ST	IRW06	$11,744	$51,989	$71,742	na	na	na	0.2	0.2	na	na	na	N		No Action
1016	11904210	1209 & 1211 SPRUCE STREET	IRW06	$16,354	$51,989	$73,273	na	na	na	0.3	0.2	na	na	na	N		No Action
1018	11904211	1215 SPRUCE ST	IRW06	$11,358	$51,308	$18,923	na	na	na	0.2	0.6	na	na	na	N		No Action
1024	11904212	1217 SPRUCE ST	IRW06	$8,639	$29,648	$14,345	na	na	na	0.3	0.6	na	na	na	N		No Action
1028	11904213	1221 SPRUCE ST	IRW06	$8,225	$38,666	$13,090	na	na	na	0.2	0.6	na	na	na	N		No Action
1035	11904214	1225 SPRUCE ST	IRW06	$19,431	$38,824	$14,656	na	na	na	0.5	1.3	na	na	na	N		Elevation
1043	11904215	1229 SPRUCE ST	IRW06	$30,348	$43,944	$20,436	na	na	na	0.7	1.5	na	na	na	N		Elevation
1054	11904216	1233 SPRUCE ST	IRW06	$43,390	$37,905	$15,446	na	na	na	1.1	2.8	na	na	na	N		Acquisition
1058	11904217	1237 SPRUCE ST	IRW06	$61,317	$37,756	$15,786	na	na	na	1.6	3.9	na	na	na	N		Acquisition
1063	11904201	1243 SPRUCE ST	IRW06	$51,656	$41,888	$37,315	na	na	na	1.2	1.4	na	na	na	N		Acquisition
1064	11904202	1932 MERRIMAN AV	IRW06	$7,797	$59,110	$73,206	na	na	na	0.1	0.1	na	na	na	N		No Action
1074	11904121	1935 MERRIMAN AV	IRW06	$28,982	$56,530	$69,715	na	na	na	0.5	0.4	na	na	na	N		No Action
1076	11904121	1935 MERRIMAN AV	IRW06	$37,869	$56,530	$69,715	na	na	na	0.7	0.5	na	na	na	N		No Action
1079	11904121	1943 MERRIMAN AV	IRW06	$56,169	$56,530	$71,142	na	na	na	1.0	0.8	na	na	na	N		Acquisition
1081	11904121	1309 SPRUCE ST	IRW06	$59,040	$56,530	$71,142	na	na	na	1.0	0.8	na	na	na	N		Acquisition
1084	11904122	1315 SPRUCE ST	IRW06	$124,317	$58,142	$24,067	na	na	na	2.1	5.2	na	na	na	N		Acquisition
895	06701403	1900 W. WILKINSON BLVD.	IRW07	$12,490	$94,092	$190,332	$60,000	na	na	0.1	0.1	0.2	na	na	N		No Action
900	06701403	1900 W. WILKINSON BLVD.	IRW07	$28,278	$170,844	$255,698	$60,000	na	na	0.2	0.1	0.5	na	na	N		No Action
901	06701403	1900 W. WILKINSON BLVD.	IRW07	$872,676	$1,544,290	$2,558,124	na	na	na	0.6	0.3	na	na	na	N		No Action
795	06703102	1627 FREEDOM DR	IRW08	$23,406	$27,066	$65,472	na	$759,200	na	0.9	0.4	na	0.0	na	N	levee cost distributed among 20 bldgs	No Action
806	06703102	1616 MOREHEAD ST	IRW08	$122,965	$206,795	$521,730	na	$759,200	na	0.6	0.2	na	0.2	na	N	levee cost distributed among 20 bldgs	No Action
826	07325403	1213 W. MOREHEAD STREET	IRW08	$154,348	$352,200	$872,533	na	$759,200	na	0.4	0.2	na	0.2	na	N	levee cost distributed among 20 bldgs	No Action
827	07325405	1233W MOREHEAD ST	IRW08	$40,781	$104,468	$261,274	na	$759,200	na	0.4	0.2	na	0.1	na	N	levee cost distributed among 20 bldgs	No Action
829	07325407	1307W MOREHEAD ST	IRW08	$56,569	$351,650	$1,206,067	$60,000	$759,200	na	0.2	0.0	0.9	0.1	na	N	levee cost distributed among 20 bldgs	No Action
832	07325409	WEST MOREHEAD ST	IRW08	$13,221	$321,359	$1,454,819	$60,000	$759,200	na	0.0	0.0	0.2	0.0	na	N	levee cost distributed among 20 bldgs	No Action
833	06701302	1601W MOREHEAD ST	IRW08	$24,069	$216,670	$154,998	$60,000	$759,200	na	0.1	0.2	0.4	0.0	na	N	levee cost distributed among 20 bldgs	No Action
839	06701305	1637W MOREHEAD ST	IRW08	$1,672,126	$1,769,820	$5,374,047	na	$759,200	na	0.9	0.3	na	2.2	na	N	acquired by Meck Co 12/2002; levee cost distributed among 20 bldgs	No Action
844	07325409	811 WEST MOREHEAD ST	IRW08	$7,770	$49,952	$229,709	$60,000	$759,200	na	0.2	0.0	0.1	0.0	na	N	levee cost distributed among 20 bldgs	No Action
851	06701207	S SUMMIT AV	IRW08	$1,080,585	$766,902	$2,654,859	na	$759,200	na	1.4	0.4	na	1.4	na	N	levee cost distributed among 20 bldgs	Acquisition
854	06701202	1518 BRYANT ST	IRW08	$265,223	$356,180	$304,992	na	$759,200	na	0.7	0.9	na	0.3	na	N	levee cost distributed among 20 bldgs	No Action
862	07325410	829 S. SUMMIT AVENUE	IRW08	$47,833	$54,880	$90,633	na	$759,200	na	0.9	0.5	na	0.1	na	N	levee cost distributed among 20 bldgs	No Action
863	07325410	829 SUMMIT AV	IRW08	$374,097	$512,789	$883,247	na	$759,200	na	0.7	0.4	na	0.5	na	N	levee cost distributed among 20 bldgs	No Action
867	06701301	1501 FREEDOM DR	IRW08	$282,805	$458,790	$586,030	na	$759,200	na	0.6	0.5	na	0.4	na	N	levee cost distributed among 20 bldgs	No Action
869	07325410	829 S. SUMMIT AVENUE	IRW08	$170,398	$145,772	$260,404	na	$759,200	na	1.2	0.7	na	0.2	na	N	levee cost distributed among 20 bldgs	Acquisition
872	06701102	1429 BRYANT ST	IRW08	$371,212	$224,776	$704,035	na	$759,200	na	1.7	0.5	na	0.5	na	N	levee cost distributed among 20 bldgs	Acquisition
874	06701103	1431 BRYANT ST	IRW08	$507,481	$275,354	$606,474	na	$759,200	na	1.8	0.8	na	0.7	na	N	levee cost distributed among 20 bldgs	Acquisition
875	06701104	1451 BRYANT ST	IRW08	$952,472	$827,712	$1,723,418	na	$759,200	na	1.2	0.6	na	1.3	na	N	levee cost distributed among 20 bldgs	Acquisition
879	06701406	1401 FREEDOM DR	IRW08	$1,485,250	$965,471	$2,044,975	na	$759,200	na	1.5	0.7	na	2.0	na	N	levee cost distributed among 20 bldgs	Acquisition
881	07325301	935 S. SUMMIT AVENUE	IRW08	$317,528	$576,600	$705,197	na	$759,200	na	0.6	0.5	na	0.4	na	Y	levee cost distributed among 20 bldgs	Acquisition
641	07104111	2000 THRIFT ROAD	IRW09	$88,739	$640,758	$2,204,724	$60,000	na	na	0.1	0.0	1.5	na	na	N		Flood Proofing
695	06703106	1921 FREEDOM DR	IRW09	$131,825	$1,019,075	$2,501,412	$60,000	na	na	0.1	0.1	2.2	na	na	N		Flood Proofing
424	07111412	GARDENER AVE	SCK1	$96,191	$961,376	$1,854,423	$60,000	$51,542	$86,400	0.1	0.1	1.6	1.9	1.1	N	430' long, 3' high earthen lev	Flood Barrier
198	06905113	800 SELDON DR	SCK2	$12,697	$39,088	$13,836	na	na	na	0.3	0.9	na	na	na	N		No Action
207	06905112	808 SELDON DR	SCK2	$25,490	$40,466	$15,434	na	na	na	0.6	1.7	na	na	na	N		Elevation
213	06905111	814 SELDON DR	SCK2	$72,054	$39,688	$15,050	na	na	na	1.8	4.8	na	na	na	N	further investigate water qual	Acquisition
218	06905110	820 SELDON DR	SCK2	$42,437	$41,084	$13,594	na	na	na	1.0	3.1	na	na	na	N	further investigate water qual	Acquisition
220	06905109	826 SELDON DR	SCK2	$54,913	$42,896	$14,018	na	na	na	1.3	3.9	na	na	na	N	further investigate water qual	Acquisition
228	06905108	832 SELDON DR	SCK2	$13,608	$38,508	$13,327	na	na	na	0.4	1.0	na	na	na	N		Elevation
159	06906201	2730 PITTS DR	SCK3	$16,230	$29,897	$119,853	na	na	na	0.5	0.1	na	na	na	N		No Action

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November 2003

UNQBLD_ID	PID	SITE ADDRESS	FLD_GRP	FLOOD DAMAGE	ACQUISITION	ELEVATION	FLOOD PROOFING	LEVEE/FLOOD WALL	DRAINAGE IMPRVMNTS	ACQUISITION	ELEVATION	FLOOD PROOFING	LEVEE/FLOOD WALL	DRAINAGE IMPRVMNTS	IN 0.1' FLOODWAY?	NOTES	RECOMMENDED ALTERNATIVE
161	06906201	2740 PITTS DR	SCK3	$22,909	$41,179	$165,080	na	na	na	0.6	0.1	na	na	na	N		No Action
48	06907102	816 PRINCE ST	SCK4	$77,464	$77,100	$24,110	na	na	na	1.0	3.2	na	na	na	N	Acquisition price account for all units on parcel	Acquisition
50	06907102	800 PRINCE ST	SCK4	$94,935	$77,100	$24,110	na	na	na	1.2	3.9	na	na	na	N	Acquisition price account for all units on parcel	Acquisition
51	06907102	800 PRINCE ST	SCK4	$95,819	$82,950	$94,505	na	na	na	1.2	1.0	na	na	na	N	Acquisition price account for all units on parcel	Acquisition
668	06707352	1552 BERRYHILL RD	ST1-1	$70,425	$144,880	$148,354	na	na	na	0.5	0.5	na	na	na	N		No Action
674	06703112	1501 BERRYHILL RD	ST1-1	$11,924	$81,716	$48,494	na	na	na	0.1	0.2	na	na	na	N		No Action
603	06707359	2301 FREEDOM DR	ST1-2	$1,346,042	$695,660	$455,838	na	na	na	1.9	3.0	na	na	na	N		Acquisition
281	06511111	835 NORWOOD DR	ST2-1	$356,763	$44,465	$35,439	na	na	na	8.0	10.1	na	na	na	N		Acquisition
284	06511110	831 NORWOOD DR	ST2-1	$9,895	$46,132	$35,348	na	na	na	0.2	0.3	na	na	na	N		No Action
339	07113127	2922 OCTOBER CT	ST2-1	$18,162	$61,020	$16,108	na	na	na	0.3	1.1	na	na	na	N		Elevation
160	06513105	530 GALLAGHER ST	ST2-2	$66,547	$57,040	$21,240	na	na	na	1.2	3.1	na	na	na	Y		Acquisition
141	06514304	4016 BARLOWE RD	ST2-3	$11,358	$43,444	$30,956	na	na	na	0.3	0.4	na	na	na	N		No Action
143	06514109	4017 BARLOWE RD	ST2-3	$110,737	$53,052	$38,724	na	na	na	2.1	2.9	na	na	na	N		Acquisition
144	06514305	4012 BARLOWE RD	ST2-3	$17,085	$42,850	$33,824	na	na	na	0.4	0.5	na	na	na	N		No Action
145	06514108	4015 BARLOWE RD	ST2-3	$115,071	$48,660	$38,576	na	na	na	2.4	3.0	na	na	na	Y		Acquisition
149	06514307	3946 BARLOWE RD	ST2-3	$13,994	$45,174	$30,956	na	na	na	0.3	0.5	na	na	na	N		No Action
150	06514107	606 DEWOLFE ST	ST2-3	$30,210	$52,230	$37,028	na	na	na	0.6	0.8	na	na	na	Y	ɒt cost-effective, but in floodw	Acquisition
152	06514106	612 DEWOLFE ST	ST2-3	$11,579	$40,824	$30,956	na	na	na	0.3	0.4	na	na	na	Y	ɒt cost-effective, but in floodw	Acquisition
114	06302210	4139 BLENHEIN RD	ST2-4	$12,517	$58,636	$36,324	na	na	na	0.2	0.3	na	na	na	N		No Action
116	06302209	4133 BLENHEIN RD	ST2-4	$20,135	$59,438	$35,462	na	na	na	0.3	0.6	na	na	na	N		No Action
119	06302208	4129 BLENHEIN RD	ST2-4	$22,040	$57,332	$37,171	na	na	na	0.4	0.6	na	na	na	N		No Action
121	06302207	4125 BLENHEIN RD	ST2-4	$14,698	$57,960	$36,254	na	na	na	0.3	0.4	na	na	na	N		No Action
123	06302206	4121 BLENHEIN RD	ST2-4	$26,553	$57,056	$38,602	na	na	na	0.5	0.7	na	na	na	N		No Action
125	06302205	4117 BLENHEIN RD	ST2-4	$24,924	$54,580	$37,802	na	na	na	0.5	0.7	na	na	na	N		No Action
127	06302204	4115 BLENHEIN RD	ST2-4	$26,359	$48,745	$17,983	na	na	na	0.5	1.5	na	na	na	N		Elevation
130	06302203	4109 BLENHEIN RD	ST2-4	$43,224	$57,330	$37,092	na	na	na	0.8	1.2	na	na	na	N		Elevation
138	06302229	4116 WELLING AV	ST2-4	$10,185	$47,160	$16,108	na	na	na	0.2	0.6	na	na	na	N		No Action

APPENDIX C

BUILDING DEPTH-DAMAGE FUNCTION (DDF) Mecklenburg County Flood Hazard Mitigation Project Lower Little Sugar, Briar, Irwin, and McMullen Creek Watersheds													
		Flood Depth (feet)											
Building Type	***Curve Type***	***-2***	***-1***	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***>8***
1 Story, w/o Basement	Local	0	0	9	22	35	40	45	50	55	55	55	55
2 Story, w/o Basement	Default	0	0	5	9	13	18	20	22	24	26	29	33
Split Level, w/o Basement	Default	0	0	3	9	13	25	27	28	33	34	41	43
1 or 2 Story, with Basement	Default	4	8	11	15	20	23	28	33	38	44	49	51
Split Level, with Basement	Default	3	5	6	16	19	22	27	32	35	36	44	48
Mobile Home	Default	0	0	8	44	63	73	78	80	81	82	82	82

NOTES: Local curve developed by Watershed Concepts (1998

Default curves from FEMA Full Riverine Benefit:Cost Model (V5.2.3)

CONTENTS DEPTH-DAMAGE FUNCTION (DDF) Mecklenburg County Flood Hazard Mitigation Project Lower Little Sugar, Briar, Irwin, and McMullen Creek Watersheds													
		Flood Depth (feet)											
Building Type	***Curve Type***	***-2***	***-1***	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***>8***
1 Story, w/o Basement	Local	0	0	8	18	30	50	55	60	65	70	75	75
2 Story, w/o Basement	Default	0	0	7.5	13.5	19.5	27	30	33	36	39	43.5	49.5
Split Level, w/o Basement	Default	0	0	4.5	13.5	19.5	37.5	40.5	42	49.5	51	61.5	64.5
1 or 2 Story, with Basement	Default	6	12	16.5	22.5	30	34.5	42	49.5	57	66	73.5	76.5
Split Level, with Basement	Default	4.5	7.5	9	24	28.5	33	40.5	48	52.5	54	66	72
Mobile Home	Default	0	0	12	66	90	90	90	90	90	90	90	90

NOTES: Local curve developed by Watershed Concepts (1998

Default curves from FEMA Full Riverine Benefit:Cost Model (V5.2.3)

Prepared By:
Neal Banerjee, PE
Dewberry
March 2003

APPENDIX D

MEETING MINUTES

PROJECT NAME: Irwin Creek WWTP

D&D PROJECT NO.: Meckco

MEETING LOCATION: WWTP

DATE: 11/12/02

ATTENDEES: Nikole Dalton, Dewberry & Dewberry, Inc.
Tom Hunter, Plant Supervisor, CMUD

Irwin creek has been equipped with a dike that precedes the flood event occurring in ’96-’97. During that flood the water exceeded the dike elevation and proceeded flooding a good portion of the treatment plant. Features included in the flooding area were the primary clarifiers, aeration tanks, chlorine storage, chlorine tank, and effluent filters.

Since the last flood event the dike has been elevated by adding a brick wall. The new dike elevation is 614.33’.

The structures located on the other side of the creek from the main treatment plant have also been protected somewhat from flooding since the last flood event. New doors that help prevent excessive flooding have been added to the screening building and the windows have been blocked up to match the elevation of the dike across the river.

If flooding comes over the elevation of the dike it is likely that along with the above features flooding there will also be significant flooding of the electrical substation, trickling filters, and an office building

The above constitutes the writer’s understanding of the events and topics at the meeting. Kindly notify this office within seven (7) business days if these minutes require amendment; otherwise they shall constitute a complete and accurate record of the meeting.

Submitted By:______________________________
Signature

\nld Document1

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