Appendix A:

Hydrologic Analysis

APPENDIX A
HYDROLOGIC ANALYSIS

Three different models were used to develop design flows for the primary and secondary systems. For each system analyzed, the hydrologic model(s) was selected based on the complexity of the stormwater conveyance system.

The US Army Corps of Engineers (USACE) HEC-HMS model was selected to model the primary systems defined as the main stems of Hardee Creek and HCUT1. HEC-HMS simulates the surface runoff response to precipitation for an interconnected system of surfaces, channels, and ponds. Input data for the HEC-HMS model was developed using topographic, land use, and soils maps in GIS to delineate and calculate the basin areas and SCS hydrologic parameters. The HEC-HMS model offers a variety of methods for simulating the rainfall-runoff response, hydrograph development, channel and pond routing. The selection of methods for the analyses is based on the study objectives, data availability, and watershed characteristics. The precipitation data for the 24-hour duration, NRCS Type III storm was used to represent the synthetic rainfall event. The NRCS curve number approach was selected to calculate runoff volumes from the precipitation data, and the sub-basin unit hydrographs for these flood volumes were developed using the NRCS lag times. Where appropriate, reservoir routing was selected to model attenuation behind culvert embankments.

For the secondary systems that may: (a) have significant backwater effects from rising water surface elevations within the Primary Systems, (b) have attenuation within drainage ditches or behind roadways, and (c) show a sensitivity to the timing response of runoff to rainfall, the Storm Water Management Model (SWMM) developed by the Environmental Protection Agency (EPA) was selected as the hydrologic and hydraulic model. The NRCS curve number approach was selected to calculate runoff volumes from the precipitation data, and the sub-basin unit hydrographs for these flood volumes were developed using the watershed width parameter. SWMM simulates the surface runoff response to precipitation for an interconnected system of surfaces, channels, and ponds. Input data for the SWMM model was developed using topographic data, land use data, and soils maps in GIS to delineate and calculate the basin areas and NRCS hydrologic parameters. The SWMM model offers a variety of methods for simulating the rainfall-runoff response, hydrograph development, and channel routing. One advantage to using SWMM to model both hydrology and hydraulics is that channel routing is modeled in the EXTRAN (hydraulics) block automatically based on the geometry and nature of the conveyance system. This eliminates the need to iterate between a hydrologic model and a hydraulic model to produce reasonable flows.

Some project areas with smaller drainage areas and less complex conveyance systems required a less rigorous approach. Hydraflow Storm Sewers, an extension of AutoCAD Civil 3D, was used to generate peak flows using the Rational Method. Table A-1 lists the different systems and the modeling methodology applied to each system.

Table A-1: Project Area Model Selection

Project Area	Model Selection
Hardee Creek Primary System	HEC-HMS
HCUT1 Primary System	HEC-HMS
Fox Haven Drive – Quail Hollow Road System (Existing)	SWMM
Fox Haven Drive – Quail Hollow Road System (Alternative)	Hydraflow Storm Sewers
River Hills System	SWMM

Watershed Delineation and Connectivity

Watersheds were delineated for the Primary Systems and for each of the two (2) secondary systems utilizing digital LiDAR data available from the State of North Carolina and the stormwater inventory. The preliminary watersheds were created using automated procedures in a GIS platform and then adjusted as necessary based on the conveyance system and known ridge lines. Each flood control project watershed for the Primary Systems was subdivided into sub-watersheds selected at hydrologically and hydraulically significant points, such as major roadway crossings, stream convergences, known problem areas, etc. Each sub-watershed for the secondary systems was selected as the area that drained to each inlet modeled on the secondary system. Twenty-eight (28) sub-watersheds were delineated for the Primary Systems ranging in size from 13 to 485 acres. Sub-watersheds were delineated as necessary for the secondary systems to accurately model the hydraulics of the system. The watershed maps included in Appendix C illustrate the sub-watershed and hydrologic connectivity for the primary system.

Soils

The NRCS curve number method uses basin characteristics, such as soil types and land use, to compute the runoff response. The infiltration rate of a soil influences the volume of surface runoff that results from given storm events. Soils with high infiltration rates produce lower runoff than soils with lower infiltration rates. The Soil Conservation Service has prepared soil maps for Pitt County that identify four primary soil groups. This data is available digitally and was obtained for the City of Greenville.

The groups (A, B, C, and D) correspond to decreasing rates of infiltration. A general description of the four soil groups taken from the USDA, SCS, NEH-4 (1972) is presented in Table A-2.

Table A-2: Hydrologic Soils Groups

Soil Group	Description
A	Group A soils have high infiltration rates even when thoroughly wetted and consist chiefly of deep, well to excessively drained sand or gravels. These soils have a high rate of water transmission. (greater than 0.3 inches per hour)
B	Group B soils have moderate infiltration rates even when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse texture. These soils have a moderate rate of water transmission. (0.15 to 0.3 inches per hour)
C	Group C soils have slow infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission. (0.5 to 0.15 inches per hour)
D	Group D soils have a very slow infiltration rate when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission. (0 to 0.05 inches per hour)
A/D B/D C/D	The first letter applies to the drained condition and the second to the undrained condition. For the purpose of hydrologic soil group, adequately drained means that the seasonal high water table is kept at least 60 centimeters (24 inches) below the surface.

Soils within the watershed are predominantly NRCS hydrologic soil groups A and C soils, although seven (7) different hydrologic soil groups are represented in some quantity in the Hardee Creek watershed (See Table A-3 and Appendix C).

Table A-3: Area Distribution of Hydrologic Soil Groups

Soil Group	Total Area (acre)	Percent of Total Area
A	1,504	29%
B	489	10%
C	1,781	35%
D	851	17%
A/D	57	1%
B/D	406	8%
C/D	20	0.4%

Water cover makes up the remaining 39 acres of the Hardee Creek Watershed.

Land Use

Land use is the watershed cover condition as it relates to the actual type of development and zoning within the watershed. Land use influences the runoff characteristics of a watershed, and combined with other basin characteristics, is used to determine the SCS curve number for the basin.

The existing zoned land uses for the Hardee Creek Watershed were provided by the City of Greenville. These zoning maps were used to develop peak flows for the watershed. Eight (8) land use categories were delineated within the Hardee Creek Watershed based on the information provided and field observation of the current uses (See Appendix C).

In its entirety, the Hardee Creek Watershed covers an area of approximately 5,150 acres (8 square miles). Land use in the watershed is about 65 percent built out as shown on the Existing Conditions Land Use Map included in Appendix C. Percentages of each existing and future land use groups and the correlating acreage are listed in Table A-4 below.

Table A-4: Hardee Creek Watershed Existing Land Use

	Existing		Future	
Land Use Category	**Area (acres)**	**Percent of Basin Area**	**Area (acres)**	**Percent of Basin Area**
Right-of-Way	369	9%	372	9%
Industrial	0	0%	0	0%
Commercial	94	2%	176.5	4%
Mixed Use/Office/Institutional	9	0.2%	9	0.2%
Medical Core	2	0.05%	2	0.05%
Office/Institutional/Medical	0	0%	1	0.02%
Office/Institutional/Multi-Family	0.5	0.01%	27	1%
High Density Residential	97	2%	148	4%
Medium Density Residential	296	7%	292	7%
Low Density Residential	1,255	30%	1,568	38%
Very Low Density Residential	433	10%	1,062	26%
Conservation/Open Space	1,289	31%	506	12%
Agricultural/Cropland	305	7%	0	0%
Open Water	14	0.3%	0	0%

*Does not include downstream basins with unnamed tributaries that drain to the Tar River

NRCS Curve Numbers

The NRCS curve number approach was used in computing the runoff response. Runoff curve numbers (RCNs) were generated by using the NRCS document entitled Urban Hydrology for Small Watersheds, dated June 1986 and commonly referred to as TR-55. This method relates the drainage characteristics of the hydrologic soil group, land use category,

and antecedent moisture conditions (AMC) to a runoff curve number. The runoff curve number and an estimate of the initial surface moisture storage capacity are used to calculate a total runoff depth for a storm in a basin.

The AMC refers to the total rainfall in a 5-day period preceding a storm and relates to the soil moisture condition at the beginning of the storm event. The AMC value can be used as a calibration tool in the hydrologic computations where AMC-1 represents "dry" conditions and AMC-3 represents "wet" conditions. The average antecedent moisture conditions (AMC-2) are generally considered most representative for the humid southeastern portion of the country and were used for the hydrologic calculations in this study.

Runoff curve numbers were determined for each sub-basin based on the soil group, land use, and average antecedent moisture condition for the area. The curve numbers calculated for this study are listed in Table A-5 below.

Table A-5: Curve Numbers Based on Land Use and Soil Groups

Land Use Category	Soil Group			
	A	B	C	D
Commercial	89	92	94	95
Conservation/Open Space/Agricultural*	49	69	79	84
Open Space, Good Condition	39	61	74	80
Very Low Residential	49	69	79	84
Low Density Residential	51	68	79	84
Medium Density Residential	54	70	80	85
High Density Residential	61	75	83	87
Office/Institutional/Multifamily	77	85	90	92
Right-of-Way	83	89	92	93

*Assumed fair condition

For each sub-basin, the curve number was determined and weighted by area to calculate the composite curve number for each sub-basin. A summary of the hydrologic input data for the Primary Systems, including the runoff curve numbers, is shown in Table A-6. The detailed calculations are included in Appendix E (runoff curve numbers) and Appendix F (times of concentration).

Table A-6: Summary of Hydrologic Input Data

Drainage Basin ID	Drainage Area (acre)	Existing RCN	Future RCN	Lag Time* (minutes)
HC-1A	364.31	75	78	184
HC-1B	377.84	73	77	185
HC-1C	386.40	71	73	230
HC-1D	119.46	67	67	51

HC-2A	278.22	73	79	48
HC-2B	221.56	72	75	50
HC-2C	305.69	72	72	72
HC-3A	485.30	71	72	175
HC-3B	158.72	65	67	88
HC-3C	128.71	62	64	25
HC-4A	190.31	70	71	50
HC-4B	159.54	70	72	105
HC-5A	105.34	64	66	99
HC-5B	41.19	65	65	32
HC-5C	114.17	65	66	58
HC-6	91.93	63	64	45
HC-7A	83.54	53	54	177
HC-7B	89.52	69	81	189
HC-7C	24.56	53	56	105
HC-8A	54.58	67	57	22
HC-8B	60.15	72	73	31
HC-8C	83.73	61	61	41
HC-9	113.46	67	74	52
HCUT-1	50.67	67	73	264
HCUT-2	15.98	62	62	175
HCUT-3	28.58	64	64	51
HCUT-4	20.55	60	63	71
HCUT-5	12.87	58	61	27

*Lag time = 0.6x Time of Concentration
**Does not include downstream basins with unnamed tributaries that drain to the Tar River

Rainfall

Rainfall distributions for Greenville are derived using the NRCS Type III standard distribution. Total rainfall volumes for the modeled frequency storms were based on data published on the NOAA website, http://hdsc.nws.noaa.gov/hdsc/pfds/orb/nc_pfds.html. Table A-7 shows the total rainfall volumes used for this study based on precipitation data collected in Greenville, North Carolina

Table A-7: Design Storm Rainfall Depths

Design Storm	Rainfall Depth (in)
2-year, 24-hour	3.76
10-year, 24-hour	5.81
25-year, 24-hour	7.23
50-year, 24-hour	8.47
100-year, 24-hour	9.84

While the depth-duration-frequency curves are calculated based on real rainfall data, the rainfall data used for the SWMM and HEC-HMS models represent the Type III synthetic

rainfall distribution. Actual runoff is based on several factors including rainfall intensity, duration and the antecedent moisture conditions of the watershed.

Hydrograph Translation

The lag time, as defined by the NRCS for use in the NRCS dimensionless unit hydrograph method, is the time, or lag, between the center of mass of rainfall excess and the peak of the unit hydrograph. The lag time is based on the sub-watershed time of concentration, or travel time, and is a function of the sub-watershed size, shape, slope, cover, and other basin characteristics. For the NRCS method, the sub-watershed lag time is calculated to be 0.6 times the time of concentration for each sub-watershed.

The times of concentration for the sub-watersheds were calculated from the methodology described in TR-55. A summary of the calculations is shown in Appendix F. The longest flow path is divided into three types of flow; overland flow, shallow concentrated flow, and channel flow. A spreadsheet was developed to tabulate the incremental travel times for each type of flow for each sub-basin. The incremental travel times were totaled and multiplied by 0.6 to compute the lag time for each sub-basin. The equation detailing the travel time for sheet flow is as follows:

$$T_t = \frac{.007\,(nL)^{0.8}}{(P_2)^{0.5}\, s^{0.4}}$$

T_t = Travel Time in hours
n = Manning Roughness Coefficient (Paved=0.011, Unpaved=0.24)
L = flow length in feet
P_2 = 2-year, 24 hour rainfall = 3.76 inches
S = slope of hydraulic grade line (land slope in ft/ft)

For shallow concentrated flow, the velocity (V) is calculated for either paved or unpaved sections by using the following equations:

$$\text{Unpaved } V = 16.1345\,(S)^{1/2}$$
$$\text{Paved } V = 20.3282\,(S)^{1/2}$$

The travel time for shallow flow is then calculated by dividing the flow length (L in feet) by velocity as follows:

T_t = Travel Time = L / (3600*V)

The open channel travel times are determined by a modified version of the Manning equation, which is as follows:

$$V = \frac{1.49\ R^{2/3}\ S^{0.5}}{n}$$

V = Average full-flow velocity (ft/s)
R = Hydraulic radius (ft)
S = Slope of hydraulic grade line (ft/ft)
n = Manning roughness coefficient

Instead of a time of concentration parameter, the SWMM model uses a watershed width parameter to create the unit hydrograph used in the model that will translate the rainfall into runoff. The watershed width is a parameter unique to SWMM that typically represents the watershed area divided by the longest flow path. The width parameter is typically calibrated to flow gauge data, if available. The Hardee Creek Watershed lacks flow gauge data, so the peak flows from SWMM were compared to flows developed using the Rational Method. Based on the flow comparison, the watershed widths for each basin were increased in some instances to produce reasonable flows. Increasing the watershed width parameters is not an uncommon practice for calibrating models for areas with gradual slopes and moderate conveyance systems.

Channel Elements

Flood peaks attenuate, or reduce, as they travel downstream due to the storage characteristic of the stream reach. The Muskingum-Cunge routing method in HEC-HMS was selected to define the storage characteristic of selected stream reaches in the Hardee Creek Watershed. It can be described as a hydrologic routing method based on physical parameters of the channel and floodplain. Input data for this method consists of representative channel/floodplain sections, reach length, Manning's roughness coefficient, and channel bed slope. This method provides advantages over other hydrologic techniques based on the relative size and slope of the channels and floodplains in the watershed.

Structure and Pond Routing

Reservoir storage routing was used for routing hydrographs through the storage areas upstream from undersized structures (culverts). HEC-HMS is able to model the effects of an undersized culvert through inputs defining the relationship between water volume or area and elevation and the relationship between outflow and water surface elevations. The relationship between outflow and water surface elevations is developed using an iterative process between HEC-HMS and HEC-RAS. A rating curve generated using HEC-RAS defines the outflow of the water leaving this system.

Structures having fill heights greater than or equal to 50% of the height of the structure were assumed to provide significant peak flow attenuation and, therefore, were routed in the HEC-HMS model. In addition, any structure which exhibited significant upstream floodplain storage or significant backwater from the HEC-RAS model output would be analyzed for providing peak flow attenuation.

For each structure, the cutoff point in the backwater pool was determined where the structure routing ends and upstream channel routing begins. This determination was necessary so that available storage areas calculated for channel and structure routing did not overlap. The following procedure was used for this determination:

- The approximate limit of the 100-year frequency flood backwater pool was delineated in the topographic map.
- The distance from the upstream face of the structure to the upstream limit of the pool was measured.
- From the upstream end of the backwater pool, a distance equal to 20% of the total pool length was measured in the downstream direction and the point marked on the topographic map.
- Through this point a line was drawn perpendicular to the contour lines.
- This line was then designated as the cutoff point to be used as the upstream limit of the channel routing.

For each structure, the elevation-storage relation for the Modified Puls method was derived by calculating the surface area of the topographic contours from the upstream face of the structure to the routing cutoff point associated with the structure. A pair of "SA" (storage area) – "SE" (elevation) records, the elevation-storage relation for each structure was input from the delineated information. To avoid interpolating storage areas for each stage-discharge point, a separate stage-discharge relation was entered into the HEC-HMS model on a pair of "SQ" (discharge) – "SE" (elevation) records based on the HEC-RAS model output.

However, the method described in the previous paragraph does not account for the reduction in tailwater on the structure due to the attenuation effects of the upstream storage, which in turn can affect the stage-discharge relation of the structure. Therefore, an iterative process for storage structures was followed with an objective to obtain a set of peak discharge values, runoff volumes, and water surface elevations that are "balanced" between the two models. The process was initiated by inputting a set of discharges into the HEC-RAS model to develop a set of discharge-storage relations for each reach. This initial set of relations was input into the HEC-HMS model. These values were supplemented by the depth-storage relation for each structure.

The HEC-HMS model was run with these values to derive new discharges at downstream locations. These new values were input into the HEC-RAS model and it was recomputed. The new discharges and water surface elevations listed in the HEC-HMS summary output were compared with the discharges listed in the previous HEC-RAS run. When the values stabilized, the model was considered "balanced". If not then additional iterations were performed. Typically, three iterations are adequate to derive a balanced model.

Summary of Hydrologic Model Results

The HEC-HMS model was used to compute peak runoff for the 2-, 10-, 25-, 50- and 100- year design storms for the existing conditions.

The results of the hydrologic model are summarized in Table A-8. The HEC-HMS input and output are included in Appendix H. Additionally, a CD is included in Appendix J and contains the digital files for the HEC-HMS model.

Table A-8: Existing Conditions Flows from HEC-HMS for Hardee Creek Watershed

HEC-HMS Node	Road Name / Location	HEC-RAS Station	Storm Event				
			2-year (cfs)	10-year (cfs)	25-year (cfs)	50-year (cfs)	100-year (cfs)
HARDEE CREEK							
US End	Upstream Limit of Hardee Creek	14866	426	1,019	1,480	1,909	2,397
Portertown Road	Portertown Road	12786	443	1,070	1,558	2,014	2,532
HCUT1_HC_ Confl	Confluence of HCUT and Hardee Creek	11882	491	1,260	1,861	2,427	3,071
Railroad	Railroad	10345	501	1,285	1,925	2,517	3,188
E. 10th	East 10th Street (NC 33)	5340	777	1,811	2,516	3,124	3,794
HARDEE CREEK UT1							
ADD_HCUT_2-1	Holly Hills Road	1712	9	22	31	40	50
Cardinal Culvert	Cardinal Drive	1033	8	25	36	46	61
King George Road Culvert	King George Road	763	9	28	43	65	88

Comparison of Peak Flows

For comparison purposes, flood peaks were estimated using the U.S. Geological Survey (USGS) publication entitled "The National Flood-Frequency Program – Methods for Estimating Flood Magnitude and Frequency in Rural and Urban Areas in North Carolina – USGS Fact Sheet 007-00" (2001) at key locations within the watershed. Table A-9 compares the peak flows determined from the USGS regional regression equations the Coastal-Plain region versus the peak flows from HEC-HMS. Additional, the peak flows from HEC-HMS were also compared to available FEMA flows.

Table A-9: Comparison of Existing Conditions Peak Flows

Methodology	Location	2-Year (cfs)	10-Year (cfs)	25-Year (cfs)	50-Year (cfs)	100-Year (cfs)
HEC-HMS	Portertown Road	443	1,070	1,558	2,014	2,532
	Railroad	501	1,285	1,925	2,517	3,188
	East 10th Street	777	1,811	2,516	3,124	3,794
USGS Regression Coastal-Plains (2001)	Portertown Road	803	1,599	2,172	2,508	2,826
	Railroad	860	1,697	2,293	2,646	2,977
	East 10th Street	1,392	2,539	3,291	3,746	4,164
FEMA Flows	Portertown Road	-	1,600	-	2,550	2,890
	Railroad	-	1,600	-	2,550	2,890
	East 10th Street	-	2,010	-	3,140	3,540

Appendix B:

Hydraulic Analysis

APPENDIX B
HYDRAULIC ANALYSIS

The purpose of the hydraulic modeling analysis is to determine an existing level of flooding for the stormwater drainage network and to develop proposed solutions to mitigate flooding, on both the primary systems and the secondary systems. Three different modeling methodologies were used depending on the complexity and location of the conveyance system. For the primary systems comprised of Hardee Creek and HCUT1, the Hydrologic Engineering Center River Analysis System (HEC-RAS) was used for hydraulic modeling. For smaller less complex secondary systems, Hydraflow Storm Sewers was used to calculate the hydraulic grade lines using an energy grade based approach, while more complex secondary systems were modeled using SWMM. Table B-1 lists the project areas that were modeled using each approach.

Table B-1: Project Area Model Selection

Project Area	Model Selection
Hardee Creek Primary System	HEC-RAS
HCUT1 Primary System	HEC-RAS
Fox Haven Drive – Quail Hollow Road System (Existing)	SWMM
Fox Haven Drive – Quail Hollow Road System (Alternative)	Hydraflow Storm Sewers
River Hills System	SWMM

HEC-RAS Model

The HEC-RAS model calculates water surface profiles for steady, gradually varied flow, both sub-critical and supercritical, for user-specified discharges. The standard step backwater analysis for sub-critical flow was modeled for the Hardee Creek and HCUT1 Primary System. The model calculates the effect of obstructions, such as culverts, and building structures in the channel and floodplain on the water surface profile. The hydraulic computations are based on the solution of a one-dimensional energy equation with energy loss due to friction evaluated by Manning's equation.

Input data for the HEC-RAS computer model includes the following:

- Cross-section geometry of the channel and floodplain.
- Roughness coefficients to describe the characteristics of the channel and floodplain.
- Size, shape, and characteristics of culverts and roadways along the stream reach.
- Energy loss coefficients for flow in the channel and at roadway crossings.

Primary System Study Limits

As discussed with City of Greenville stormwater staff, study limits for the hydraulic evaluation of the primary systems include Hardee Creek from its confluence with the Tar River at the downstream end to approximately 1,900 feet upstream of the Portertown Road crossing and HCUT1 from its confluence with Hardee Creek at the downstream end to approximately 170 feet upstream of Holly Hills Road.

Stormwater Inventory

For the Hardee Creek Watershed Master Plan, stormwater utility infrastructure throughout the watershed was collected by WK Dickson personnel to compile a Geographic Information System (GIS) stormwater inventory database for the City. This was accomplished by using Global Positioning Systems (GPS) as the primary means of data capture. WK Dickson employed survey grade GPS to locate the x, y, and z coordinates of each visible stormwater system structure and conventional surveying techniques to obtain other attributes including but not limited to size, material, slope, and length. Additionally, attributes were also collected for select streams and open channel. Data was obtained for those streams and open channels required to complete connectivity for modeling purposed. The data was collected using horizontal datum NAD 1983 and vertical datum NAVD 1988

Attributes collected as part of the inventory were used to populate the various models. Field visits and digital photographs for each structure and channel were used to estimate the roughness coefficients and energy loss coefficients. The topographic data used for the Hardee Creek Watershed Master Plan was the State of North Carolina's LiDAR data.

Cross Sections

Cross sections utilized in the HEC-RAS model were based on the existing FEMA cross sections (where available). These surveyed cross sections were augmented with additional cross sections surveyed by WK Dickson. The surveyed cross section points were than merged with the digital elevation model based on the LiDAR data. Cross sections were located perpendicular to the flow and at intervals along the stream to characterize the flow capacity of the channel and floodplain for the primary system. Along stream reaches where the shape, size, and geometry of the cross-section are varying, cross sections were cut at closer intervals than for reaches having little change in channel characteristic. Additional sections were cut as required by the HEC-RAS program to sufficiently model structures such as culverts.

Surveyed cross sections are identified by station number, which for the HEC-RAS model, refers to the approximate linear distance upstream from a reference point on the main channel or tributary reach. The cross sections depict the locations of cut sections from field topographic surveys. Similarly, the cross section at each road crossing represents the top-of-road cross section. The cross sections just upstream and just downstream of highest point of roadway (commonly referred to as the weir) represent the locations of the upstream and downstream faces, respectively, of the bridge or culvert in an area not impacted by roadway fill.

Roughness Coefficients

Manning's roughness coefficients, or 'n' values, represent the resistance to flow and influence the flow capacity of channels and floodplains. The HEC-RAS model uses these coefficients to compute friction loss longitudinally in the channel and floodplain. The roughness value is a function of the type and density of the vegetation, channel bottom and stream bank material, degree of channel meandering, and depth of flow.

Roughness coefficients were determined for all stream reaches for which hydraulic analyses were performed. The "horizontal variation in n-values" option was enabled to allow for correct modeling of the widely varied surfaces on a given cross-section. The right or left bank of the stream is referenced facing downstream. Roughness coefficients used in this study are listed in Table B-2.

Table B-2: Roughness Coefficients

Location	Range of 'n' values
Main Channel	0.05 - 0.055
Left Overbank	0.08 - 0.165
Right Overbank	0.08- 0.165

All roughness coefficients were estimated through field observation and by referencing standard engineering manuals.

Culvert and Roadway Data

Culverts generally have different characteristics than the channel and floodplains away from roadway crossings. Often culverts constrict flood flows in the channel and floodplain, which may create backwater effects upstream of the structure. The constriction can produce increased velocities and result in localized scour.

For culvert analysis, the HEC-RAS model utilizes the concepts of "inlet" control and "outlet" control to simplify complicated culvert hydraulics. Inlet control flow occurs when the flow carrying capacity of the culvert entrance is less than the flow capacity of the culvert barrel. Outlet control flow occurs when the culvert carrying capacity is limited by downstream conditions or by the flow capacity of the culvert barrel.

During inlet control computations, the culvert inlet acts as either a weir or an orifice, and the resulting headwater is computed. The equations used by HEC-RAS are the same as those developed by the Federal Highway Administration during extensive laboratory testing, which describe the inlet control headwater under various conditions.

For outlet control flow conditions, the required headwater is computed considering various conditions. For culverts flowing full, a form of the Bernoulli Equation, which considers

friction losses, entrance losses and exit losses is utilized. Friction losses are based on Manning's equation. Entrance losses are computed as a coefficient times the velocity head in the culvert at the upstream end. Exit losses are computed as a coefficient times the change in velocity head from just inside the culvert (at the downstream end) to outside the culvert.

When the culvert is not flowing full, the direct step backwater procedure is used to calculate the profile through the culvert up to the culvert inlet. An entrance loss is then computed and added to the energy inside the culvert to obtain the upstream headwater. Culvert input data for the HEC-RAS model include:

- Shape and dimensions of the structure openings;
- Culvert length;
- Entrance loss coefficient, exit loss coefficient and coefficient of discharge for weir flow during roadway overtopping;
- Upstream and downstream invert elevations;
- Federal Highway Administration chart number for the culvert type;
- Top-of-road elevations to describe the weir during roadway overtopping and the weir crest length; and
- Four cross sections are required; one cross section sufficiently downstream of the culvert that flow is not affected by the culvert, one at the downstream end of the culvert, one at the upstream end of the culvert, and one located far enough upstream that the culvert has no effect on flow.

Energy Loss Coefficients

Contraction and expansion of flow produces energy losses caused by the transition. The magnitude of these losses is related to the velocity and the estimated loss coefficient. Where the transitions are gradual, the losses are small. At abrupt changes in cross-sectional area, the losses are higher. Energy losses resulting from expansion are greater than losses associated with contraction. Energy loss coefficients used for the Hardee Creek Watershed hydraulic models are presented in Table B-3.

Table B-3: Energy Loss Coefficients

Type of Transition	Expansion	Contraction
None	0	0
Gradual	0.3	0.1
Culvert sections	0.5	0.3

Starting Water Surface Elevation

The starting water surface elevations for Hardee Creek and HCUT1 HEC-RAS models were calculated using the slope-area method, which is based on normal depth. The calculated slopes are as follows:

- Hardee Creek – 0.0007 feet/feet; and
- HCUT1 – 0.003 feet/feet

Model Run Descriptions and Assumptions
The HEC-RAS model was used to compute flood elevations at each cross-section for the Hardee Creek and HCUT1 Primary Systems for the 2-, 10-, 25-, 50- and 100-year floods. A hard copy of the HEC-RAS input and output is included in Appendix H, while a digital copy of the input and output is located on the CD in Appendix J.

The hydraulic analysis for this study is based only on the condition of unobstructed flow. Therefore, flood elevations shown on the profiles are considered valid only if hydraulic structures remain unobstructed and do not fail. Flood elevations may be raised by debris blockage of the culvert, channel, or floodplain.

Model Validation
Efforts were made to verify the models for various storm events. Feedback obtained from the questionnaires was reviewed for relevant information that could be used to verify the model. The comments and responses received were not specific enough to verify the model. Likewise, the information received during the public meetings was not useful for the purposes of verifying the models. The City Staff was able to provide some feedback that was useful during the model validation process.

During the validation process, the flows and water surface elevations initially calculated were determined to be significantly higher than the FEMA flow and base flood elevations. Furthermore, the results from the initial existing conditions model were not aligned with some of the feedback received from the City. The flows were calibrated to get results to more closely match FEMA flows, USGS Regional Regression flows, and City feedback.

Open Channel Systems and Roadway Flooding
Six (6) roadway crossings were analyzed for flooding potential in the Hardee Creek Watershed Master Plan. All roadway crossings that were analyzed in this study are listed in Tables B-4 including the minimum top-of-road elevations and the 2-, 10-, 25-, 50- and 100-year flood elevations at the crossing for existing and proposed conditions.

Table B-4: Overtopping Analysis of Roadway Crossings

Location	Desired Level of Service (Year)	Minimum Elevation at Top of Road (feet NAVD)	Calculated Water Surface Elevations (feet NAVD)				
			2-year flood	10-year flood	25-year flood	50-year flood	100-year flood
Existing Conditions							
Portertown Road (Main Branch)	25	25.58	23.73	25.21	**26.83**	**28.01**	**28.91**
Railroad (Main Branch)	100	41.51	18.72	20.80	22.20	23.38	24.20
East 10th Street (Main Branch)	50	17.87	10.05	16.08	**18.27**	**19.76**	**20.27**
Holly Hills Road (HCUT1)	25	50.94	43.84	44.04	44.15	44.24	44.33
Cardinal Drive (HCUT1)	25	35.73	34.41	35.69	**36.27**	**36.44**	**36.54**
King George Road (HCUT1)	25	35.01	31.33	32.94	34.24	**35.13**	**35.27**
Alternative #1							
Portertown Road (Main Branch)	25	25.58	22.32	23.52	25.54	**26.55**	**27.58**
Railroad (Main Branch)	100	41.51	18.96	20.98	22.22	23.23	24.46
East 10th Street (Main Branch)	50	17.87	9.06	12.66	15.20	16.85	**19.44**
King George Road (HCUT1)	25	35.01	31.44	32.94	34.71	**35.17**	**35.29**

*Bold text indicates the existing water surface has exceeded the rim elevation at the road thereby causing flooding.

Hydraflow Storm Sewers

The purpose of the hydrologic analysis for the secondary systems, or closed systems, was to estimate the peak runoff that would flow to the catch basins and into the closed system. The rational method was used for the closed system hydrologic analysis. The rational method can be expressed as follows:

$$Q = CiA$$

Q = maximum rate of runoff (cfs)
C = runoff coefficient representing a ration of runoff to rainfall
i = average rainfall intensity for a duration equal to the time of concentration (in/hr)
A = drainage area contributing to the design location (acres)

SWMM

SWMM is a dynamic rainfall-runoff model capable of modeling the hydrologic response of a watershed and hydraulic routing throughout a stormwater conveyance system. The model calculates the effect of backwater, flat or negative slopes, energy losses, and minor headlosses associated with bends, entrances and exits.

Input data for the EPA SWMM (hydraulics) computer model include the following:

- Conveyance pipes including structure inverts, pipe sizes and lengths;
- Open channel cross section geometries;
- Roughness coefficients for pipes and channels;
- Energy loss coefficients for flow in the pipes and channels;
- Storage rating curves; and
- Overland flow characteristics.

SWMM provides an accurate evaluation of the existing and proposed conditions because it combines hydrology and hydraulics while accounting for the routing effects of the channel and overbank storage areas. Because hydrology and hydraulics are combined, changes to peak flows or water surface elevations resulting from proposed modifications to the existing channels or culverts are calculated in the model in one step. Additionally, changes to flows from proposed pipes and channel improvements are seen both upstream and downstream, reducing the potential for a stormwater system having increased flooding downstream.

Energy Loss Coefficients

Contraction and expansion of flow produces energy losses caused by the transition. The magnitude of these losses is related to the velocity and the estimated loss coefficient. Where the transitions are gradual, the losses are small. At abrupt changes in cross-sectional area, the losses are higher. Energy losses resulting from expansion are greater than losses associated with contraction. Energy loss coefficients used for the hydraulic SWMM models are presented in Table B-5 below:

Table B-5: Energy Loss Coefficients for SWMM Models

Type of Transition	Expansion	Contraction
None	0	0
Manhole/Inlet	0.7	0.5
Open Channel	1	0.5–Headwall/ 0.9 - Projecting

Additional energy losses for structures having bends were divided between the two joining pipes. The bend losses used for this project are based on NCDOT values, and are shown below in Table B-6.

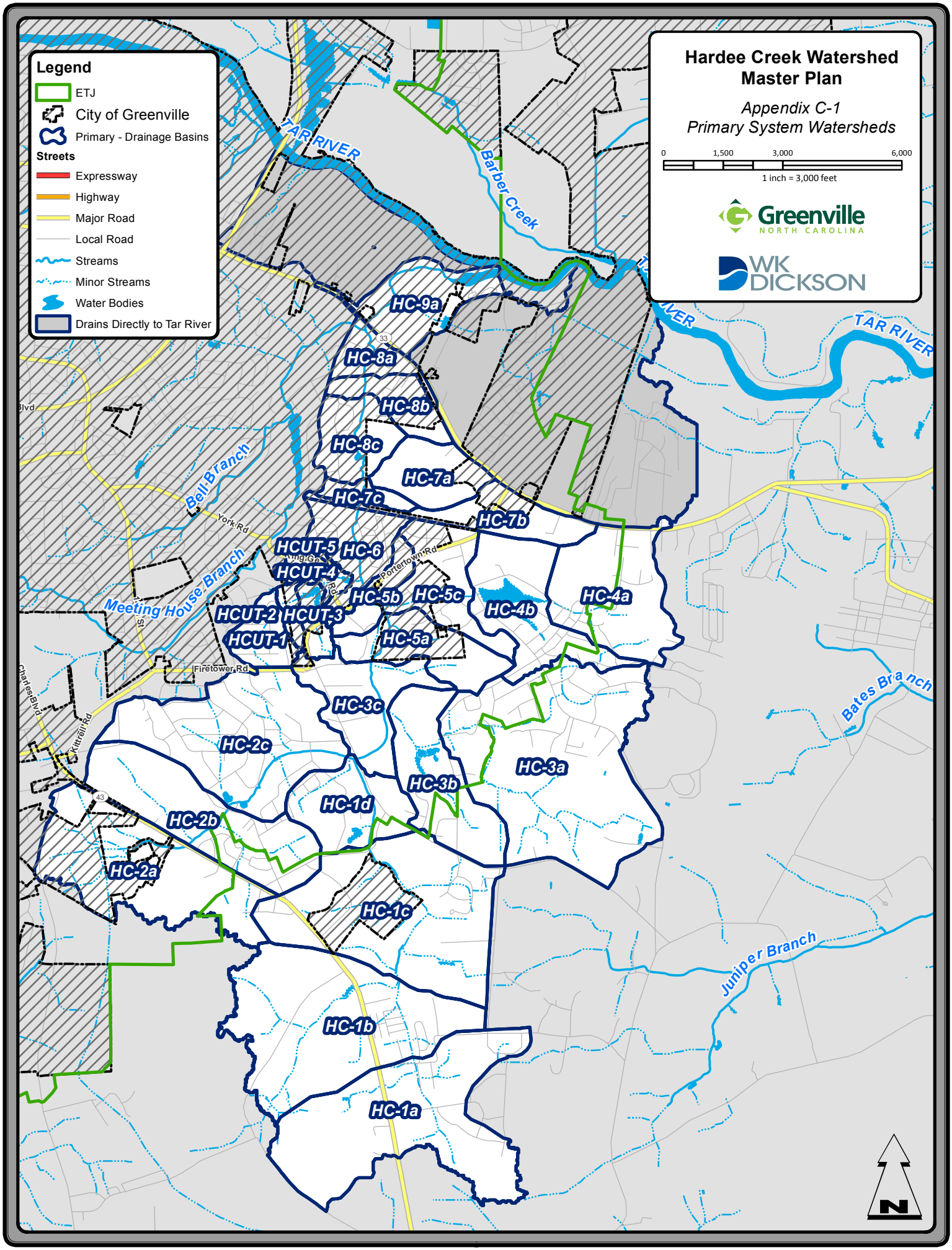
Table B-6: Bend Loss Coefficients

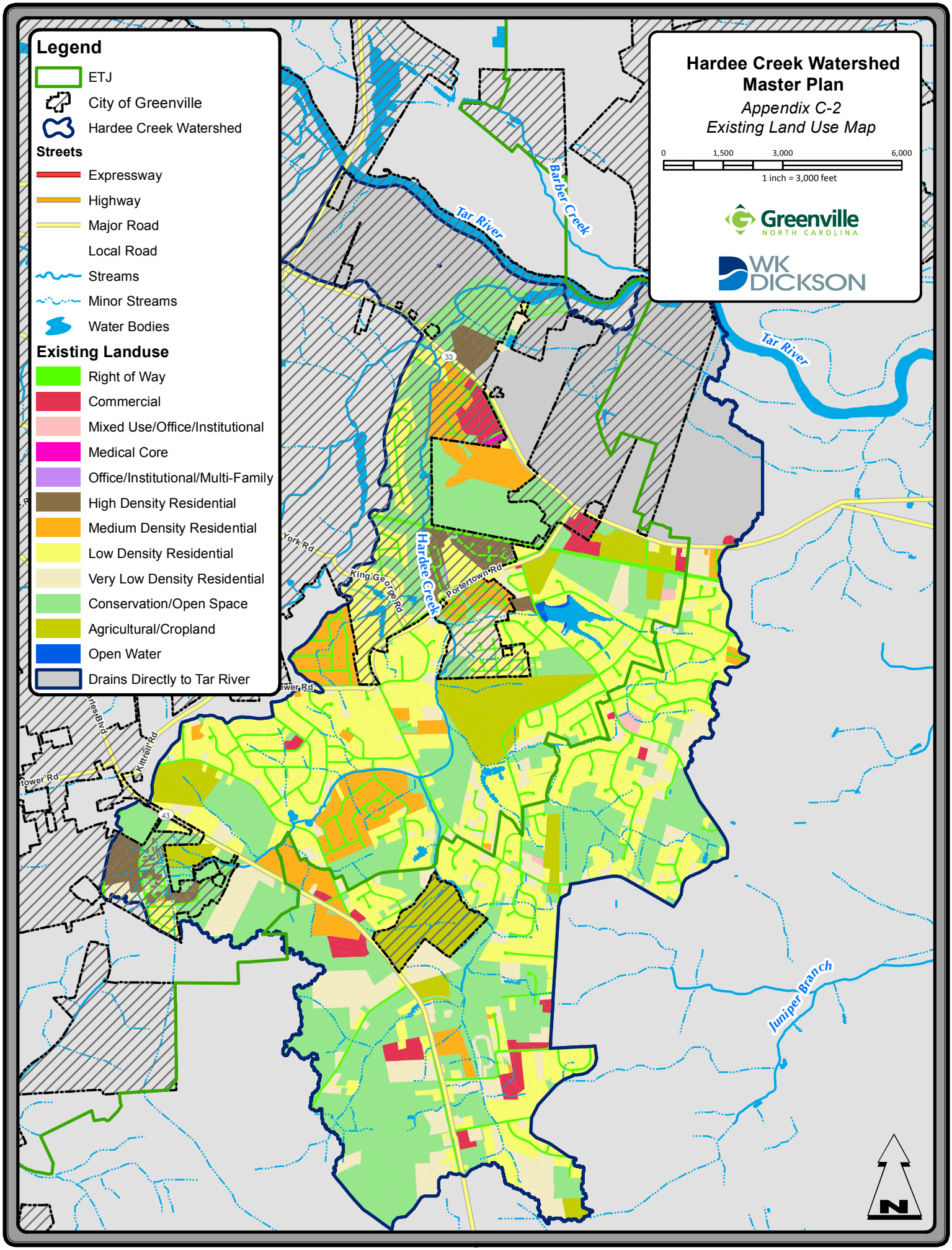
Angle (°)	Loss Coefficient	Angle (°)	Loss Coefficient
90	0.70	40	0.38
80	0.66	30	0.28
70	0.61	25	0.22
60	0.55	20	0.16
50	0.47	15	0.10

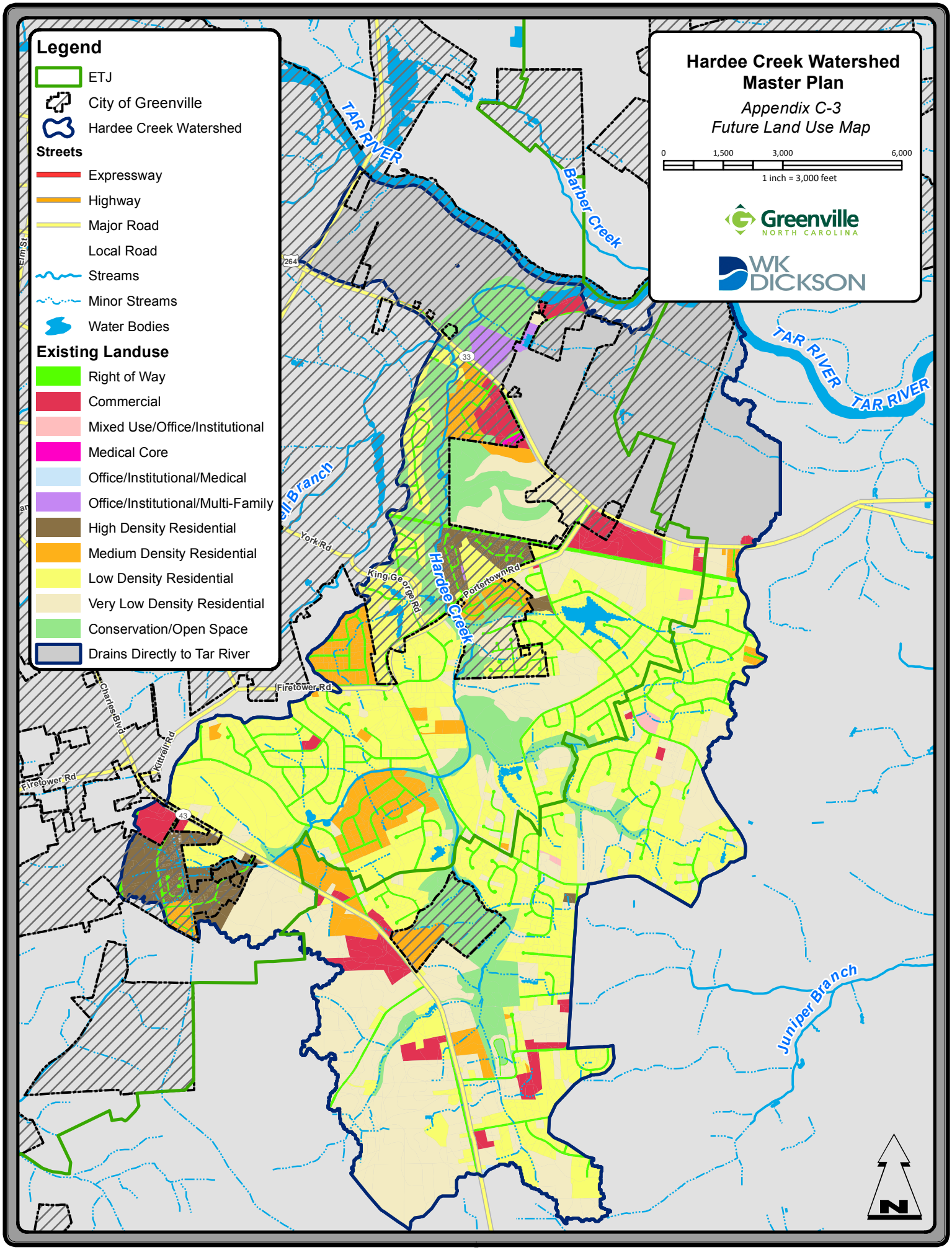
Appendix C:

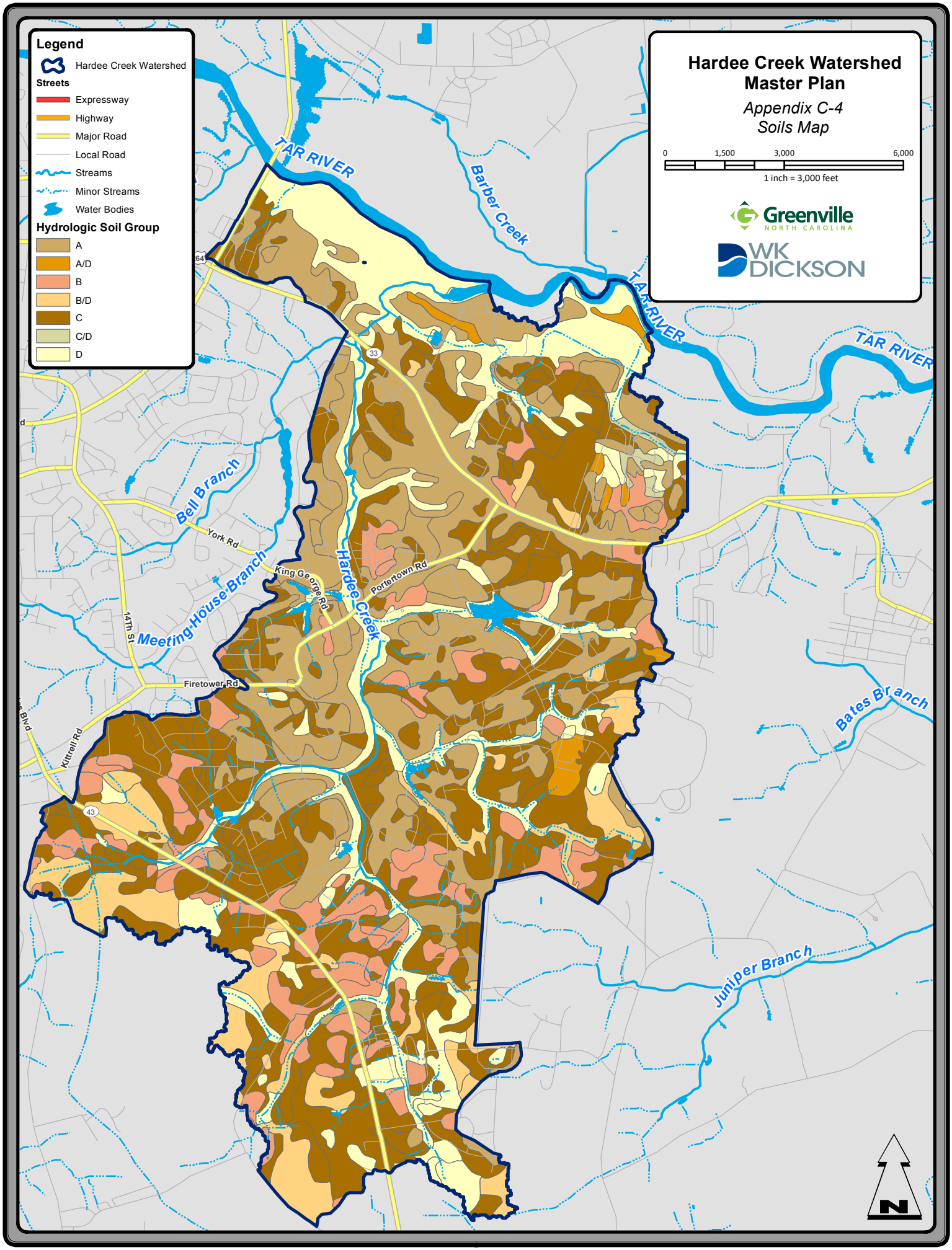
Watershed, Landuse, and Soils Maps

List of Contents:


Legend
ETJ
City of Greenville
Primary - Drainage Basins
Streets
Expressway
Highway
Major Road
Local Road
Streams
Minor Streams
Water Bodies
Drains Directly to Tar River
Hardee Creek Watershed Master Plan
Appendix C-1
Primary System Watersheds
0
1,500
3,000
6,000
1 inch = 3,000 feet
Greenville
NORTH CAROLINA
WK DICKSON
TAR RIVER
Barber Creek
Bell Branch
Meeting House Branch
Bates Branch
Juniper Branch
York Rd
Portertown Rd
Firetower Rd
Kittrell Rd
HC-9a
HC-8a
HC-8b
HC-8c
HC-7a
HC-7c
HC-7b
HC-6
HCUT-5
HCUT-4
HC-5b
HC-5c
HC-4b
HC-4a
HCUT-2
HCUT-3
HCUT-1
HC-5a
HC-3c
HC-2c
HC-3a
HC-3b
HC-1d
HC-2b
HC-2a
HC-1c
HC-1b
HC-1a
N


Legend
ETJ
City of Greenville
Hardee Creek Watershed
Streets
Expressway
Highway
Major Road
Local Road
Streams
Minor Streams
Water Bodies
Existing Landuse
Right of Way
Commercial
Mixed Use/Office/Institutional
Medical Core
Office/Institutional/Multi-Family
High Density Residential
Medium Density Residential
Low Density Residential
Very Low Density Residential
Conservation/Open Space
Agricultural/Cropland
Open Water
Drains Directly to Tar River
Hardee Creek Watershed Master Plan
Appendix C-2
Existing Land Use Map
0
1,500
3,000
6,000
1 inch = 3,000 feet
Greenville
NORTH CAROLINA
WK DICKSON
Tar River
Barber Creek
Tar River
Hardee Creek
York Rd
King George Rd
Portertown Rd
Juniper Branch
33
43
N


Legend
ETJ
City of Greenville
Hardee Creek Watershed
Streets
Expressway
Highway
Major Road
Local Road
Streams
Minor Streams
Water Bodies
Existing Landuse
Right of Way
Commercial
Mixed Use/Office/Institutional
Medical Core
Office/Institutional/Medical
Office/Institutional/Multi-Family
High Density Residential
Medium Density Residential
Low Density Residential
Very Low Density Residential
Conservation/Open Space
Drains Directly to Tar River
Hardee Creek Watershed Master Plan
Appendix C-3
Future Land Use Map
0
1,500
3,000
6,000
1 inch = 3,000 feet
Greenville
NORTH CAROLINA
WK DICKSON
TAR RIVER
Barber Creek
TAR RIVER
TAR RIVER
Hardee Creek
Juniper Branch
York Rd
King George Rd
Portertown Rd
Firetower Rd
Charles Blvd
Kittrell Rd
Firetower Rd
264
33
43
N


Legend
Hardee Creek Watershed
Streets
Expressway
Highway
Major Road
Local Road
Streams
Minor Streams
Water Bodies
Hydrologic Soil Group
A
A/D
B
B/D
C
C/D
D
Hardee Creek Watershed Master Plan
Appendix C-4
Soils Map
0
1,500
3,000
6,000
1 inch = 3,000 feet
Greenville
NORTH CAROLINA
WK DICKSON
TAR RIVER
Barber Creek
TAR RIVER
TAR RIVER
Bell Branch
York Rd
King George Rd
Meeting House Branch
Hardee Creek
Portertown Rd
14Th St
Firetower Rd
Kittrell Rd
Bates Branch
Juniper Branch
64
33
43
N

Appendix D:

Citizen Input

List of Contents:

1. General Survey Results (Table D-1)
2. Frequency and Location of Flooding Question Responses (Table D-2)
3. Impacted/Threatened by Erosion (Table D-3)
4. City Funds Utilization (Table D-4)
5. Greenville Watershed Master Plans Questionnaire
6. Hardee Creek Public Meeting Minutes

Table D-1: General Survey Results

Survey Question Number	Question	Survey Response		
		Yes	No	Maybe
1	Have you ever experienced flooding on your system property during a (non-Hurricane) storm?	5	10	-
4	Have you ever noticed flooded streets in your neighborhood?	9	4	-
5	Has flooding increased on your property due to changes on nearby properties or drainage systems?	2	11	-
6	Have you had any erosion on your property associated with a stream or drainage ditch?	6	7	-
8	Are you aware that the City of Greenville is currently analyzing and looking for possible solutions to erosion, flooding and water quality issues throughout the City with a watershed master planning process?	8	6	-
9	If a cost-sharing program was made available along with training, would you be willing to install a project such as a rain garden, cistern, backyard wetland, etc. to help improve water quality in your area?	7	1	6
10	Are you aware of how the City of Greenville currently spends or utilizes its stormwater utility fee?	3	10	-

Table D-2: Frequency and Location of Flooding Question Responses (Question 2)

Frequency of Flooding	Flooding Location						
	Storage Building	AC Unit	Crawl Space	Living Space	Yard flooding from stream/ditch	Yard flooding from street runoff	Yard flooding from adjacent property
Never	4	4	3	4	2	2	3
Less than once per year	-	-	1	1	1	-	-
Once per year	1	-	-	-	-	-	-
2-3 times per year	-	1	2	1	1	1	-
More than 3 times per year	-	-	1	-	2	1	1
Every time it rains	-	-	-	-	1	1	1

Table D-3: Impacted/Threatened by Erosion (Question 7)

Item	Number of Responses
Street	-
Yard	5
Garage	-
Fence	-
Other	4

Table D-4: How should City utilize funds to address stormwater runoff, erosion and flooding issues? (Question 11)

Item	Number of Responses
Develop cost-share program for installation of water projects to reduce stormwater flows	12
Develop incentives for replanting riparian areas	7
Develop program to address erosion on private property	9
Construct and maintain water quality control practices on private property	6
Stream restoration	6
Buyout of flood-prone properties	2
Other	2

Greenville
NORTH CAROLINA
Find yourself in good company

GREENVILLE WATERSHED MASTER PLANS
QUESTIONNAIRE

The City of Greenville's Stormwater Management Program is conducing a citywide study to identify flooding, erosion, and water quality concerns. Your answers will help us target our efforts. Please take this brief survey to let us know what you are experiencing. Thank you for your participation!

1. Have you ever experienced flooding on your property during a (non-Hurricane) storm? ❑ Yes ❑ No
   If yes, please provide the address where this flooding is occurring.
   _____

2. If yes, which of the following would apply and what is the frequency?

   ❑ Water in storage building _____
   ❑ Water on air condition units_____
   ❑ Water in crawl space _____
   ❑ Water up to, or in the living space _____
   ❑ Yard flooding from stream/ditch _____
   ❑ Yard flooding from street runoff _____
   ❑ Yard flooding from adjacent property _____

   FREQUENCY
   A Less than once a year
   B Once a year
   C 2-3 times a year
   D More than 3 times a year

3. List dates, locations, and depth of water *(ex: On May 10, 2014, at my mailbox it was 2 feet deep)*
   _____
   _____
   _____

4. Have you ever noticed flooded streets in your neighborhood? ❑ Yes ❑ No
   If yes, tell us when, the locations, and depth of water.
   _____
   _____

5. Has flooding increased on your property due to any changes on nearby properties or drainage systems? If yes, what were those changes and the approximate timeframe?
   ❑ Yes ❑ No
   _____

6. Have you had any erosion on your property associated with a stream or drainage ditch? ❑ Yes ❑ No

7. If yes, which of the following are impacted or threatened by erosion ❑ Street ❑ Yard
   ❑ Building/House ❑ Fence
   ❑ Other _____

Over To Continue

8. Are you aware that the City of Greenville is currently analyzing and looking for possible solutions to flooding, erosion, and water quality issues throughout the City with a watershed master planning process?
   ❑ Yes ❑ No

9. If a cost-sharing program was made available along with training, would you be willing to install a project such as a rain garden, cistern, backyard wetland, etc. to help improve water quality in your area?
   ❑ Yes ❑ No ❑ Maybe

10. Are you aware of how the City of Greenville currently spends or utilizes its stormwater utility fee?
    ❑ Yes ❑ No

11. In what ways should the City of Greenville utilize funds to address excessive stormwater runoff, erosion and flooding issues throughout the City? (Check all that apply)

    Examples include the following:
    - ❑ Develop cost-sharing program for installation of projects to reduce stormwater flows
    - ❑ Develop incentives for replanting areas adjacent to streams
    - ❑ Construct and maintain regional detention facilities on public properties
    - ❑ Construct and maintain water quality facilities on public properties
    - ❑ Stream restoration
    - ❑ Buyout of flood prone properties
    - ❑ Other _____

12. Is there anything else you would like for us to know about water quality issues in your area?
    _____
    _____

May we contact you if we need additional information about flooding and erosion in your area?

Name: _____

Property Address: _____

Primary Residence or Business (if different from Property Address): _____

Phone # (if needed for a response by the City): _____

How long have you been at this location?_____

To Send This Comment Form

Direct Mail:
Greenville Watershed Master Plans
c/o The Wooten Company
301 West 14th Street
Greenville, NC 27834
FAX: 252-757-3221
E-Mail:wsmp@greenvillenc.gov

MEETING MINUTES

WK DICKSON
community infrastructure consultants

720 Corporate Center Drive, Raleigh, North Carolina 27607 919.782.0495

City of Greenville - Stormwater Master Plan

Hardee Creek Public Meeting on November 4, 2014

Port Terminal Building Greenville, NC

4:30 pm – 5:30 pm

Meeting Attendees:

Name	Role	Organization
City of Greenville		
Amanda Boone	Stormwater Engineer	City of Greenville
Scott Godefroy	City Engineer	City of Greenville
Victor Long	Engineering Assistant II	City of Greenville
WK Dickson Team		
Tom Murray	Project Manager	WK Dickson
Stefani Barlow	GIS/Inventory	WK Dickson
David Kiker	Technical Manager	WK Dickson
PEQ Team		
Inga Kennedy	Public Outreach	PEQ
Marla Hill	Public Outreach	PEQ

Citizen Input:

- 115 Lakeview Dr – Jeff
  - Lake Glenwood causes floods during frequent events
  - Private lake, in city ETJ
  - Residents are responsible for controlling lake levels during rain events
  - Neighbors that experience backyard flooding during storms are 114, 115, and 117 Lakeview Dr although they expect there are more
  - Installation of detention ponds at Walmart ~2 years ago made flooding problems better, but they are concerned that city development upstream will make problems worse
  - Suspects culvert on Leon Rd is not properly sized.
  - Some spillway erosion at Eastern Pines Road where the lake dam is located
  - Eastern Pines Road only washed out during Hurricane Floyd
  - Wanted to identify funding sources for dam replacement project

- Port Terminal Rd - Koehler Queen
  - Former city employee, now retired, was around during Hurricane Floyd. The historical flooding accounts are mainly from this event. The Port Terminal Road area does not have much of a history of flooding in non-Floyd events.
  - #1 – Koehler saw Floyd reached elevation 22 or 23 feet which came halfway up Port Terminal Road.
  - #2 – Koehler has seen the parking lot under water on three (3) separate occasions. The boat ramp completely overtops approximately once per year.
  - #3 – The road here overtopped during Floyd, and has not seen a problem before or since.
  - #4 – The road here overtopped during Floyd but Koehler has never seen it have a problem before or since.
  - #5 – Water was at least 6 feet into the community center at 920 Port Terminal Road.
  - #6 – Riser/barrel/culvert fixed after Floyd. No problems since.

- Sir Hugh Court - Bill Koch
  - Bill has lived at this address for 18 years. Bill sees Leon Rd and Hardee flood approximately once per year. The roadside ditches completely fill in however the road does not flood.

- 104 Lakeview Drive
  - Dredging channel downstream of Pineridge Drive to Lake Glenwood
  - Owned house approximately 5 years. No recent flooding, there are water marks in the garage. Past flooding indicates water was approximately 4 steps up at front of house

and in the garage, but no finished floor flooding. Water was approximately 2 feet deep at the shed. Flooding noted above occurred during Hurricane Floyd.

- Lake Glenwood can be lowered by residents in anticipation of storm events.
- Standing water collects at intersection of Pineridge Drive and Lakeview Road. The culdesac at the end of Lakeview Road has standing water as well during storm events and can take a couple of days to dissipate.

Appendix E:

SCS Hydrology Calculations

List of Contents:

SCS Runoff Curve Number - Primary System

Project: City of Greenville - Hardee Creek Watershed

Conditions: Existing

Prepared by: EVH

Checked by: DJK

Date: August 6, 2015

Subbasin: HC - 1A

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	2.4	0.004	203
Right-Of-Way	B	89	1.2	0.002	103
Right-Of-Way	B/D	89	2.6	0.004	235
Right-Of-Way	C	92	11.1	0.017	1025
Right-Of-Way	D	93	0.9	0.001	84
Commercial	B	92	0.2	0.000	21
Commercial	B/D	92	0.1	0.000	13
Commercial	C	94	7.3	0.011	690
Commercial	D	95	7.5	0.012	717
Medium Density Residential	D	85	0.5	0.001	39
Low Density Residential	A	51	9.2	0.014	467
Low Density Residential	B	68	2.1	0.003	144
Low Density Residential	B/D	68	12.4	0.019	842
Low Density Residential	C	79	34.4	0.054	2719
Low Density Residential	D	84	33.0	0.052	2773
Very Low Density Residential	A	49	0.9	0.001	42
Very Low Density Residential	B	69	5.2	0.008	358
Very Low Density Residential	B/D	69	2.5	0.004	170
Very Low Density Residential	C	79	39.3	0.061	3103
Very Low Density Residential	D	84	33.1	0.052	2783
Conservation/Open Space	A	39	0.4	0.001	15
Conservation/Open Space	B	61	8.7	0.014	533
Conservation/Open Space	B/D	61	59.4	0.093	3620
Conservation/Open Space	C	74	75.2	0.118	5567
Conservation/Open Space	D	80	7.6	0.012	605
Agricultural/Cropland	B/D	61	4.2	0.007	257
Agricultural/Cropland	C	74	2.8	0.004	209
		Totals =	364.31	0.569	27337.3

Total (weighted) RCN = total product/total area = 75.04

RCN used = 75

Subbasin: HC - 1B

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	0.5	0.001	44
Right-Of-Way	B	89	4.1	0.006	365
Right-Of-Way	B/D	89	1.6	0.003	146
Right-Of-Way	C	92	7.2	0.011	663
Right-Of-Way	D	93	3.9	0.006	367
Commercial	B	92	4.9	0.008	451
Commercial	B/D	92	1.5	0.002	139
Commercial	C	94	5.9	0.009	553
Commercial	D	95	3.5	0.005	333
Medium Density Residential	B	70	5.2	0.008	361
Medium Density Residential	B/D	70	0.3	0.001	23
Medium Density Residential	C	80	6.4	0.010	512
Medium Density Residential	D	85	3.0	0.005	259
Low Density Residential	A	51	1.6	0.003	84
Low Density Residential	B	68	2.5	0.004	171
Low Density Residential	B/D	68	3.3	0.005	224
Low Density Residential	C	79	11.6	0.018	920
Low Density Residential	D	84	4.6	0.007	387
Very Low Density Residential	A	49	2.2	0.004	110
Very Low Density Residential	B	69	19.6	0.031	1355
Very Low Density Residential	B/D	69	18.9	0.029	1301
Very Low Density Residential	C	79	27.0	0.042	2130
Very Low Density Residential	D	84	12.2	0.019	1024
Conservation/Open Space	A	39	4.2	0.007	165
Conservation/Open Space	B	61	40.6	0.063	2475
Conservation/Open Space	B/D	61	49.3	0.077	3009
Conservation/Open Space	C	74	83.2	0.130	6160
Conservation/Open Space	D	80	41.6	0.065	3329
Agricultural/Cropland	B	61	6.3	0.010	382
Agricultural/Cropland	C	74	0.0	0.000	0
Agricultural/Cropland	D	80	0.8	0.001	66
		Totals =	377.84	0.590	27508.5

Total (weighted) RCN = total product/total area = 72.81

RCN used = 73

Subbasin: HC - 1C

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	7.4	0.012	614
Right-Of-Way	B	89	8.9	0.014	788
Right-Of-Way	B/D	89	2.0	0.003	174
Right-Of-Way	C	92	8.6	0.014	795
Right-Of-Way	D	93	1.7	0.003	159
Commercial	B	92	2.1	0.003	191
Commercial	B/D	92	5.8	0.009	538
Commercial	C	94	2.9	0.005	274
Commercial	D	95	3.4	0.005	322
Medium Density Residential	A	54	0.1	0.000	7
Medium Density Residential	B	70	0.4	0.001	26
Medium Density Residential	B/D	70	2.9	0.005	206
Medium Density Residential	C	80	6.6	0.010	530
Medium Density Residential	D	85	0.7	0.001	60
Low Density Residential	A	51	31.5	0.049	1608
Low Density Residential	B	68	36.9	0.058	2506
Low Density Residential	B/D	68	0.9	0.001	58
Low Density Residential	C	79	37.1	0.058	2931
Low Density Residential	D	84	5.9	0.009	497
Very Low Density Residential	A	49	2.8	0.004	137
Very Low Density Residential	B	69	17.1	0.027	1182
Very Low Density Residential	B/D	69	3.4	0.005	234
Very Low Density Residential	C	79	13.6	0.021	1077
Very Low Density Residential	D	84	3.4	0.005	285
Conservation/Open Space	A	39	10.7	0.017	416
Conservation/Open Space	B	61	18.1	0.028	1104
Conservation/Open Space	B/D	61	4.6	0.007	283
Conservation/Open Space	C	74	42.3	0.066	3132
Conservation/Open Space	D	80	27.2	0.042	2173
Agricultural/Cropland	A	39	5.5	0.009	214
Agricultural/Cropland	B	61	38.4	0.060	2343
Agricultural/Cropland	B/D	61	1.6	0.002	95
Agricultural/Cropland	C	74	26.9	0.042	1990
Agricultural/Cropland	D	80	5.0	0.008	401
		Totals =	386.40	0.604	27350.1

Total (weighted) RCN = total product/total area = 70.78

RCN used = 71

Subbasin: HC - 1D

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	8.4	0.013	694
Right-Of-Way	C	92	4.0	0.006	371
Right-Of-Way	D	93	4.9	0.008	460
Medium Density Residential	A	54	11.3	0.018	608
Medium Density Residential	C	80	10.6	0.017	847
Medium Density Residential	D	85	3.5	0.005	295
Low Density Residential	A	51	23.8	0.037	1216
Low Density Residential	B	68	0.0	0.000	0
Low Density Residential	C	79	9.3	0.015	734
Low Density Residential	D	84	6.7	0.010	560
Very Low Density Residential	A	49	4.5	0.007	222
Very Low Density Residential	C	79	1.3	0.002	100
Very Low Density Residential	D	84	1.7	0.003	141
Conservation/Open Space	A	39	12.3	0.019	479
Conservation/Open Space	C	74	13.2	0.021	977
Conservation/Open Space	D	80	4.0	0.006	321
		Totals =	119.46	0.187	8026.7

Total (weighted) RCN = total product/total area = 67.19

RCN used = 67

Subbasin: HC - 2A

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	0.8	0.001	67
Right-Of-Way	B	89	2.8	0.004	247
Right-Of-Way	B/D	89	9.1	0.014	806
Right-Of-Way	C	92	7.3	0.011	672
Right-Of-Way	D	93	0.4	0.001	34
Commercial	B	92	0.0	0.000	2
High Density Residential	B	75	8.9	0.014	665
High Density Residential	B/D	75	19.0	0.030	1425
High Density Residential	C	83	7.5	0.012	619
Medium Density Residential	B	70	2.5	0.004	177
Medium Density Residential	B/D	70	0.7	0.001	51
Medium Density Residential	C	80	3.1	0.005	245
Low Density Residential	B	69	0.0	0.000	2
Low Density Residential	B/D	69	13.1	0.020	904
Low Density Residential	C	79	3.0	0.005	236
Very Low Density Residential	B	69	9.0	0.014	618
Very Low Density Residential	B/D	69	16.1	0.025	1114
Very Low Density Residential	C	79	16.3	0.025	1289
Very Low Density Residential	D	84	1.7	0.003	147
Conservation/Open Space	A	39	0.7	0.001	26
Conservation/Open Space	B	61	14.6	0.023	889
Conservation/Open Space	B/D	61	31.7	0.050	1933
Conservation/Open Space	C	74	75.2	0.118	5568
Conservation/Open Space	D	80	20.5	0.032	1638
Agricultural/Cropland	B	61	2.9	0.005	179
Agricultural/Cropland	B/D	61	0.4	0.001	27
Agricultural/Cropland	C	74	10.3	0.016	764
Agricultural/Cropland	D	80	0.6	0.001	47
		Totals =	278.22	0.435	20393.2

Total (weighted) RCN = total product/total area = 73.30

RCN used = 73

Subbasin: HC - 2B

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	1.8	0.003	152
Right-Of-Way	B	89	2.9	0.005	258
Right-Of-Way	B/D	89	1.5	0.002	130
Right-Of-Way	C	92	11.1	0.017	1017
Right-Of-Way	D	93	0.4	0.001	40
Commercial	B	92	0.0	0.000	0
Commercial	C	94	1.6	0.003	154
Medium Density Residential	A	54	5.2	0.008	281
Medium Density Residential	B	70	5.9	0.009	411
Medium Density Residential	C	80	26.6	0.042	2130
Medium Density Residential	D	85	4.1	0.006	352
Low Density Residential	A	51	4.0	0.006	202
Low Density Residential	B	68	6.2	0.010	425
Low Density Residential	B/D	69	12.9	0.020	893
Low Density Residential	C	79	14.4	0.022	1135
Low Density Residential	D	84	2.4	0.004	198
Very Low Density Residential	A	49	0.6	0.001	28
Very Low Density Residential	B	69	0.4	0.001	30
Very Low Density Residential	B/D	69	6.0	0.009	416
Very Low Density Residential	C	79	8.6	0.013	680
Very Low Density Residential	D	84	0.4	0.001	34
Conservation/Open Space	A	39	2.0	0.003	79
Conservation/Open Space	B	61	15.7	0.025	957
Conservation/Open Space	B/D	61	12.0	0.019	732
Conservation/Open Space	C	74	39.3	0.061	2908
Conservation/Open Space	D	80	0.7	0.001	59
Agricultural/Cropland	B	61	16.1	0.025	982
Agricultural/Cropland	B/D	61	9.6	0.015	584
Agricultural/Cropland	C	74	3.8	0.006	281
Agricultural/Cropland	D	80	5.3	0.008	420
		Totals =	221.56	0.346	15968.9

Total (weighted) RCN = total product/total area = 72.07

RCN used = 72

Subbasin: HC - 2C

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	12.3	0.019	1021
Right-Of-Way	B	89	4.2	0.007	374
Right-Of-Way	C	92	23.4	0.037	2155
Right-Of-Way	D	93	0.3	0.001	31
Commercial	A	89	0.0	0.000	2
Commercial	C	94	2.6	0.004	241
Medium Density Residential	A	54	25.2	0.039	1363
Medium Density Residential	C	80	7.8	0.012	623
Medium Density Residential	D	85	8.6	0.013	729
Low Density Residential	A	51	60.4	0.094	3081
Low Density Residential	B	68	13.1	0.021	894
Low Density Residential	C	79	121.4	0.190	9588
Low Density Residential	D	84	11.0	0.017	922
Very Low Density Residential	A	49	3.8	0.006	187
Very Low Density Residential	B	69	0.2	0.000	15
Very Low Density Residential	C	79	6.7	0.010	529
Very Low Density Residential	D	84	1.7	0.003	141
Conservation/Open Space	A	39	0.2	0.000	8
Conservation/Open Space	B	61	0.0	0.000	3
Conservation/Open Space	C	74	1.7	0.003	123
Conservation/Open Space	D	80	1.0	0.002	82
Agricultural/Cropland	B	61	0.0	0.000	0
		Totals =	305.69	0.478	22111.2

Total (weighted) RCN = total product/total area = 72.33

RCN used = 72

Subbasin: HC - 3A

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	11.3	0.018	939
Right-Of-Way	A/D	83	1.3	0.002	106
Right-Of-Way	B	89	3.5	0.006	314
Right-Of-Way	B/D	89	3.5	0.005	307
Right-Of-Way	C	92	20.3	0.032	1868
Right-Of-Way	D	93	3.1	0.005	289
Commercial	A	89	0.0	0.000	3
Commercial	A/D	89	1.5	0.002	131
Commercial	C	94	0.6	0.001	60
Commercial	D	95	0.0	0.000	3
Mixed Use/Office/Institutional	B	85	2.6	0.004	217
Mixed Use/Office/Institutional	C	90	0.3	0.000	25
Mixed Use/Office/Institutional	D	92	2.5	0.004	226
Low Density Residential	A	51	45.8	0.072	2338
Low Density Residential	A/D	51	10.8	0.017	551
Low Density Residential	B	68	14.4	0.022	979
Low Density Residential	B/D	68	16.4	0.026	1116
Low Density Residential	C	79	119.0	0.186	9402
Low Density Residential	D	84	25.0	0.039	2100
Very Low Density Residential	A	49	6.3	0.010	310
Very Low Density Residential	A/D	49	6.1	0.010	299
Very Low Density Residential	B	69	3.9	0.006	271
Very Low Density Residential	B/D	69	11.2	0.018	776
Very Low Density Residential	C	79	21.4	0.033	1688
Very Low Density Residential	D	84	5.9	0.009	499
Conservation/Open Space	A	39	21.8	0.034	852
Conservation/Open Space	A/D	39	4.4	0.007	172
Conservation/Open Space	B	61	17.4	0.027	1061
Conservation/Open Space	B/D	61	31.2	0.049	1903
Conservation/Open Space	C	74	47.6	0.074	3524
Conservation/Open Space	D	80	19.7	0.031	1575
Agricultural/Cropland	A	39	2.8	0.004	109
Agricultural/Cropland	C	74	2.1	0.003	153
Agricultural/Cropland	D	80	1.5	0.002	120
		Totals =	485.30	0.758	34283.8

Total (weighted) RCN = total product/total area = 70.64

RCN used = 71

Subbasin: HC - 3B

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	4.5	0.007	372
Right-Of-Way	B	89	1.1	0.002	95
Right-Of-Way	B/D	89	0.3	0.001	29
Right-Of-Way	C	92	3.7	0.006	336
Right-Of-Way	D	93	0.2	0.000	23
Mixed Use/Office/Institutional	A	77	0.6	0.001	48
Mixed Use/Office/Institutional	B	85	0.0	0.000	0
Mixed Use/Office/Institutional	C	90	0.6	0.001	53
Medium Density Residential	A	54	0.2	0.000	12
Medium Density Residential	C	80	0.3	0.001	26
Low Density Residential	A	51	17.6	0.027	897
Low Density Residential	B	68	3.2	0.005	217
Low Density Residential	B/D	68	7.2	0.011	489
Low Density Residential	C	79	24.0	0.037	1893
Low Density Residential	D	84	5.6	0.009	468
Very Low Density Residential	A	49	10.4	0.016	507
Very Low Density Residential	B	69	0.2	0.000	13
Very Low Density Residential	B/D	69	1.3	0.002	89
Very Low Density Residential	C	79	4.8	0.008	382
Very Low Density Residential	D	84	1.0	0.001	80
Conservation/Open Space	A	39	5.7	0.009	222
Conservation/Open Space	B/D	61	2.2	0.004	137
Conservation/Open Space	C	74	10.9	0.017	809
Conservation/Open Space	D	80	4.4	0.007	356
Agricultural/Cropland	A	39	23.4	0.037	914
Agricultural/Cropland	B	61	2.4	0.004	147
Agricultural/Cropland	B/D	61	3.9	0.006	238
Agricultural/Cropland	C	74	16.0	0.025	1185
Agricultural/Cropland	D	80	3.0	0.005	239
		Totals =	158.72	0.248	10275.4

Total (weighted) RCN = total product/total area = 64.74

RCN used = 65

Subbasin: HC - 3C

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	6.4	0.010	535
Right-Of-Way	C	92	1.1	0.002	102
Right-Of-Way	D	93	0.2	0.000	16
Medium Density Residential	A	54	6.2	0.010	334
Medium Density Residential	C	80	1.4	0.002	110
Medium Density Residential	D	85	1.7	0.003	145
Low Density Residential	A	51	32.0	0.050	1634
Low Density Residential	B	68	0.1	0.000	9
Low Density Residential	C	79	10.6	0.017	837
Low Density Residential	D	84	5.2	0.008	440
Very Low Density Residential	A	49	3.9	0.006	191
Very Low Density Residential	C	79	0.4	0.001	31
Very Low Density Residential	D	84	2.4	0.004	206
Conservation/Open Space	A	39	7.9	0.012	310
Conservation/Open Space	C	74	15.5	0.024	1150
Conservation/Open Space	D	80	5.5	0.009	441
Agricultural/Cropland	A	39	12.9	0.020	501
Agricultural/Cropland	B	61	6.8	0.011	415
Agricultural/Cropland	C	74	7.7	0.012	568
Agricultural/Cropland	D	80	0.6	0.001	51
		Totals =	128.71	0.201	8026.9

Total (weighted) RCN = total product/total area = 62.36

RCN used = 62

Subbasin: HC - 4A

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	10.0	0.016	827
Right-Of-Way	A/D	83	0.9	0.001	74
Right-Of-Way	B	89	2.6	0.004	234
Right-Of-Way	C	92	11.2	0.017	1029
Right-Of-Way	D	93	2.1	0.003	195
Commercial	A	89	2.8	0.004	246
Commercial	C	94	1.8	0.003	165
Mixed Use/Office/Institutional	A	77	2.0	0.003	153
Mixed Use/Office/Institutional	C	90	0.2	0.000	20
Medium Density Residential	A	54	0.0	0.000	0
Medium Density Residential	A/D	54	2.6	0.004	140
Medium Density Residential	B	70	2.5	0.004	173
Medium Density Residential	C	80	2.9	0.005	236
Low Density Residential	A	51	38.6	0.060	1971
Low Density Residential	A/D	51	0.9	0.001	46
Low Density Residential	B	68	6.3	0.010	430
Low Density Residential	B/D	68	0.3	0.000	21
Low Density Residential	C	79	35.1	0.055	2774
Low Density Residential	D	84	10.1	0.016	846
Very Low Density Residential	A	49	2.5	0.004	122
Very Low Density Residential	B	69	6.8	0.011	469
Very Low Density Residential	C	79	8.8	0.014	695
Very Low Density Residential	D	84	3.7	0.006	308
Conservation/Open Space	A	39	10.3	0.016	402
Conservation/Open Space	C	74	7.1	0.011	522
Conservation/Open Space	D	80	4.3	0.007	340
Agricultural/Cropland	A	39	5.5	0.009	216
Agricultural/Cropland	C	74	8.4	0.013	623
Agricultural/Cropland	D	80	0.1	0.000	9
		Totals =	190.31	0.297	13286.8

Total (weighted) RCN = total product/total area = 69.82

RCN used = 70

Subbasin: HC - 4B

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	7.7	0.012	636
Right-Of-Way	B	89	0.6	0.001	56
Right-Of-Way	B/D	89	1.2	0.002	105
Right-Of-Way	C	92	8.2	0.013	754
Right-Of-Way	D	93	1.7	0.003	155
Low Density Residential	A	51	39.5	0.062	2017
Low Density Residential	B	68	0.7	0.001	48
Low Density Residential	B/D	68	2.8	0.004	191
Low Density Residential	C	79	28.5	0.045	2255
Low Density Residential	D	84	12.1	0.019	1019
Very Low Density Residential	A	49	3.0	0.005	148
Very Low Density Residential	B	69	0.0	0.000	0
Very Low Density Residential	C	79	1.6	0.003	128
Very Low Density Residential	D	84	0.5	0.001	39
Conservation/Open Space	A	39	11.9	0.019	466
Conservation/Open Space	B	61	1.5	0.002	94
Conservation/Open Space	C	74	15.4	0.024	1142
Agricultural/Cropland	A	39	3.3	0.005	128
Agricultural/Cropland	B	61	0.0	0.000	0
Agricultural/Cropland	C	74	4.2	0.007	309
Agricultural/Cropland	D	80	1.5	0.002	118
Water	N/A	100	13.5	0.021	1354
		Totals =	159.54	0.249	11159.4

Total (weighted) RCN = total product/total area = 69.95

RCN used = 70

Subbasin: HC - 5A

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	7.1	0.011	593
Right-Of-Way	B	89	0.9	0.001	81
Right-Of-Way	C	92	1.0	0.002	93
Low Density Residential	A	51	20.4	0.032	1038
Low Density Residential	B	68	1.7	0.003	115
Low Density Residential	C	79	3.1	0.005	247
Low Density Residential	D	84	3.9	0.006	324
Very Low Density Residential	A	49	10.2	0.016	501
Very Low Density Residential	C	79	3.1	0.005	242
Very Low Density Residential	D	84	7.4	0.012	619
Conservation/Open Space	A	39	4.6	0.007	179
Conservation/Open Space	B	61	3.5	0.006	216
Conservation/Open Space	C	74	1.9	0.003	143
Conservation/Open Space	D	80	5.1	0.008	408
Agricultural/Cropland	A	39	9.5	0.015	370
Agricultural/Cropland	B	61	4.4	0.007	266
Agricultural/Cropland	C	74	17.6	0.027	1301
Agricultural/Cropland	D	80	0.0	0.000	2
		Totals =	105.34	0.165	6736.3

Total (weighted) RCN = total product/total area = 63.95

RCN used = 64

Subbasin: HC - 5B

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	5.1	0.008	422
Right-Of-Way	B	89	0.3	0.001	30
Right-Of-Way	C	92	0.8	0.001	71
Right-Of-Way	D	93	0.5	0.001	49
High Density Residential	A	61	0.2	0.000	14
High Density Residential	B	75	0.2	0.000	13
High Density Residential	D	87	0.1	0.000	11
Medium Density Residential	A	54	5.7	0.009	310
Medium Density Residential	B	70	0.3	0.001	24
Medium Density Residential	C	80	1.6	0.003	131
Medium Density Residential	D	85	0.2	0.000	17
Low Density Residential	A	51	13.6	0.021	694
Low Density Residential	B	68	5.1	0.008	347
Low Density Residential	C	79	0.1	0.000	12
Low Density Residential	D	84	2.8	0.004	237
Very Low Density Residential	A	49	0.4	0.001	20
Very Low Density Residential	D	84	1.3	0.002	106
Conservation/Open Space	A	39	0.6	0.001	23
Conservation/Open Space	B	61	0.2	0.000	11
Conservation/Open Space	C	74	0.0	0.000	3
Conservation/Open Space	D	80	1.8	0.003	147
		Totals =	41.19	0.064	2692.5

Total (weighted) RCN = total product/total area = 65.37

RCN used = 65

Subbasin: HC - 5C

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
	Soil		Area	Area	Product of
Landuse	Group	RCN	(Acres)	(Sq. Mi.)	RCN and Area
Right-Of-Way	A	83	12.8	0.020	1062
Right-Of-Way	B	89	1.8	0.003	163
Right-Of-Way	C	92	2.3	0.004	210
Right-Of-Way	D	93	0.5	0.001	43
Commercial	A	89	0.7	0.001	63
High Density Residential	A	61	13.0	0.020	791
High Density Residential	B	75	0.4	0.001	30
High Density Residential	C	83	3.2	0.005	262
High Density Residential	D	87	0.6	0.001	52
Medium Density Residential	A	54	6.0	0.009	322
Medium Density Residential	B	70	5.5	0.009	385
Medium Density Residential	C	80	0.3	0.000	21
Medium Density Residential	D	85	1.5	0.002	125
Low Density Residential	A	51	23.5	0.037	1200
Low Density Residential	B	68	0.2	0.000	15
Low Density Residential	C	79	1.7	0.003	138
Low Density Residential	D	84	2.4	0.004	199
Very Low Density Residential	A	49	9.1	0.014	443
Very Low Density Residential	C	79	1.1	0.002	85
Very Low Density Residential	D	84	3.5	0.005	290
Conservation/Open Space	A	39	3.4	0.005	132
Conservation/Open Space	B	61	3.6	0.006	219
Conservation/Open Space	C	74	5.7	0.009	421
Conservation/Open Space	D	80	4.1	0.006	328
Agricultural/Cropland	A	39	5.4	0.008	210
Agricultural/Cropland	C	74	0.8	0.001	60
Agricultural/Cropland	D	80	1.3	0.002	107
		Totals =	114.17	0.178	7378.6

Total (weighted) RCN = total product/total area = 64.63

RCN used = 65

Subbasin: HC - 6

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
	Soil		Area	Area	Product of
Landuse	Group	RCN	(Acres)	(Sq. Mi.)	RCN and Area
Right-Of-Way	A	83	6.6	0.010	550
Right-Of-Way	B	89	1.3	0.002	114
Right-Of-Way	C	92	2.0	0.003	185
Right-Of-Way	D	93	0.3	0.000	27
Office/Institutional/Multi-Family	A	77	0.0	0.000	4
Office/Institutional/Multi-Family	B	85	0.4	0.001	38
High Density Residential	A	61	6.3	0.010	383
High Density Residential	B	75	4.2	0.007	312
High Density Residential	C	83	7.2	0.011	594
High Density Residential	D	87	4.7	0.007	413
Low Density Residential	A	51	18.3	0.029	934
Low Density Residential	B	68	8.6	0.014	588
Low Density Residential	C	79	0.5	0.001	38
Very Low Density Residential	A	49	0.3	0.000	13
Very Low Density Residential	D	84	0.9	0.001	74
Conservation/Open Space	A	39	21.0	0.033	818
Conservation/Open Space	B	61	0.9	0.001	56
Conservation/Open Space	C	74	1.0	0.002	72
Conservation/Open Space	D	80	7.4	0.012	594
		Totals =	91.93	0.144	5807.6

Total (weighted) RCN = total product/total area = 63.17

RCN used = 63

Subbasin: HC - 7A

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
	Soil		Area	Area	Product of
Landuse	Group	RCN	(Acres)	(Sq. Mi.)	RCN and Area
Right-Of-Way	A	83	0.1	0.000	8
Medium Density Residential	A	54	24.5	0.038	1322
Medium Density Residential	C	80	0.1	0.000	6
Medium Density Residential	D	85	1.5	0.002	128
Conservation/Open Space	A	39	39.6	0.062	1545
Conservation/Open Space	C	74	5.2	0.008	388
Conservation/Open Space	D	80	12.5	0.020	1001
		Totals =	83.54	0.131	4398.8

Total (weighted) RCN = total product/total area = 52.65

RCN used = 53

Subbasin: HC - 7B

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
	Soil		Area	Area	Product of
Landuse	Group	RCN	(Acres)	(Sq. Mi.)	RCN and Area
Right-Of-Way	A	83	9.6	0.015	795
Right-Of-Way	B	89	1.3	0.002	117
Right-Of-Way	C	92	5.8	0.009	532
Right-Of-Way	D	93	0.7	0.001	64
Commercial	A	89	8.7	0.014	770
Commercial	C	94	7.8	0.012	734
Low Density Residential	A	51	2.7	0.004	137
Low Density Residential	C	79	0.0	0.000	1
Very Low Density Residential	A	49	0.8	0.001	39
Conservation/Open Space	A	39	19.7	0.031	767
Conservation/Open Space	B	61	0.5	0.001	30
Conservation/Open Space	C	74	12.3	0.019	911
Conservation/Open Space	D	80	0.6	0.001	50
Agricultural/Cropland	A	39	5.0	0.008	196
Agricultural/Cropland	C	74	14.1	0.022	1042
		Totals =	89.52	0.140	6185.0

Total (weighted) RCN = total product/total area = 69.09

RCN used = 69

Subbasin: HC - 7C

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
	Soil		Area	Area	Product of
Landuse	Group	RCN	(Acres)	(Sq. Mi.)	RCN and Area
Right-Of-Way	A	83	0.3	0.000	24
Low Density Residential	A	51	2.8	0.004	141
Conservation/Open Space	A	39	13.4	0.021	525
Conservation/Open Space	B	61	0.8	0.001	50
Conservation/Open Space	C	74	3.1	0.005	227
Conservation/Open Space	D	80	4.2	0.007	333
		Totals =	24.56	0.038	1300.0

Total (weighted) RCN = total product/total area = 52.93

RCN used = 53

Subbasin: HC - 8A

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
	Soil		Area	Area	Product of
Landuse	Group	RCN	(Acres)	(Sq. Mi.)	RCN and Area
Right-Of-Way	A	83	7.9	0.012	654
Right-Of-Way	B	89	0.8	0.001	75
Right-Of-Way	C	92	1.8	0.003	164
Right-Of-Way	D	93	0.4	0.001	35
Commercial	A	89	2.9	0.005	261
High Density Residential	A	61	0.0	0.000	0
Medium Density Residential	A	54	8.8	0.014	474
Medium Density Residential	B	70	0.1	0.000	5
Medium Density Residential	C	80	3.8	0.006	306
Medium Density Residential	D	85	0.8	0.001	68
Low Density Residential	A	51	3.5	0.006	180
Low Density Residential	C	79	2.3	0.004	179
Low Density Residential	D	84	3.3	0.005	275
Conservation/Open Space	A	39	11.9	0.019	464
Conservation/Open Space	D	80	6.3	0.010	504
		Totals =	54.58	0.085	3645.6

Total (weighted) RCN = total product/total area = 66.80

RCN used = 67

Subbasin: HC - 8B

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
	Soil		Area	Area	Product of
Landuse	Group	RCN	(Acres)	(Sq. Mi.)	RCN and Area
Right-Of-Way	A	83	3.0	0.005	248
Right-Of-Way	C	92	1.2	0.002	113
Commercial	A	89	10.1	0.016	903
Commercial	C	94	8.9	0.014	837
Medical Core	A	89	1.9	0.003	171
Medical Core	C	94	0.2	0.000	17
Medium Density Residential	A	54	13.0	0.020	703
Medium Density Residential	C	80	7.2	0.011	580
Medium Density Residential	D	85	2.3	0.004	198
Low Density Residential	A	51	4.7	0.007	239
Low Density Residential	C	79	0.2	0.000	16
Conservation/Open Space	A	39	5.9	0.009	230
Conservation/Open Space	C	74	1.3	0.002	98
Conservation/Open Space	D	80	0.1	0.000	6
		Totals =	60.15	0.094	4358.4

Total (weighted) RCN = total product/total area = 72.46

RCN used = 72

Subbasin: HC - 8C

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)					
	Soil		Area	Area	Product of
Landuse	Group	RCN	(Acres)	(Sq. Mi.)	RCN and Area
Right-Of-Way	A	83	2.2	0.003	180
Right-Of-Way	C	92	3.0	0.005	272
Medium Density Residential	A	54	1.9	0.003	101
Medium Density Residential	C	80	9.3	0.015	745
Medium Density Residential	D	85	2.7	0.004	226
Low Density Residential	A	51	8.4	0.013	428
Low Density Residential	C	79	10.8	0.017	857
Conservation/Open Space	A	39	31.6	0.049	1234
Conservation/Open Space	C	74	2.8	0.004	209
Conservation/Open Space	D	80	11.1	0.017	887
		Totals =	83.73	0.131	5137.9

Total (weighted) RCN = total product/total area = 61.36

RCN used = 61

Subbasin: HC - 9

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	2.5	0.004	206
Right-Of-Way	A/D	89	0.2	0.000	17
Right-Of-Way	C	92	0.7	0.001	62
Right-Of-Way	D	93	0.9	0.001	81
High Density Residential	A	61	11.3	0.018	691
High Density Residential	C	83	7.3	0.011	609
High Density Residential	D	87	3.1	0.005	268
Medium Density Residential	A	54	0.1	0.000	5
Medium Density Residential	C	80	0.1	0.000	5
Low Density Residential	A	51	1.3	0.002	67
Low Density Residential	C	79	0.0	0.000	2
Low Density Residential	D	84	0.3	0.000	25
Very Low Density Residential	A	49	2.5	0.004	121
Very Low Density Residential	A/D	50	1.5	0.002	77
Very Low Density Residential	C	79	0.7	0.001	54
Very Low Density Residential	D	84	1.0	0.002	82
Conservation/Open Space	A	39	26.6	0.042	1036
Conservation/Open Space	A/D	39	3.9	0.006	150
Conservation/Open Space	C	74	1.9	0.003	142
Conservation/Open Space	D	80	40.7	0.064	3258
Water	N/A	100	7.0	0.011	700
		Totals =	113.46	0.177	7656.7

Total (weighted) RCN = total product/total area = 67.48

RCN used = 67

Subbasin: HCUT - 1

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	3.5	0.006	293
Right-Of-Way	B	89	0.6	0.001	55
Right-Of-Way	C	92	5.6	0.009	520
Medium Density Residential	A	54	13.4	0.021	724
Medium Density Residential	B	70	1.0	0.002	73
Medium Density Residential	C	80	24.3	0.038	1940
Low Density Residential	A	51	1.9	0.003	99
Low Density Residential	C	79	0.2	0.000	12
Very Low Density Residential	A	49	0.1	0.000	4
Very Low Density Residential	C	79	0.0	0.000	1
		Totals =	50.67	0.079	3720.3

Total (weighted) RCN = total product/total area = 73.42

RCN used = 73

Subbasin: HCUT - 2

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	0.4	0.001	33
Right-Of-Way	C	92	0.1	0.000	8
Medium Density Residential	A	54	2.4	0.004	131
Medium Density Residential	C	80	1.4	0.002	113
Low Density Residential	A	51	7.8	0.012	398
Low Density Residential	C	79	3.5	0.005	277
Very Low Density Residential	A	49	0.1	0.000	6
Very Low Density Residential	C	79	0.1	0.000	10
Water	N/A	100	0.1	0.000	10
		Totals =	15.98	0.025	986.1

Total (weighted) RCN = total product/total area = 61.69

RCN used = 62

Subbasin: HCUT - 3

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	1.2	0.002	102
Low Density Residential	A	51	15.9	0.025	810
Low Density Residential	C	79	6.1	0.009	479
Low Density Residential	D	84	0.4	0.001	31
Very Low Density Residential	A	49	1.2	0.002	58
Very Low Density Residential	C	79	0.1	0.000	8
Conservation/Open Space	A	39	0.4	0.001	17
Conservation/Open Space	D	80	0.0	0.000	2
Water	N/A	100	3.3	0.005	328
		Totals =	28.58	0.045	1835.2

Total (weighted) RCN = total product/total area = 64.22

RCN used = 64

Subbasin: HCUT - 4

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	1.3	0.002	107
Right-Of-Way	C	92	0.1	0.000	7
Right-Of-Way	D	93	0.1	0.000	7
Low Density Residential	A	51	13.0	0.020	663
Low Density Residential	C	79	2.4	0.004	193
Low Density Residential	D	84	0.4	0.001	34
Very Low Density Residential	A	49	0.3	0.000	14
Very Low Density Residential	D	84	0.6	0.001	48
Conservation/Open Space	A	39	1.1	0.002	42
Conservation/Open Space	C	74	0.2	0.000	14
Conservation/Open Space	D	80	0.2	0.000	12
Water	N/A	100	1.0	0.002	97
		Totals =	20.55	0.032	1238.8

Total (weighted) RCN = total product/total area = 60.28

RCN used = 60

Subbasin: HCUT - 5

For Conservation/Open Space and Agricultural/Cropland used CNs for Open Space(Good Condition)

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	1.4	0.002	115
Right-Of-Way	C	92	0.1	0.000	6
Right-Of-Way	D	93	0.0	0.000	3
Low Density Residential	A	51	6.5	0.010	332
Low Density Residential	C	79	0.1	0.000	11
Low Density Residential	D	84	0.4	0.001	33
Conservation/Open Space	A	39	2.8	0.004	109
Conservation/Open Space	C	74	0.2	0.000	16
Conservation/Open Space	D	80	0.6	0.001	47
Water	N/A	100	0.8	0.001	77
		Totals =	12.87	0.020	747.9

Total (weighted) RCN = total product/total area = 58.11

RCN used = 58

SCS Runoff Curve Number - Primary System

Project: City of Greenville - Hardee Creek Watershed

Conditions: Future

Prepared by: SMB

Checked by: DJK

Date: August 6, 2015

Subbasin: HC - 1A

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	2.4	0.004	203
Right-Of-Way	B	89	1.2	0.002	103
Right-Of-Way	B/D	89	2.6	0.004	235
Right-Of-Way	C	92	11.1	0.017	1025
Right-Of-Way	D	93	0.9	0.001	84
Commercial	B	92	0.2	0.000	21
Commercial	B/D	92	0.1	0.000	13
Commercial	C	94	7.3	0.011	690
Commercial	D	95	7.5	0.012	717
Office/Institutional/Medical	C	90	0.8	0.001	70
Office/Institutional/Medical	D	92	0.3	0.000	26
Medium Density Residential	D	85	0.5	0.001	39
Low Density Residential	A	51	9.5	0.015	487
Low Density Residential	B	68	2.8	0.004	193
Low Density Residential	B/D	68	20.2	0.032	1374
Low Density Residential	C	79	49.7	0.078	3928
Low Density Residential	D	84	34.8	0.054	2924
Very Low Density Residential	A	49	0.9	0.001	42
Very Low Density Residential	B	69	13.2	0.021	911
Very Low Density Residential	B/D	69	58.2	0.091	4015
Very Low Density Residential	C	79	101.2	0.158	7998
Very Low Density Residential	D	84	38.6	0.060	3244
Very Low Density Residential	W	100	0.2	0.000	20
		Totals =	364.5	0.570	28363.0

Total (weighted) RCN = total product/total area = 77.81

RCN used = 78

Subbasin: HC - 1B

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	0.5	0.001	44
Right-Of-Way	B	89	4.3	0.007	384
Right-Of-Way	B/D	89	1.8	0.003	162
Right-Of-Way	C	92	7.7	0.012	705
Right-Of-Way	D	93	4.1	0.006	385
Commercial	B	92	7.0	0.011	641
Commercial	B/D	92	4.6	0.007	420
Commercial	C	94	9.0	0.014	844
Commercial	D	95	4.1	0.006	393
High Density Residential	C	83	0.0	0.000	0
Medium Density Residential	B	70	5.2	0.008	361
Medium Density Residential	B/D	70	0.3	0.001	23
Medium Density Residential	C	80	6.4	0.010	512
Medium Density Residential	D	85	3.0	0.005	259
Low Density Residential	A	51	2.8	0.004	144
Low Density Residential	B	68	7.6	0.012	518
Low Density Residential	B/D	68	3.3	0.005	224
Low Density Residential	C	79	13.8	0.022	1089
Low Density Residential	D	84	4.6	0.007	387
Low Density Residential	W	100	0.7	0.001	71
Very Low Density Residential	A	49	5.3	0.008	260
Very Low Density Residential	B	69	55.2	0.086	3808
Very Low Density Residential	B/D	69	58.1	0.091	4008
Very Low Density Residential	C	79	94.7	0.148	7481
Very Low Density Residential	D	84	40.1	0.063	3370
Open Space, Good Condition	B	61	3.9	0.006	239
Open Space, Good Condition	B/D	61	6.9	0.011	418
Open Space, Good Condition	C	74	9.8	0.015	726
Open Space, Good Condition	D	80	12.6	0.020	1011
		Totals =	377.5	0.590	28887.4

Total (weighted) RCN = total product/total area = 76.52

RCN used = 77

Subbasin: HC - 1C

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	7.4	0.012	614
Right-Of-Way	B	89	8.9	0.014	788
Right-Of-Way	B/D	89	2.0	0.003	174
Right-Of-Way	C	92	8.6	0.014	795
Right-Of-Way	D	93	1.7	0.003	159
Commercial	B	92	4.8	0.008	446
Commercial	B/D	92	7.3	0.011	676
Commercial	C	94	8.7	0.014	822
Commercial	D	95	3.4	0.005	327
High Density Residential	A	61	0.8	0.001	47
High Density Residential	C	83	0.9	0.001	74
Medium Density Residential	A	54	0.1	0.000	7
Medium Density Residential	B	70	5.6	0.009	395
Medium Density Residential	B/D	70	4.5	0.007	315
Medium Density Residential	C	80	20.7	0.032	1659
Medium Density Residential	D	85	0.7	0.001	60
Low Density Residential	A	51	39.7	0.062	2027
Low Density Residential	B	68	39.9	0.062	2714
Low Density Residential	B/D	68	3.2	0.005	218
Low Density Residential	C	79	50.3	0.079	3975
Low Density Residential	D	84	7.4	0.012	624
Very Low Density Residential	A	49	2.8	0.004	137
Very Low Density Residential	B	69	18.7	0.029	1290
Very Low Density Residential	B/D	69	3.6	0.006	249
Very Low Density Residential	C	79	18.7	0.029	1481
Very Low Density Residential	D	84	4.8	0.008	405
Open Space, Good Condition	A	39	7.2	0.011	280
Open Space, Good Condition	B	61	43.9	0.069	2676
Open Space, Good Condition	B/D	61	0.6	0.001	34
Open Space, Good Condition	C	74	30.1	0.047	2224
Open Space, Good Condition	D	80	29.2	0.046	2336
		Totals =	386.4	0.604	28024.9

Total (weighted) RCN = total product/total area = 72.53

RCN used = 73

Subbasin: HC - 1D

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	9.4	0.015	777
Right-Of-Way	C	92	6.0	0.009	555
Right-Of-Way	D	93	0.4	0.001	36
Medium Density Residential	A	54	11.3	0.018	608
Medium Density Residential	C	80	10.6	0.017	847
Medium Density Residential	D	85	2.0	0.003	171
Low Density Residential	A	51	36.1	0.056	1839
Low Density Residential	B	68	0.0	0.000	0
Low Density Residential	C	79	18.9	0.029	1491
Low Density Residential	D	84	4.3	0.007	362
Low Density Residential	W	100	1.6	0.002	156
Very Low Density Residential	A	49	4.5	0.007	222
Very Low Density Residential	C	79	1.2	0.002	95
Very Low Density Residential	D	84	1.3	0.002	105
Open Space, Good Condition	A	39	0.1	0.000	3
Open Space, Good Condition	C	74	3.7	0.006	272
Open Space, Good Condition	D	80	8.3	0.013	660
		Totals =	119.5	0.2	8201.5

Total (weighted) RCN = total product/total area = 68.66

RCN used = 69

Subbasin: HC - 2A

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	0.8	0.001	67
Right-Of-Way	B	89	2.8	0.004	247
Right-Of-Way	B/D	89	9.1	0.014	806
Right-Of-Way	C	92	7.3	0.011	672
Right-Of-Way	D	93	0.4	0.001	34
Commercial	B	92	2.0	0.003	180
Commercial	B/D	92	2.5	0.004	233
Commercial	C	94	18.0	0.028	1690
Commercial	D	95	0.2	0.000	20
High Density Residential	A	61	0.7	0.001	40
High Density Residential	B	75	16.8	0.026	1258
High Density Residential	B/D	75	44.5	0.070	3339
High Density Residential	C	83	39.5	0.062	3279
High Density Residential	D	87	1.3	0.002	117
Medium Density Residential	B	70	2.5	0.004	177
Medium Density Residential	B/D	70	10.5	0.016	736
Medium Density Residential	C	80	3.6	0.006	289
Low Density Residential	B	68	3.0	0.005	202
Low Density Residential	B/D	68	3.8	0.006	257
Low Density Residential	C	79	12.8	0.020	1014
Low Density Residential	D	84	0.6	0.001	49
Very Low Density Residential	B	69	13.7	0.021	946
Very Low Density Residential	B/D	69	19.8	0.031	1365
Very Low Density Residential	C	79	41.5	0.065	3277
Very Low Density Residential	D	84	20.7	0.032	1736
		Totals =	278.2	0.435	22027.8

Total (weighted) RCN = total product/total area = 79.17

RCN used = 79

Subbasin: HC - 2B

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	1.8	0.003	152
Right-Of-Way	B	89	2.9	0.005	258
Right-Of-Way	B/D	89	1.5	0.002	130
Right-Of-Way	C	92	11.1	0.017	1017
Right-Of-Way	D	93	0.4	0.001	40
Commercial	B	92	0.0	0.000	0
Commercial	C	94	1.6	0.003	154
Medium Density Residential	A	54	5.2	0.008	281
Medium Density Residential	B	70	5.9	0.009	411
Medium Density Residential	C	80	26.6	0.042	2130
Medium Density Residential	D	85	4.1	0.006	352
Low Density Residential	A	51	5.2	0.008	263
Low Density Residential	B	68	35.5	0.056	2416
Low Density Residential	B/D	68	34.5	0.054	2346
Low Density Residential	C	79	57.0	0.089	4502
Low Density Residential	D	84	5.5	0.009	462
Very Low Density Residential	A	49	1.4	0.002	69
Very Low Density Residential	B	69	0.4	0.001	31
Very Low Density Residential	B/D	69	6.0	0.009	416
Very Low Density Residential	C	79	9.1	0.014	718
Very Low Density Residential	D	84	0.4	0.001	34
Open Space, Good Condition	B	61	2.5	0.004	152
Open Space, Good Condition	D	80	2.9	0.004	228
		Totals =	221.6	0.346	16562.7

Total (weighted) RCN = total product/total area = 74.75

RCN used = 75

Subbasin: HC - 2C

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	12.3	0.019	1021
Right-Of-Way	B	89	4.2	0.007	374
Right-Of-Way	C	92	23.4	0.037	2155
Right-Of-Way	D	93	0.3	0.001	31
Commercial	A	89	0.0	0.000	2
Commercial	C	94	2.6	0.004	241
Medium Density Residential	A	54	26.2	0.041	1415
Medium Density Residential	C	80	7.8	0.012	623
Medium Density Residential	D	85	7.3	0.011	619
Low Density Residential	A	51	59.6	0.093	3041
Low Density Residential	B	68	13.4	0.021	909
Low Density Residential	C	79	127.2	0.199	10052
Low Density Residential	D	84	11.8	0.018	994
Low Density Residential	W	100	0.8	0.001	75
Very Low Density Residential	A	49	2.6	0.004	128
Very Low Density Residential	B	69	0.0	0.000	3
Very Low Density Residential	C	79	2.5	0.004	195
Very Low Density Residential	D	84	0.4	0.001	35
Open Space, Good Condition	A	39	1.2	0.002	49
Open Space, Good Condition	D	80	2.7	0.004	218
		Totals =	306.4	0.5	22179.4

Total (weighted) RCN = total product/total area = 72.38

RCN used = 72

Subbasin: HC - 3A

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	11.3	0.018	939
Right-Of-Way	A/D	83	1.3	0.002	106
Right-Of-Way	B	89	3.5	0.006	314
Right-Of-Way	B/D	89	3.5	0.005	307
Right-Of-Way	C	92	20.3	0.032	1868
Right-Of-Way	D	93	3.1	0.005	289
Commercial	A	89	0.0	0.000	3
Commercial	A/D	89	1.5	0.002	131
Commercial	C	94	0.6	0.001	60
Commercial	D	95	0.0	0.000	3
Mixed Use/Office/Institutional	B	85	2.6	0.004	217
Mixed Use/Office/Institutional	C	90	0.3	0.000	25
Mixed Use/Office/Institutional	D	92	2.5	0.004	226
Low Density Residential	A	51	48.6	0.076	2480
Low Density Residential	A/D	51	10.8	0.017	551
Low Density Residential	B	68	24.8	0.039	1684
Low Density Residential	B/D	68	31.0	0.048	2110
Low Density Residential	C	79	140.6	0.220	11108
Low Density Residential	D	84	17.8	0.028	1492
Very Low Density Residential	A	49	25.9	0.041	1271
Very Low Density Residential	A/D	49	10.5	0.016	515
Very Low Density Residential	B	69	10.9	0.017	755
Very Low Density Residential	B/D	69	25.3	0.040	1745
Very Low Density Residential	C	79	45.2	0.071	3574
Very Low Density Residential	D	84	7.1	0.011	599
Open Space, Good Condition	A	39	2.2	0.003	87
Open Space, Good Condition	B/D	61	2.5	0.004	155
Open Space, Good Condition	C	74	4.2	0.007	312
Open Space, Good Condition	D	80	27.2	0.043	2178
		Totals =	485.3	0.758	35104.0

Total (weighted) RCN = total product/total area = 72.33

RCN used = 72

Subbasin: HC - 3B

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	4.5	0.007	372
Right-Of-Way	B	89	1.1	0.002	95
Right-Of-Way	B/D	89	0.3	0.001	29
Right-Of-Way	C	98	3.7	0.006	358
Right-Of-Way	D	93	0.2	0.000	23
Mixed Use/Office/Institutional	A	77	0.6	0.001	48
Mixed Use/Office/Institutional	B	85	0.0	0.000	0
Mixed Use/Office/Institutional	C	90	0.6	0.001	53
Medium Density Residential	A	54	0.2	0.000	12
Medium Density Residential	C	80	0.3	0.001	26
Low Density Residential	A	51	20.1	0.031	1027
Low Density Residential	B	68	3.2	0.005	217
Low Density Residential	B/D	68	12.9	0.020	878
Low Density Residential	C	79	33.3	0.052	2628
Low Density Residential	D	84	3.0	0.005	251
Low Density Residential	W	100	2.7	0.004	271
Very Low Density Residential	A	49	14.7	0.023	718
Very Low Density Residential	B	69	2.6	0.004	179
Very Low Density Residential	B/D	69	1.7	0.003	118
Very Low Density Residential	C	79	16.0	0.025	1261
Very Low Density Residential	D	84	1.0	0.001	80
Open Space, Good Condition	A	39	22.3	0.035	869
Open Space, Good Condition	C	74	6.5	0.010	482
Open Space, Good Condition	D	80	7.3	0.011	585
		Totals =	158.7	0.248	10579.8

Total (weighted) RCN = total product/total area = 66.66

RCN used = 67

Subbasin: HC - 3C

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	6.4	0.010	535
Right-Of-Way	C	92	1.1	0.002	102
Right-Of-Way	D	93	0.2	0.000	16
Medium Density Residential	A	54	6.2	0.010	334
Medium Density Residential	C	80	1.4	0.002	110
Medium Density Residential	D	85	1.7	0.003	145
Low Density Residential	A	51	35.3	0.055	1799
Low Density Residential	B	68	0.1	0.000	9
Low Density Residential	C	79	20.0	0.031	1582
Low Density Residential	D	84	5.0	0.008	424
Very Low Density Residential	A	49	12.2	0.019	598
Very Low Density Residential	B	69	6.8	0.011	469
Very Low Density Residential	C	79	8.5	0.013	672
Very Low Density Residential	D	84	2.4	0.004	206
Open Space, Good Condition	A	39	9.2	0.014	361
Open Space, Good Condition	C	74	5.7	0.009	421
Open Space, Good Condition	D	80	6.3	0.010	508
		Totals =	128.7	0.2	8290.2

Total (weighted) RCN = total product/total area = 64.41

RCN used = 64

Subbasin: HC - 4A

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	10.0	0.016	827
Right-Of-Way	A/D	83	0.9	0.001	74
Right-Of-Way	B	89	2.6	0.004	234
Right-Of-Way	C	92	11.2	0.017	1029
Right-Of-Way	D	93	2.1	0.003	195
Commercial	A	89	3.0	0.005	263
Commercial	C	94	1.8	0.003	165
Mixed Use/Office/Institutional	A	54	0.0	0.000	0
Mixed Use/Office/Institutional	C	54	2.6	0.004	140
Medium Density Residential	A	70	2.5	0.004	173
Medium Density Residential	A/D	80	2.9	0.005	236
Medium Density Residential	B	51	54.3	0.085	2769
Medium Density Residential	C	51	0.9	0.001	46
Low Density Residential	A	68	6.3	0.010	430
Low Density Residential	A/D	68	0.3	0.000	21
Low Density Residential	B	79	50.6	0.079	3997
Low Density Residential	B/D	84	14.4	0.023	1213
Low Density Residential	C	49	2.5	0.004	122
Low Density Residential	D	69	6.8	0.011	469
Very Low Density Residential	A	79	8.8	0.014	695
Very Low Density Residential	B	84	3.7	0.006	308
Very Low Density Residential	C	77	2.0	0.003	153
Very Low Density Residential	D	90	0.2	0.000	20
		Totals =	190.3	0.297	13578.9

Total (weighted) RCN = total product/total area = 71.35

RCN used = 71

Subbasin: HC - 4B

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	7.7	0.012	636
Right-Of-Way	B	89	0.6	0.001	56
Right-Of-Way	B/D	89	1.2	0.002	105
Right-Of-Way	C	92	8.2	0.013	754
Right-Of-Way	D	93	1.7	0.003	155
Low Density Residential	A	51	41.4	0.065	2111
Low Density Residential	B	68	2.2	0.004	153
Low Density Residential	B/D	68	2.8	0.004	191
Low Density Residential	C	79	30.8	0.048	2437
Low Density Residential	D	84	13.5	0.021	1137
Low Density Residential	W	100	13.1	0.020	1312
Very Low Density Residential	A	49	16.5	0.026	806
Very Low Density Residential	B	69	0.0	0.000	0
Very Low Density Residential	C	79	19.2	0.030	1514
Very Low Density Residential	D	84	1.6	0.002	133
		Totals =	160.5	0.251	11499.7

Total (weighted) RCN = total product/total area = 71.66

RCN used = 72

Subbasin: HC - 5A

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	7.1	0.011	593
Right-Of-Way	B	89	0.9	0.001	81
Right-Of-Way	C	92	1.0	0.002	93
Low Density Residential	A	51	22.0	0.034	1123
Low Density Residential	B	68	3.4	0.005	234
Low Density Residential	C	79	3.4	0.005	266
Low Density Residential	D	84	3.5	0.005	295
Very Low Density Residential	A	49	19.5	0.030	954
Very Low Density Residential	B	69	6.1	0.009	419
Very Low Density Residential	C	79	21.8	0.034	1724
Very Low Density Residential	D	84	4.5	0.007	382
Open Space, Good Condition	A	39	3.2	0.005	123
Open Space, Good Condition	B	61	0.1	0.000	4
Open Space, Good Condition	C	74	0.5	0.001	37
Open Space, Good Condition	D	80	8.3	0.013	663
		Totals =	105.3	0.2	6992.1

Total (weighted) RCN = total product/total area = 66.38

RCN used = 66

Subbasin: HC - 5B

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	5.1	0.008	422
Right-Of-Way	B	89	0.3	0.001	30
Right-Of-Way	C	92	0.8	0.001	71
Right-Of-Way	D	93	0.5	0.001	49
High Density Residential	A	61	0.2	0.000	15
High Density Residential	B	75	0.2	0.000	13
High Density Residential	D	87	0.1	0.000	11
Medium Density Residential	A	54	5.7	0.009	310
Medium Density Residential	B	70	0.3	0.001	24
Medium Density Residential	C	80	1.6	0.003	131
Medium Density Residential	D	85	0.2	0.000	17
Low Density Residential	A	51	13.8	0.022	705
Low Density Residential	B	68	5.1	0.008	347
Low Density Residential	C	79	0.2	0.000	15
Low Density Residential	D	84	0.4	0.001	34
Very Low Density Residential	A	49	0.4	0.001	20
Open Space, Good Condition	A	39	0.4	0.001	15
Open Space, Good Condition	B	61	0.2	0.000	11
Open Space, Good Condition	D	80	5.5	0.009	441
		Totals =	41.2	0.064	2680.6

Total (weighted) RCN = total product/total area = 65.08

RCN used = 65

Subbasin: HC - 5C

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	12.8	0.020	1062
Right-Of-Way	B	89	1.8	0.003	163
Right-Of-Way	C	92	2.3	0.004	210
Right-Of-Way	D	93	0.5	0.001	43
Commercial	A	89	0.7	0.001	63
High Density Residential	A	61	13.4	0.021	819
High Density Residential	B	75	0.4	0.001	30
High Density Residential	C	83	3.2	0.005	262
High Density Residential	D	87	0.6	0.001	52
Medium Density Residential	A	54	6.0	0.009	322
Medium Density Residential	B	70	5.5	0.009	385
Medium Density Residential	C	80	0.3	0.000	21
Medium Density Residential	D	85	1.5	0.002	125
Low Density Residential	A	51	23.5	0.037	1200
Low Density Residential	B	68	0.2	0.000	17
Low Density Residential	C	79	1.7	0.003	138
Low Density Residential	D	84	1.5	0.002	125
Very Low Density Residential	A	49	17.1	0.027	838
Very Low Density Residential	B	69	2.2	0.004	155
Very Low Density Residential	C	79	7.6	0.012	598
Very Low Density Residential	D	84	1.3	0.002	112
Open Space, Good Condition	A	39	0.2	0.000	10
Open Space, Good Condition	B	61	1.3	0.002	81
Open Space, Good Condition	D	80	8.5	0.013	677
		Totals =	114.2	0.178	7509.6

Total (weighted) RCN = total product/total area = 65.76

RCN used = 66

Subbasin: HC - 6

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	6.6	0.010	550
Right-Of-Way	B	89	1.3	0.002	114
Right-Of-Way	C	92	2.0	0.003	185
Right-Of-Way	D	93	0.3	0.000	27
Office/Institutional/Multi-Family	A	77	0.0	0.000	4
Office/Institutional/Multi-Family	B	85	0.4	0.001	38
High Density Residential	A	61	7.3	0.011	445
High Density Residential	B	75	5.1	0.008	381
High Density Residential	C	83	7.9	0.012	659
High Density Residential	D	87	5.3	0.008	463
Low Density Residential	A	51	18.7	0.029	953
Low Density Residential	B	68	8.6	0.014	588
Low Density Residential	C	79	0.5	0.001	38
Very Low Density Residential	A	49	0.1	0.000	4
Very Low Density Residential	D	84	0.1	0.000	12
Open Space, Good Condition	A	39	19.8	0.031	771
Open Space, Good Condition	C	74	0.2	0.000	14
Open Space, Good Condition	D	80	7.6	0.012	608
		Totals =	91.9	0.144	5853.3

Total (weighted) RCN = total product/total area = 63.67

RCN used = 64

Subbasin: HC - 7A

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	0.1	0.000	8
Very Low Density Residential	A	49	50.6	0.079	2482
Very Low Density Residential	C	79	0.1	0.000	6
Open Space, Good Condition	A	39	13.5	0.021	525
Open Space, Good Condition	C	74	5.2	0.008	388
Open Space, Good Condition	D	80	14.0	0.022	1122
		Totals =	83.5	0.131	4530.4

Total (weighted) RCN = total product/total area = 54.23

RCN used = 54

Subbasin: HC - 7B

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	9.6	0.015	795
Right-Of-Way	B	89	1.3	0.002	117
Right-Of-Way	C	92	5.8	0.009	532
Right-Of-Way	D	93	0.7	0.001	64
Commercial	A	89	18.5	0.029	1643
Commercial	C	94	25.0	0.039	2355
Low Density Residential	A	51	1.2	0.002	64
Very Low Density Residential	A	49	16.7	0.026	819
Very Low Density Residential	B	69	0.5	0.001	34
Very Low Density Residential	C	79	9.1	0.014	721
Open Space, Good Condition	A	39	0.4	0.001	16
Open Space, Good Condition	C	74	0.0	0.000	2
Open Space, Good Condition	D	80	0.6	0.001	50
		Totals =	89.5	0.140	7211.7

Total (weighted) RCN = total product/total area = 80.56

RCN used = 81

Subbasin: HC - 7C

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	0.3	0.000	24
Low Density Residential	A	51	2.8	0.004	141
Very Low Density Residential	A	49	6.9	0.011	338
Very Low Density Residential	B	69	0.8	0.001	56
Very Low Density Residential	C	79	1.0	0.002	83
Open Space, Good Condition	A	39	6.6	0.010	256
Open Space, Good Condition	C	74	2.0	0.003	149
Open Space, Good Condition	D	80	4.2	0.007	333
		Totals =	24.6	0.038	1380.7

Total (weighted) RCN = total product/total area = 56.21

RCN used = 56

Subbasin: HC - 8A

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	7.9	0.012	654
Right-Of-Way	B	89	0.8	0.001	75
Right-Of-Way	C	92	1.8	0.003	164
Right-Of-Way	D	93	0.4	0.001	35
Commercial	A	89	2.9	0.005	261
High Density Residential	A	61	0.0	0.000	0
Medium Density Residential	A	54	8.8	0.014	474
Medium Density Residential	B	70	0.1	0.000	5
Medium Density Residential	C	80	3.8	0.006	306
Medium Density Residential	D	85	0.8	0.001	68
Low Density Residential	A	51	3.5	0.006	180
Low Density Residential	C	79	2.3	0.004	179
Low Density Residential	D	84	3.3	0.005	275
Open Space, Good Condition	A	39	11.9	0.019	464
Open Space, Good Condition	D	80	6.3	0.010	504
		Totals =	54.6	0.085	3645.6

Total (weighted) RCN = total product/total area = 66.80

RCN used = 67

Subbasin: HC - 8B

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	3.0	0.005	248
Right-Of-Way	C	92	1.2	0.002	113
Commercial	A	89	1.9	0.003	171
Commercial	C	94	0.2	0.000	17
Medical Core	A	54	13.0	0.020	703
Medical Core	C	80	7.2	0.011	580
Medium Density Residential	A	85	2.3	0.004	198
Medium Density Residential	C	51	3.5	0.005	177
Medium Density Residential	D	79	0.2	0.000	16
Low Density Residential	A	39	5.9	0.009	230
Low Density Residential	C	74	1.3	0.002	98
Open Space, Good Condition	A	80	0.1	0.000	6
Open Space, Good Condition	C	89	11.4	0.018	1011
Open Space, Good Condition	D	94	8.9	0.014	837
		Totals =	60.2	0.094	4404.8

Total (weighted) RCN = total product/total area = 73.23

RCN used = 73

Subbasin: HC - 8C

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	2.2	0.003	180
Right-Of-Way	C	92	3.0	0.005	272
Medium Density Residential	A	**54**	**1.9**	0.003	101
Medium Density Residential	**C**	80	3.8	0.006	308
Medium Density Residential	D	85	2.6	0.004	220
Low Density Residential	A	51	8.4	0.013	428
Low Density Residential	C	79	10.8	0.017	857
Open Space, Good Condition	A	39	31.6	0.049	1234
Open Space, Good Condition	C	74	8.3	0.013	614
Open Space, Good Condition	D	80	11.2	0.017	893
		Totals =	83.7	0.1	5104.7

Total (weighted) RCN = total product/total area = 60.96

RCN used = 61

Subbasin: HC - 9A

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	2.5	0.004	206
Right-Of-Way	A/D	83	0.2	0.000	16
Right-Of-Way	C	92	0.7	0.001	62
Right-Of-Way	D	93	0.9	0.001	81
Right-Of-Way	W	100	4.7	0.007	471
Commercial	A	89	8.1	0.013	725
Commercial	D	95	2.3	0.004	220
Commercial	W	100	0.4	0.001	38
Office/Institutional/Multi-Family	A	77	12.7	0.020	974
Office/Institutional/Multi-Family	C	90	8.0	0.013	721
Office/Institutional/Multi-Family	D	92	4.3	0.007	398
Office/Institutional/Multi-Family	W	100	1.8	0.003	175
Medium Density Residential	A	54	0.1	0.000	5
Medium Density Residential	C	80	0.1	0.000	5
Low Density Residential	C	79	0.0	0.000	2
Low Density Residential	D	84	0.0	0.000	0
Very Low Density Residential	A	49	1.2	0.002	56
Very Low Density Residential	A/D	49	1.5	0.002	75
Very Low Density Residential	D	84	0.2	0.000	14
Very Low Density Residential	W	100	0.0	0.000	0
Open Space, Good Condition	A	39	19.7	0.031	769
Open Space, Good Condition	A/D	39	3.9	0.006	150
Open Space, Good Condition	C	74	1.9	0.003	142
Open Space, Good Condition	D	80	38.3	0.060	3061
Open Space, Good Condition	W	100	0.2	0.000	20
		Totals =	113.5	0.177	8387.8

Total (weighted) RCN = total product/total area = 73.90

RCN used = 74

Subbasin: HCUT - 1

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	3.5	0.006	293
Right-Of-Way	B	89	0.6	0.001	55
Right-Of-Way	C	92	5.6	0.009	520
Medium Density Residential	A	54	13.4	0.021	724
Medium Density Residential	B	70	1.0	0.002	73
Medium Density Residential	C	80	24.3	0.038	1940
Low Density Residential	A	51	1.9	0.003	99
Low Density Residential	C	79	0.2	0.000	12
Very Low Density Residential	A	49	0.1	0.000	4
Very Low Density Residential	C	79	0.0	0.000	1
		Totals =	50.7	0.079	3720.3

Total (weighted) RCN = total product/total area = 73.42

RCN used = 73

Subbasin: HCUT - 2

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	0.4	0.001	33
Right-Of-Way	C	92	0.1	0.000	8
Medium Density Residential	A	54	2.4	0.004	131
Medium Density Residential	C	80	1.4	0.002	113
Low Density Residential	A	51	7.8	0.012	398
Low Density Residential	C	79	3.5	0.005	277
Low Density Residential	W	100	0.1	0.000	11
Very Low Density Residential	A	49	0.1	0.000	6
Very Low Density Residential	C	79	0.0	0.000	3
Very Low Density Residential	W	100	0.0	0.000	0
		Totals =	15.9	0.025	980.1

Total (weighted) RCN = total product/total area = 61.62

RCN used = 62

Subbasin: HCUT - 3

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	1.2	0.002	102
Low Density Residential	A	51	16.3	0.025	832
Low Density Residential	C	79	6.1	0.009	479
Low Density Residential	D	84	0.4	0.001	31
Low Density Residential	W	100	3.1	0.005	314
Very Low Density Residential	A	49	1.2	0.002	58
Very Low Density Residential	C	79	0.1	0.000	8
Very Low Density Residential	W	100	0.1	0.000	14
Open Space, Good Condition	A	49	0.0	0.000	0
Open Space, Good Condition	D	84	0.0	0.000	2
		Totals =	28.6	0.045	1840.4

Total (weighted) RCN = total product/total area = 64.41

RCN used = 64

Subbasin: HCUT - 4

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	2.4	0.004	197
Right-Of-Way	C	92	0.3	0.000	25
Right-Of-Way	D	93	0.2	0.000	21
Low Density Residential	A	51	13.0	0.020	663
Low Density Residential	C	79	2.4	0.004	193
Low Density Residential	D	84	0.4	0.001	34
Low Density Residential	W	100	1.0	0.002	97
Very Low Density Residential	A	49	0.3	0.000	14
Very Low Density Residential	D	79	0.6	0.001	45
Very Low Density Residential	W	100	0.0	0.000	0
		Totals =	20.5	0.032	1288.9

Total (weighted) RCN = total product/total area = 62.73

RCN used = 63

Subbasin: HCUT - 5

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Right-Of-Way	A	83	1.4	0.002	115
Right-Of-Way	C	92	0.1	0.000	6
Right-Of-Way	D	93	0.0	0.000	3
Low Density Residential	A	51	6.5	0.010	332
Low Density Residential	C	79	0.1	0.000	11
Low Density Residential	D	84	0.4	0.001	33
Open Space, Good Condition	A	49	2.8	0.004	136
Open Space, Good Condition	C	79	0.2	0.000	17
Open Space, Good Condition	D	84	0.6	0.001	49
Open Space, Good Condition	W	100	0.8	0.001	77
		Totals =	12.9	0.020	779.2

Total (weighted) RCN = total product/total area = 60.54

RCN used = 61

Appendix F:

Time of Concentration Calculations

Project: Hardee Creek Watershed Master Plan
Prepared by: SMB
Checked by: DJK
Date: 5/18/2015

Time of Concentration - Hardee Creek Watershed

Sub-basin	Sheet Flow						Shallow Concentration					Channel Flow									Lag	Calibration
	Description	n	Flow Length (ft)	P-2 (in)	Land Slope (ft/ft)	Tt (min)	Surface Description 0--Unpaved/1-Paved	Flow Length (ft)	Slope (ft/ft)	Velocity (ft/s)	Tt (min)	Channel Area (ft2)	Channel Perimeter (ft)	Hydraulic Radius (ft)	Slope (ft/ft)	n	Velocity (ft/s)	Flow Length (ft)	Tt (min)	Tc (min)		(min)	(min)
HC-1a	Woods	0.40	137	3.76	0.001	95.80	0	483	0.001	0.51	15.78	Pipe			0.026	0.013	5.00	124	0.41	153.17		91.90	184
												16.5	10.7	1.54	0.002	0.055	1.47	3635	41.18				
HC-1b	Grass	0.24	311	3.76	0.001	118.02	0	356	0.003	0.86	6.94	Pipe			0.026	0.013	5.00	0	0.00	153.91		92.35	185
												16.5	10.7	1.54	0.005	0.05	2.87	4993	28.95				
HC-1c	Grass	0.24	300	3.76	0.000	163.07	0	1007	0.001	0.62	26.95	Pipe			0.026	0.013	5.00	61	0.20	191.98		115.19	230
												108.5	17	27.70	0.010	0.055	25.24	2665	1.76				
HC-1d	Grass	0.24	168	3.76	0.010	25.82	1	526	0.008	1.77	4.95	Pipe			0.026	0.013	5.00		0.00	42.83		25.70	51
												16.5	10.7	1.54	0.011	0.055	3.79	2742	12.07				
HC-2a	Woods	0.40	150	3.76	0.007	42.52	0	1290	0.009	1.54	13.93	Pipe			0.020	0.013	5.00	248	0.83	80.65		48.39	
												33.6	12.9	2.60	0.001	0.055	1.96	2751	23.37				
HC-2b	Grass	0.24	150	3.76	0.007	28.26	0	949	0.006	1.28	12.33	Pipe			0.026	0.013	5.00	50	0.17	83.48		50.09	
												16.5	10.7	1.54	0.002	0.055	1.72	4417	42.73				
HC-2c	Grass	0.24	198	3.76	0.003	52.03	0	2982	0.008	1.45	34.34	Pipe			0.026	0.013	5.00	39	0.13	120.30		72.18	
												16.5	10.7	1.54	0.004	0.05	2.37	4806	33.81				
HC-3a	Grass	0.24	353	3.76	0.003	77.13	0	98	0.010	1.63	1.00	Pipe			0.026	0.013	5.00	157	0.52	145.44		87.27	175
												16.5	10.7	1.54	0.003	0.055	1.93	7738	66.79				
HC-3b	Grass	0.24	418	3.76	0.005	73.25	0	617	0.039	3.18	3.23	Pipe			0.026	0.013	5.00	0	0.00	97.56		58.53	88
												16.5	10.7	1.54	0.008	0.055	3.34	4218	21.07				
HC-3c	Grass	0.24	195	3.76	0.031	18.91	0	906	0.029	2.73	5.52	Pipe			0.005	0.013	5.00	0	0.00	41.40		24.84	
												40.5	14	2.89	0.001	0.055	2.08	2116	16.97				
HC-4a	Grass	0.24	212	3.76	0.005	42.80	0	1019	0.004	1.01	16.80	Pipe			0.005	0.013	5.00	0	0.00	83.11		49.87	
												9	7.7	1.17	0.006	0.055	2.34	3302	23.51				
HC-4b	Grass	0.24	154	3.76	0.003	38.48	0	1557	0.000	0.29	89.75	Pipe			0.005	0.013	5.00	0	0.00	175.76		105.46	
												94	17	5.53	0.000	0.05	1.15	3293	47.53				
HC-5a	Woods	0.40	470	3.76	0.004	126.88	0	903	0.001	0.54	28.03	Pipe			0.026	0.013	5.00	1842	6.14	165.09		99.05	
												16.5	10.7	1.54	0.014	0.055	4.23	1024	4.03				
HC-5b	Grass	0.24	158	3.76	0.003	39.68	1	1013	0.010	2.02	8.36	Pipe			0.012	0.013	5.00	1155	3.85	53.80		32.28	
												90	25.4	3.54	0.005	0.055	4.31	494	1.91				
HC-5c	Grass	0.24	397	3.76	0.005	68.86	0	1723	0.008	1.41	20.33	Pipe			0.005	0.013	5.00	0	0.00	96.85		58.11	
												14	7.8	1.79	0.012	0.055	4.45	2045	7.66				
HC-6	Grass	0.40	285	3.76	0.014	52.76	0	218	0.004	1.00	3.63	Pipe			0.005	0.013	5.00	766	2.55	74.51		44.71	
												49	13.6	3.60	0.001	0.055	2.36	2204	15.57				
HC-7a	Grass	0.24	525	3.76	0.006	81.88	0	570	0.018	2.16	4.40	Pipe			0.005	0.013	5.00	0	0.00	98.53		59.12	177
												16.5	10.7	1.54	0.012	0.055	3.89	2860	12.25				
HC-7b	Grass	0.24	187	3.76	0.016	23.72	0	2419	0.002	0.76	53.38	Pipe			0.005	0.013	5.00	320	1.07	105.09		63.05	189
												8.25	8.4	0.98	0.008	0.055	2.40	3869	26.91				
HC-7c	Grass	0.24	363	3.76	0.008	52.59	0	564	0.023	2.45	3.84	Pipe			0.005	0.013	5.00	0	0.00	58.31		34.99	105
												16.5	10.7	1.54	0.034	0.055	6.70	760	1.89				
HC-8a	Grass	0.24	100	3.76	0.005	22.92	1	148	0.003	1.18	2.09	Pipe			0.005	0.013	5.00	1514	5.05	36.39		21.83	
												8	7.7	1.04	0.018	0.055	3.75	1426	6.33				
HC-8b	Grass	0.24	251	3.76	0.008	39.72	0	140	0.014	1.93	1.21	Pipe			0.005	0.013	5.00	202	0.67	52.32		31.39	
												3.75	4.25	0.88	0.022	0.055	3.74	2402	10.72				
HC-8c	Grass	0.24	327	3.76	0.005	58.22	0	329	0.023	2.47	2.22	Pipe			0.005	0.013	5.00	483	1.61	67.67		40.60	
												90	25.4	3.54	0.003	0.055	3.71	1249	5.61				
HC-9	Grass	0.24	131	3.76	0.038	12.62	1	494	0.028	3.42	2.41	Pipe			0.005	0.013	5.00	302	1.01	86.41		51.85	
												28	28	1.00	0.002	0.055	1.07	4508	70.38				
HCUT-1	Grass	0.24	204	3.76	0.002	53.93	0	909	0.001	0.38	40.04	8	7.7	1.04	0.005	0.05	2.13	1239	9.71	103.67		62.20	264
HCUT-2	Woods	0.40	334	3.76	0.024	48.37	0	1062	0.002	0.74	23.99	65	32.6	1.99	0.018	0.035	9.05	223	0.41	72.77		43.66	175
HCUT-3	Woods	0.40	129	3.76	0.008	35.48	0	85	0.001	0.51	2.78	Pipe			0.005	0.013	5.00	159	0.53	42.74		25.64	51
												282	72	3.92	0.009	0.05	7.20	1707	3.95				
HCUT-4	Woods	0.40	276	3.76	0.002	116.63	0	81	0.049	3.59	0.38	Pipe			0.005	0.13	5.00	192	0.64	118.36		71.02	
												308	46.3	6.65	0.015	0.035	18.61	796	0.71				
HCUT-5	*Grass*	*0.24*	*158*	*3.76*	*0.003*	*39.68*	0	771	0.042	3.29	3.91	Pipe			0.033	0.013	5.00	80	0.27	44.17		26.50	
												392	79	4.96	0.021	0.035	18.11	331	0.30				

Appendix G:

Preliminary Opinion of Probable Construction Costs

List of Contents:

Unit Costs - Hardee Creek Watershed Master Plan

	Item Description	*Unit*	*Unit Price*
1	Mobilization (10%)	LS	
2	Comprehensive Grading (20%)	LS	
3	Excavation	CY	$ 25.00
4	Hauling	CY	$ 4.00
5	Clearing & Grubbing	AC	$ 5,000.00
6	Channel Grading including seeding	SY	$ 15.00
7	Construction Staking (0-300000)	LS	$ 3,000.00
8	Construction Staking (300000-800000)	LS	$ 6,000.00
9	Construction Staking (Greater than 800000)	LS	$ 10,000.00
10	Select Material	CY	$ 25.00
11	Flowable Fill	CY	$ 500.00
12	8" Perforated PVC Underdrain	LF	$ 10.00
13	8" PVC Pipe, SDR 35	LF	$ 10.00
14	15" PVC Pipe, SDR 35	LF	$ 18.00
15	18" PVC Pipe, SDR 35	LF	$ 25.00
16	24" PVC Pipe, SDR 35	LF	$ 28.00
17	12" R.C. Pipe Culvert, Class III	LF	$ 45.00
18	15" R.C. Pipe Culvert, Class III	LF	$ 50.00
19	18" R.C. Pipe Culvert, Class III	LF	$ 55.00
20	18" R.C. Pipe Culvert, Class IV	LF	$ 60.00
21	24" R.C. Pipe Culvert, Class III	LF	$ 70.00
22	24" R.C. Pipe Culvert, Class IV	LF	$ 75.00
23	30" R.C. Pipe Culvert, Class III	LF	$ 90.00
24	30" R.C. Pipe Culvert, Class IV, 0' - 6' depth	LF	$ 100.00
25	36" R.C. Pipe Culvert, Class III	LF	$ 120.00
26	36" R.C. Pipe Culvert, Class IV	LF	$ 130.00
27	36" Steel Pipe Culvert (Tunnel Installation)	LF	$ 800.00
28	42" R.C. Pipe Culvert, Class III	LF	$ 150.00
29	42" R.C. Pipe Culvert, Class IV	LF	$ 165.00
30	48" R.C. Pipe Culvert, Class III	LF	$ 180.00
31	48" R.C. Pipe Culvert, Class IV	LF	$ 195.00
32	48" Steel Pipe Culvert (Tunnel Installation)	LF	$ 1,100.00
33	54" R.C. Pipe Culvert, Class III	LF	$ 200.00
34	60" R.C. Pipe Culvert, Class III	LF	$ 225.00
35	60" Steel Pipe Culvert (Tunnel Installation)	LF	$ 1,500.00
36	66" R.C. Pipe Culverts, Class III	LF	$ 260.00
37	72" R.C. Pipe Culvert, Class III	LF	$ 320.00
38	72" R.C. Pipe Culvert, Class IV	LF	$ 370.00
39	72" Steel Pipe Culvert (Tunnel Installation)	LF	$ 1,800.00
40	78" R.C. Pipe Culvert, Class III	LF	$ 350.00
41	4' x 4' Precast R.C. Box Culvert	LF	$ 400.00
42	5' x 3' Precast R.C. Box Culvert	LF	$ 450.00
43	5' x 4' Precast R.C. Box Culvert	LF	$ 500.00
44	6' x 3' Precast R.C. Box Culvert	LF	$ 600.00
45	6' x 4' Precast R.C. Box Culvert	LF	$ 650.00
46	6' x 5' Precast R.C. Box Culvert	LF	$ 700.00
47	7' x 5' Precast R.C. Box Culvert	LF	$ 750.00
48	7' x 6' Precast R.C. Box Culvert	LF	$ 850.00
49	7' x 7' Reinforced Concrete Box Culvert	LF	$ 1,200.00
50	8’ x 4’ Precast R.C. Box Culvert	LF	$ 750.00
51	8’ x 5’ Precast R.C. Box Culvert	LF	$ 900.00
52	8' X 6' Reinforced Concrete Box Culvert	LF	$ 1,200.00
53	9' x 5' Precast R.C. Box Culvert	LF	$ 1,100.00
54	9' X 6' Reinforced Concrete Box Culvert	LF	$ 1,400.00
55	10' x 4' Precast R.C. Box Culvert	LF	$ 1,050.00
56	10 x 5' Precast R.C. Box Culvert	LF	$ 1,200.00
57	10' x 6' Precast R.C. Box Culvert	LF	$ 1,450.00
58	11' x 4' Precast R.C. Box Culvert	LF	$ 1,150.00
59	11' x 6' Precast R.C. Box Culvert	LF	$ 1,500.00
60	11’ x 7’ Precast R.C. Box Culvert	LF	$ 1,800.00
61	Drainage Structures, Manhole	EA	$ 3,500.00
62	Drainage Structures, Inlet	EA	$ 3,000.00
63	Drainage Structures, DOT Standard Endwall	EA	$ 6,000.00
64	Drainage Structures, Box Culvert Custom Endwall	EA	$ 15,000.00
65	BMP Outlet Structure	EA	$ 4,000.00
66	Convert Yard Inlet to Junction Box	EA	$ 1,500.00
67	Curb Cut	EA	$ 400.00
68	Flared End Section, 18 inch	EA	$ 1,000.00
69	Flared End Section, 24 inch	EA	$ 2,000.00
70	Flared End Section, 36 inch	EA	$ 2,500.00
71	Flared End Section, 42 inch	EA	$ 2,500.00
72	Flared End Section, 48 inch	EA	$ 3,000.00
73	Custom Junction Box	EA	$ 15,000.00

	Item Description	*Unit*	*Unit Price*
74	Concrete Curb and Gutter	LF	$ 35.00
75	6" Concrete Driveway Replacement	EA	$ 1,500.00
76	4" Concrete Sidewalk	LF	$ 40.00
77	Concrete Pipe Plug	EA	$ 450.00
78	Asphalt Milling/Overlay	SY	$ 30.00
79	Asphalt Replacement (Surface, Base Course, & Milling)	SY	$ 55.00
80	ABC Stone	TN	$ 35.00
81	Rip Rap Stone, Class B	TN	$ 65.00
82	Rip Rap Stone, Class 1	TN	$ 70.00
83	Rip Rap Stone, Class A	TN	$ 65.00
84	#5 stone	TN	$ 50.00
85	#57 stone	TN	$ 65.00
86	Gravel Walkway #78 stone	TN	$ 65.00
87	Stone Boulder	TN	$ 200.00
88	Sand 2S	CY	$ 60.00
89	Rock Grade Control	EA	$ 10,000.00
90	Traffic Control (Single 2-lane road)	LS	$ 10,000.00
91	Traffic Control (4+ lane road or multiple 2-lane roads)	LS	$ 20,000.00
92	Erosion Control (1-2 acre LOD)	LS	$ 15,000.00
93	Erosion Control (2-5 acre LOD)	LS	$ 30,000.00
94	Erosion Control (Greater than 5 acre LOD)	LS	$ 50,000.00
95	Erosion Control Matting	SY	$ 10.00
96	Fence Removal / Replacement	LF	$ 50.00
97	4' Personnel Gates	EA	$ 375.00
98	20' Roadway Gates	EA	$ 400.00
99	Soil Media	CY	$ 50.00
100	BMP Plantings	SF	$ 2.00
101	Riparian Seed Mix	SY	$ 1.50
102	Live Staking	SY	$ 15.00
103	Seeding and Mulching	AC	$ 7,500.00
104	Wood Retaining Wall (4' high)	LF	$ 100.00
105	Log Grade Control Structure	EA	$ 2,000.00
106	Gabion Wall	LF	$ 300.00
107	Foundation Protection	EA	$ 15,000.00
108	Utility Relocations (Minor Water line adjustments)	LS	$ 5,000.00
109	Utility Relocations (Substantial Water line adjustements including)	LS	$ 15,000.00
110	Utility Relocations (Substantial sanitary sewer and water line adjustments)	LS	$ 30,000.00
111	Buffer Plantings	SY	$ 4.00
112	PICP (Permeable Pavers), 3.5" thick	SF	$ 20.00
113	Hauling	CY	$ 45.00
114	Cascade Boulder	TN	$ 75.00
115	Cobble	TN	$ 75.00
116	RSC Sand/Wood Chip Mixture	CY	$ 45.00

Cost Summary Table	
System	**Cost**
East 10th Street (Hardee Creek)	$890,000
Portertown Road (Hardee Creek)	$3,780,000
Fox Haven Drive/Quail Hollow Drive Closed System (Hardee Creek)	$410,000
River Hills Closed System (Hardee Creek)	$550,000

East 10th Street (Hardee Creek)

Item Number	*Item Description*	*Quantities*	*Unit*	*Unit Price*	*Amount*
1	Mobilization (10%)	1	LS	$ 46,500.00	$ 46,500.00
2	Comprehensive Grading (20%)*	1	LS	$ 77,600.00	$ 77,600.00
3	Construction Staking (300000-800000)	1	LS	$ 6,000.00	$ 6,000.00
4	Select Material	646	CY	$ 25.00	$ 16,150.00
5	60" R.C. Pipe Culvert, Class III	178	LF	$ 1,800.00	$ 320,400.00
6	9' x 5' Precast R.C. Box Culvert	2	EA	$ 15,000.00	$ 30,000.00
7	Utility Relocations **	1	LS	$ 15,000.00	$ 15,000.00
8	4" Concrete Sidewalk	1	LS	$ 15,000.00	$ 15,000.00
				Subtotal	$ 526,700.00
				30% Contingency	$158,000.00
				Total	**$ 684,700.00**
				Design, Administration, Fiscal and Legal (30% of Construction Costs)	205,400.00
				Total Opinion of Project Cost	**$ 890,100.00**

* Cost for comprehensive grading includes roadway excavation, saw cutting, compaction of select material, geotechnical recommendations, home owner coordination, tree and structure protection, structure removal and disposal, shoring, and culvert excavation.

** Cost for utility conflicts includes all utilities that need to be moved including sanitary sewer and potable water lines. Additional survey may be required to locate pressurized utilities.

The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.

Portertown Road (Hardee Creek)

Item Number	*Item Description*	*Quantities*	*Unit*	*Unit Price*	*Amount*
1	Mobilization (10%)	1	LS	$ 203,500.00	$ 203,500.00
2	Comprehensive Grading (20%)*	1	LS	$ 339,200.00	$ 339,200.00
3	Construction Staking (Greater than 800000)	1	LS	$ 10,000.00	$ 10,000.00
4	Excavation	57953	CY	$ 25.00	$ 1,448,825.00
5	Hauling	57953	CY	$ 4.00	$ 231,812.00
6	Traffic Control (Single 2-lane road)	1	LS	$ 5,000.00	$ 5,000.00
7	Clearing & Grubbing	6.2	AC	$ 5,000.00	$ 31,000.00
8	Asphalt Milling/Overlay	1	LS	$ 50,000.00	$ 50,000.00
9	Rip Rap Stone, Class A	30008	SY	$ 1.50	$ 45,012.00
				Subtotal	$ 2,238,300.00
				30% Contingency	$671,500.00
				Total	**$ 2,909,800.00**
				Design, Administration, Fiscal and Legal (30% of Construction Costs)	872,900.00
				Total Opinion of Project Cost	**$ 3,782,700.00**

* Cost for comprehensive grading includes roadway excavation, saw cutting, compaction of select material, geotechnical recommendations, home owner coordination, tree and structure protection, structure removal and disposal, shoring, and culvert excavation.

** Cost for utility conflicts includes all utilities that need to be moved including sanitary sewer and potable water lines. Additional survey may be required to locate pressurized utilities.

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Fox Haven Drive/Quail Hollow Drive Closed System (Hardee Creek)

Item Number	*Item Description*	*Quantities*	*Unit*	*Unit Price*	*Amount*
1	Mobilization (10%)	1	LS	$ 22,000.00	$ 22,000.00
2	Comprehensive Grading (20%)*	1	LS	$ 36,800.00	$ 36,800.00
3	Construction Staking (0-300000)	1	LS	$ 3,000.00	$ 3,000.00
4	Select Material	400	CY	$ 25.00	$ 10,000.00
5	18" PVC Pipe, SDR 35	941	LF	$ 60.00	$ 56,460.00
6	8’ x 5’ Precast R.C. Box Culvert	9	EA	$ 3,000.00	$ 27,000.00
7	Asphalt Replacement (Surface, Base Course, & Milling)	323	SY	$ 55.00	$ 17,765.00
8	11' x 4' Precast R.C. Box Culvert	711	LF	$ 35.00	$ 24,885.00
9	11' x 6' Precast R.C. Box Culvert	3	EA	$ 1,500.00	$ 4,500.00
10	Concrete Curb and Gutter	1	LS	$ 10,000.00	$ 10,000.00
11	4" Concrete Sidewalk	1	LS	$ 15,000.00	$ 15,000.00
12	Utility Relocations (Substantial Water line adjustements including)**	1	LS	$ 15,000.00	$ 15,000.00
				Subtotal	$ 242,400.00
				30% Contingency	$72,700.00
				Total	**$ 315,100.00**
				Design, Administration, Fiscal and Legal (30% of Construction Costs)	94,500.00
				Total Opinion of Project Cost	**$ 409,600.00**

* Cost for comprehensive grading includes roadway excavation, saw cutting, compaction of select material, geotechnical recommendations, home owner coordination, tree and structure protection, structure removal and disposal, shoring, and culvert excavation.

** Cost for utility conflicts includes all utilities that need to be moved including sanitary sewer and potable water lines. Additional survey may be required to locate pressurized utilities.

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River Hills Closed System (Hardee Creek)

Item Number	*Item Description*	*Quantities*	*Unit*	*Unit Price*	*Amount*
1	Mobilization (10%)	1	LS	$ 29,500.00	$ 29,500.00
2	Comprehensive Grading (20%)*	1	LS	$ 49,200.00	$ 49,200.00
3	Construction Staking (300000-800000)	1	LS	$ 6,000.00	$ 6,000.00
4	Select Material	400	CY	$ 25.00	$ 10,000.00
5	Drainage Structures, Manhole	2	EA	$ 450.00	$ 900.00
6	15" PVC Pipe, SDR 35	166	LF	$ 55.00	$ 9,130.00
7	18" PVC Pipe, SDR 35	188	LF	$ 60.00	$ 11,280.00
8	15" R.C. Pipe Culvert, Class III	139	LF	$ 90.00	$ 12,510.00
9	30" R.C. Pipe Culvert, Class IV	31	LF	$ 100.00	$ 3,100.00
10	30" R.C. Pipe Culvert, Class III	185	LF	$ 150.00	$ 27,750.00
11	30" R.C. Pipe Culvert, Class IV, 0' - 6' depth	40	LF	$ 165.00	$ 6,600.00
12	36" R.C. Pipe Culvert, Class III	257	LF	$ 180.00	$ 46,260.00
13	36" R.C. Pipe Culvert, Class IV	42	LF	$ 195.00	$ 8,190.00
14	8’ x 5’ Precast R.C. Box Culvert	11	EA	$ 3,000.00	$ 33,000.00
15	8’ x 4’ Precast R.C. Box Culvert	2	EA	$ 3,500.00	$ 7,000.00
16	Asphalt Replacement (Surface, Base Course, & Milling)	235	SY	$ 55.00	$ 12,925.00
17	11' x 4' Precast R.C. Box Culvert	325	LF	$ 35.00	$ 11,375.00
18	Concrete Curb and Gutter	1	LS	$ 10,000.00	$ 10,000.00
19	4" Concrete Sidewalk	1	LS	$ 15,000.00	$ 15,000.00
20	Utility Relocations (Substantial Water line adjustements including)**	1	LS	$ 15,000.00	$ 15,000.00
				Subtotal	$ 324,700.00
				30% Contingency	$97,400.00
				Total	**$ 422,100.00**
				Design, Administration, Fiscal and Legal (30% of Construction Costs)	126,600.00
				Total Opinion of Project Cost	**$ 548,700.00**

* Cost for comprehensive grading includes roadway excavation, saw cutting, compaction of select material, geotechnical recommendations, home owner coordination, tree and structure protection, structure removal and disposal, shoring, and culvert excavation.

** Cost for utility conflicts includes all utilities that need to be moved including sanitary sewer and potable water lines. Additional survey may be required to locate pressurized utilities.

The Engineer’s opinions of probable construction costs are made on the basis of the Engineer’s experience and qualifications and represent the Engineer’s best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer’s cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.

Cost Summary Table	
System	**Cost**
Willow Run Bioretention	$250,000
Pinebrook RSC	$320,000
Oakhurst RSC	$150,000
Arbor Hills South RSC	$160,000

Willow Run - Bioretention Pond

Preliminary Opinion of Probable Construction Cost

	Item Description	*QUANTITIES*	*Unit*	*Unit Price*	*Amount*
1	Mobilization (10%)	1	LS	$ 14,530.00	$ 14,530.00
2	Comprehensive Grading (20%)	1	LS	$ 24,200.00	$ 24,200.00
3	Erosion Control (1-2 acre LOD)	1	LS	$ 15,000.00	$ 15,000.00
4	Excavation	930	CY	$ 25.00	$ 23,250.00
5	Hauling	930	CY	$ 4.00	$ 3,720.00
6	Soil Media	930	CY	$ 50.00	$ 46,500.00
7	Construction Staking (0-300000)	1	LS	$ 3,000.00	$ 3,000.00
8	BMP Plantings	5000	SF	$ 2.00	$ 10,000.00
9	Seeding and Mulching	0.11	AC	$ 7,500.00	$ 860.88
10	15" R.C. Pipe Culvert, Class III	15	LF	$ 50.00	$ 750.00
11	Drainage Structures, Inlet	2	EA	$ 3,000.00	$ 6,000.00
12	Drainage Structures, Manhole	1	EA	$ 3,500.00	$ 3,500.00
13	24" R.C. Pipe Culvert, Class III	65	LF	$ 70.00	$ 4,550.00
14	Asphalt Replacement (Surface, Base Course, & Milling)	29	SY	$ 55.00	$ 1,595.00
15	24" R.C. Pipe Culvert, Class III	5	LF	$ 70.00	$ 350.00
16	Flared End Section, 24 inch	1	EA	$ 2,000.00	$ 2,000.00
				Subtotal	$ 147,810.88
				30% Contingency	$ 44,300.00
				Total	**$ 192,110.88**
				Design, Administration, Fiscal and Legal (30% of Construction Costs)	$ 57,600.00
				Total Opinion of Project Cost	**$ 249,700.00**

* Cost for comprehensive grading includes roadway excavation, saw cutting, compaction of select material, geotechnical recommendations, home owner coordination, tree and structure protection, structure removal and disposal, shoring, and culvert excavation.

The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.

Pinebrook - Regenerative Stormwater Conveyance
Preliminary Opinion of Probable Construction Cost

	Item Description	*QUANTITIES*	*Unit*	*Unit Price*	*Amount*
1	Mobilization (10%)	1	LS	$ 14,550.00	$ 14,550.00
2	Comprehensive Grading (20%)	1	LS	$ 29,110.00	$ 29,110.00
3	RSC Sand/Wood Chip Mixture	1389	CY	$ 45.00	$ 62,500.00
4	Cascade Boulders	385	TN	$ 75.00	$ 28,888.89
5	Cobble	385	TN	$ 75.00	$ 28,888.89
6	Geotextile for Drainage, Type 2	18	SY	$ 7.00	$ 124.44
7	RSC Plantings, Bare Root Plants	195	EA	$ 40.00	$ 7,812.50
8	Planting Mix	116	CY	$ 20.00	$ 2,314.81
9	Erosion Control (1-2 acre LOD)	1	LS	$ 15,000.00	$ 15,000.00
				Subtotal	$ 189,189.54
				30% Contingency	$ 56,800.00
				Total	**$ 245,989.54**
				Design, Administration, Fiscal and Legal (30% of Construction Costs)	$ 73,800.00
				Total Opinion of Project Cost	**$ 319,800.00**

* Cost for comprehensive grading includes roadway excavation, saw cutting, compaction of select material, geotechnical recommendations, home owner coordination, tree and structure protection, structure removal and disposal, shoring, and culvert excavation.

The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.

Oakhurst - Regenerative Stormwater Conveyance
Preliminary Opinion of Probable Construction Cost

	Item Description	*QUANTITIES*	*Unit*	*Unit Price*	*Amount*
1	Mobilization (10%)	1	LS	$ 6,900.00	$ 6,900.00
2	Comprehensive Grading (20%)	1	LS	$ 13,800.00	$ 13,800.00
3	RSC Sand/Wood Chip Mixture	567	CY	$ 45.00	$ 25,500.00
4	Cascade Boulders	162	TN	$ 75.00	$ 12,133.33
5	Cobble	162	TN	$ 75.00	$ 12,133.33
6	Geotextile for Drainage, Type 2	12	SY	$ 7.00	$ 87.11
7	RSC Plantings, Bare Root Plants	80	EA	$ 40.00	$ 3,187.50
8	Planting Mix	47	CY	$ 20.00	$ 944.44
9	Erosion Control (1-2 acre LOD)	1	LS	$ 15,000.00	$ 15,000.00
				Subtotal	$ 89,685.72
				30% Contingency	$ 26,900.00
				Total	**$ 116,585.72**
				Design, Administration, Fiscal and Legal (30% of Construction Costs)	$ 35,000.00
				Total Opinion of Project Cost	**$ 151,600.00**

* Cost for comprehensive grading includes roadway excavation, saw cutting, compaction of select material, geotechnical recommendations, home owner coordination, tree and structure protection, structure removal and disposal, shoring, and culvert excavation.

The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.

Arbor Hills South - Regenerative Stormwater Conveyance

Preliminary Opinion of Probable Construction Cost

	Item Description	*QUANTITIES*	*Unit*	*Unit Price*	*Amount*
1	Mobilization (10%)	1	LS	$ 7,070.00	$ 7,070.00
2	Comprehensive Grading (20%)	1	LS	$ 14,150.00	$ 14,150.00
3	RSC Sand/Wood Chip Mixture	667	CY	$ 45.00	$ 30,000.00
4	Cascade Boulders	139	TN	$ 75.00	$ 10,400.00
5	Cobble	139	TN	$ 75.00	$ 10,400.00
6	Geotextile for Drainage, Type 2	11	SY	$ 7.00	$ 74.67
7	RSC Plantings, Bare Root Plants	94	EA	$ 40.00	$ 3,750.00
8	Planting Mix	56	CY	$ 20.00	$ 1,111.11
9	Erosion Control (1-2 acre LOD)	1	LS	$ 15,000.00	$ 15,000.00
				Subtotal	$ 91,955.78
				30% Contingency	$ 27,600.00
				Total	**$ 119,555.78**
				Design, Administration, Fiscal and Legal (30% of Construction Costs)	$ 35,900.00
				Total Opinion of Project Cost	**$ 155,500.00**

* Cost for comprehensive grading includes roadway excavation, saw cutting, compaction of select material, geotechnical recommendations, home owner coordination, tree and structure protection, structure removal and disposal, shoring, and culvert excavation.

The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.

Appendix H:

Hydraulic & Hydrologic Input and Output Data

List of Contents:

1. Primary System Existing Conditions HEC-HMS Output (2-,10-,25-,50-, and 100-Year Storms)

2. Primary System Future Conditions HEC-HMS Output (2-,10-,25-,50-, and 100-Year Storms)

3. Primary System Existing Conditions HEC-RAS Output (2-,10-,25-,50-, and 100-Year Storms)
    a. Hardee Creek Main Branch
    b. Hardee Creek UT1

4. Primary System Future Conditions HEC-RAS Output (2-,10-,25-,50-, and 100-Year Storms)
    a. Hardee Creek Main Branch
    b. Hardee Creek UT1

5. Primary System Alternative HEC-RAS Output (2-,10-,25-,50-, and 100-Year Storms)
    a. Hardee Creek Main Branch
    b. Hardee Creek UT1

6. Secondary System Existing Conditions SWMM Input
    a. Quail Hollow/Fox Haven
    b. River Hills

7. Secondary System Existing Conditions SWMM Output (10-Year)
    a. Quail Hollow/Fox Haven
    b. River Hills

8. Secondary System Alternative SWMM Output (10-Year)
    a. River Hills

9. Secondary System Alternative Hydraflow Storm Sewers (10-Year)
    a. Quail Hollow/Fox Haven

PRIMARY SYSTEM EXISTING CONDITIONS: HEC-HMS OUTPUT

2-YEAR EXISTING				
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-1b	0.59	77.8	04Aug2013, 16:40	39.3
HC-1a	0.57	83.8	04Aug2013, 16:35	41.8
RT_HC-1a	0.57	82.7	04Aug2013, 17:20	41.1
Add_1b	1.16	158.7	04Aug2013, 17:00	80.4
RT_HC-1b	1.16	157.3	04Aug2013, 17:30	79.5
HC-1c	0.6	60.8	04Aug2013, 17:40	34.7
Add_1c	1.76	218	04Aug2013, 17:30	114.2
RT_HC-1c	1.76	214.2	04Aug2013, 18:25	109.5
HC-1d	0.19	41.5	04Aug2013, 14:05	10
Add_1d	1.95	220.7	04Aug2013, 18:20	119.5
RT_HC-1(a-d)	1.95	219.9	04Aug2013, 18:45	117.4
HC-2a	0.43	142.6	04Aug2013, 13:55	30.8
RT_2a	0.43	126	04Aug2013, 14:10	30.2
HC-2b	0.35	106.9	04Aug2013, 14:00	23.9
Add_2b	0.78	229.1	04Aug2013, 14:05	54.1
RT_HC-2b	0.78	215.8	04Aug2013, 14:25	53.5
HC-2c	0.48	115.4	04Aug2013, 14:25	32.5
Add_2c	1.26	331.1	04Aug2013, 14:25	86
RT_HC-2c	1.26	320.6	04Aug2013, 15:00	84.8
ADD_2c&1d	3.21	357.3	04Aug2013, 15:00	202.2
HC-3a	0.75	92	04Aug2013, 16:30	45.6
RT_HC-3a	0.75	91.5	04Aug2013, 17:15	44.9
HC-3b	0.25	33	04Aug2013, 14:50	11.5
Add_HC-3b	1	106.7	04Aug2013, 17:00	56.4
RT_HC-3b	1	106.5	04Aug2013, 17:20	55.9
HC-3c	0.2	43.9	04Aug2013, 13:35	7.9
Add_3c	1.2	112.7	04Aug2013, 17:15	63.8
Add_2c&3c	4.41	430.9	04Aug2013, 15:05	266
RT_HC-3c	4.41	425.5	04Aug2013, 15:30	261.7
US End	4.41	425.5	04Aug2013, 15:30	261.7
HC-5a	0.16	18.1	04Aug2013, 15:05	6.9
Add_5a	4.57	442.6	04Aug2013, 15:30	268.6
RT_5a	4.57	437.9	04Aug2013, 15:50	266.8
ADD_5a&5b	4.57	437.9	04Aug2013, 15:50	266.8
HC-4a	0.3	81.2	04Aug2013, 14:00	18.5
HC-4b	0.25	41.2	04Aug2013, 15:05	15.1
Add_4b	0.55	104.3	04Aug2013, 14:10	33.6
RT_HC-4b	0.55	48.8	04Aug2013, 16:20	28.6
ADD_5c	0.55	48.8	04Aug2013, 16:20	28.6
HC-5c	0.18	31.2	04Aug2013, 14:15	8.4
RT_HC-5c	0.73	60.6	04Aug2013, 16:00	36.8
ADD_5cto5b	0.73	60.6	04Aug2013, 16:00	36.8
ADD_5a&cto5b	5.3	498.3	04Aug2013, 15:50	303.5
HC-5b	0.06	14.9	04Aug2013, 13:40	2.8
Add_5b	0.06	14.9	04Aug2013, 13:40	2.8
RT_5b	5.36	491	04Aug2013, 16:05	304
Portertown Road	5.36	491	04Aug2013, 16:05	304
HCUT-1	0.08	8.2	04Aug2013, 18:15	4.9
HCUT-2	0.02	1.3	04Aug2013, 16:50	0.7
ADD_HCUT2-1	0.1	9.3	04Aug2013, 18:00	5.6
HCUT-3	0.04	7	04Aug2013, 14:05	1.8
ADD_HCUT-3-2	0.14	10.7	04Aug2013, 17:45	7.4
RT_HCUT-2-3	0.14	7.6	04Aug2013, 20:35	4.7
Cardinal Road Culvert	0.14	7.6	04Aug2013, 20:35	4.7
HCUT-4	0.03	3	04Aug2013, 14:35	1
RT_HCUT-4	0.03	2.4	04Aug2013, 15:35	0.9

2-YEAR EXISTING				
Hydrologic Element	**Drainage Area (mi^2)**	**Peak Discharge (CFS)**	**Time of Peak**	**Volume (AC-FT)**
ADD_HCUT-4-3	0.17	8.5	04Aug2013, 20:35	5.6
RT_HCUT-3-5	0.17	8.5	04Aug2013, 20:40	5.6
King George Rd Culvert	0.17	8.5	04Aug2013, 20:40	5.6
HCUT-5	0.02	2.8	04Aug2013, 13:40	0.6
ADD_HCUT-5-4	0.19	8.8	04Aug2013, 20:40	6.1
RT_HCUT-4-5	0.19	8.6	04Aug2013, 20:55	5.7
HCUT01 Outlet	0.19	8.6	04Aug2013, 20:55	5.7
HC-6	0.14	24.2	04Aug2013, 14:00	5.8
HCUT1_HC_Confl	5.69	503.2	04Aug2013, 16:05	315.5
RT_HC-6	5.69	500.6	04Aug2013, 16:20	310.1
Railroad	5.69	500.6	04Aug2013, 16:20	310.1
HC-7b	0.14	14.5	04Aug2013, 16:50	7.6
RT_HC-7b	0.14	14.2	04Aug2013, 18:00	7
ADD_6to7b	5.83	509.2	04Aug2013, 16:20	317.1
HC-7c	0.04	1.4	04Aug2013, 15:40	0.7
Add_7bto7c	5.87	510.5	04Aug2013, 16:20	317.8
RT_HC-7c	5.87	507.8	04Aug2013, 16:25	316.5
HC-7a	0.13	3.7	04Aug2013, 17:30	2.2
RT_HC-7a	0.13	3.7	04Aug2013, 17:50	2.2
HC-8c	0.13	25.8	04Aug2013, 13:55	5.8
ADD_HC-7a&cto8c	6.13	517	04Aug2013, 16:25	324.4
RT_HC-8c	6.13	503.9	04Aug2013, 16:55	316.4
HC-8b	0.09	36.2	04Aug2013, 13:40	6.2
RT_HC-8	0.09	32.7	04Aug2013, 13:55	6.1
ADD_8cto8b	6.22	509.3	04Aug2013, 16:55	322.5
RT_HC-8b	6.22	508.8	04Aug2013, 17:00	320.9
HC-8a	0.09	31.3	04Aug2013, 13:30	4.8
ADD_8bto8a	6.31	512.4	04Aug2013, 17:00	325.7
RT_HC-8a	6.31	422.4	04Aug2013, 20:55	245.8
MHB	3.01	484	04Aug2013, 17:00	227.9
ADD MHB	3.01	484	04Aug2013, 23:40	132.7
E. 10th	9.32	776.8	04Aug2013, 23:35	378.5
HC-9	0.18	38.9	04Aug2013, 14:05	9.5
RT_HC-9	0.18	38.9	04Aug2013, 14:10	9.5
ADD_8a&9a	9.5	779.8	04Aug2013, 23:35	387.9
RT_HC-8-9	9.5	773.2	05Aug2013, 00:10	359.9
OUTLET	9.5	773.2	05Aug2013, 00:10	359.9

10-YEAR EXISTING				
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-1b	0.59	174.8	04Aug2013, 16:30	86
HC-1a	0.57	181.4	04Aug2013, 16:25	88.7
RT_HC-1a	0.57	178.7	04Aug2013, 17:05	87.5
Add_1b	1.16	350	04Aug2013, 16:45	173.4
RT_HC-1b	1.16	346.2	04Aug2013, 17:10	171.6
HC-1c	0.6	141.4	04Aug2013, 17:25	78.8
Add_1c	1.76	487.4	04Aug2013, 17:15	250.4
RT_HC-1c	1.76	476.6	04Aug2013, 18:05	241.3
HC-1d	0.19	108.8	04Aug2013, 14:00	23.9
Add_1d	1.95	490.7	04Aug2013, 18:00	265.3
RT_HC-1(a-d)	1.95	488.6	04Aug2013, 18:25	260.8
HC-2a	0.43	321.1	04Aug2013, 13:55	66.7
RT_2a	0.43	286.1	04Aug2013, 14:05	65.7
HC-2b	0.35	245.8	04Aug2013, 13:55	52.5
Add_2b	0.78	526.7	04Aug2013, 14:00	118.2
RT_HC-2b	0.78	503.8	04Aug2013, 14:15	117.6
HC-2c	0.48	266.2	04Aug2013, 14:20	71.5
Add_2c	1.26	768	04Aug2013, 14:15	189
RT_HC-2c	1.26	749.2	04Aug2013, 14:40	187.3
ADD_2c&1d	3.21	866.1	04Aug2013, 14:40	448.1
HC-3a	0.75	215.3	04Aug2013, 16:20	102.8
RT_HC-3a	0.75	214.2	04Aug2013, 16:55	101.5
HC-3b	0.25	91.3	04Aug2013, 14:40	28.8
Add_HC-3b	1	253.3	04Aug2013, 16:40	130.3
RT_HC-3b	1	253	04Aug2013, 16:55	129.4
HC-3c	0.2	135.6	04Aug2013, 13:30	20.9
Add_3c	1.2	268.8	04Aug2013, 16:50	150.3
Add_2c&3c	4.41	1041.3	04Aug2013, 14:45	598.3
RT_HC-3c	4.41	1019.1	04Aug2013, 15:05	588.8
US End	4.41	1019.1	04Aug2013, 15:05	588.8
HC-5a	0.16	51.4	04Aug2013, 14:55	17.6
Add_5a	4.57	1070	04Aug2013, 15:05	606.4
RT_5a	4.57	1060.8	04Aug2013, 15:20	602.3
ADD_5a&5b	4.57	1060.8	04Aug2013, 15:20	602.3
HC-4a	0.3	195.7	04Aug2013, 13:55	42.1
HC-4b	0.25	99.3	04Aug2013, 15:00	34.3
Add_4b	0.55	255.1	04Aug2013, 14:05	76.4
RT_HC-4b	0.55	209.2	04Aug2013, 14:45	68.7
ADD_5c	0.55	209.2	04Aug2013, 14:45	68.7
HC-5c	0.18	86.9	04Aug2013, 14:05	21
RT_HC-5c	0.73	262.3	04Aug2013, 14:55	89.3
ADD_5cto5b	0.73	262.3	04Aug2013, 14:55	89.3
ADD_5a&cto5b	5.3	1280.7	04Aug2013, 15:15	691.6
HC-5b	0.06	41.3	04Aug2013, 13:40	7.1
Add_5b	0.06	41.3	04Aug2013, 13:40	7.1
RT_5b	5.36	1260.3	04Aug2013, 15:25	694.1
Portertown Road	5.36	1260.3	04Aug2013, 15:25	694.1
HCUT-1	0.08	18.3	04Aug2013, 18:00	10.9
HCUT-2	0.02	3.9	04Aug2013, 16:30	1.9
ADD_HCUT2-1	0.1	21.5	04Aug2013, 17:45	12.8
HCUT-3	0.04	20.1	04Aug2013, 14:00	4.5
ADD_HCUT-3-2	0.14	24.7	04Aug2013, 17:20	17.3
RT_HCUT-2-3	0.14	24.7	04Aug2013, 17:25	14.1
Cardinal Road Culvert	0.14	24.7	04Aug2013, 17:25	14.1
HCUT-4	0.03	9.9	04Aug2013, 14:25	2.8
RT_HCUT-4	0.03	12.1	04Aug2013, 14:05	2.6

10-YEAR EXISTING				
Hydrologic Element	**Drainage Area (mi^2)**	**Peak Discharge (CFS)**	**Time of Peak**	**Volume (AC-FT)**
ADD_HCUT-4-3	0.17	27.6	04Aug2013, 17:05	16.7
RT_HCUT-3-5	0.17	27.6	04Aug2013, 17:10	16.7
King George Rd Culvert	0.17	27.6	04Aug2013, 17:10	16.7
HCUT-5	0.02	10.5	04Aug2013, 13:35	1.7
ADD_HCUT-5-4	0.19	28.9	04Aug2013, 17:00	18.4
RT_HCUT-4-5	0.19	28.9	04Aug2013, 17:00	18
HCUT01 Outlet	0.19	28.9	04Aug2013, 17:00	18
HC-6	0.14	72.3	04Aug2013, 13:55	15.1
HCUT1_HC_Confl	5.69	1298.1	04Aug2013, 15:25	727.2
RT_HC-6	5.69	1284.6	04Aug2013, 15:40	718.2
Railroad	5.69	1284.6	04Aug2013, 15:40	718.2
HC-7b	0.14	35.3	04Aug2013, 16:35	17.7
RT_HC-7b	0.14	34.5	04Aug2013, 17:30	16.8
ADD_6to7b	5.83	1301	04Aug2013, 15:40	735
HC-7c	0.04	6.5	04Aug2013, 15:15	2.6
Add_7bto7c	5.87	1307.1	04Aug2013, 15:40	737.6
RT_HC-7c	5.87	1294.6	04Aug2013, 15:45	735
HC-7a	0.13	15.1	04Aug2013, 16:50	8
RT_HC-7a	0.13	15.1	04Aug2013, 17:05	7.9
HC-8c	0.13	74.5	04Aug2013, 13:50	14.7
ADD_HC-7a&cto8c	6.13	1323.5	04Aug2013, 15:45	757.5
RT_HC-8c	6.13	1276.9	04Aug2013, 16:10	743.2
HC-8b	0.09	83	04Aug2013, 13:35	13.6
RT_HC-8	0.09	75.3	04Aug2013, 13:50	13.4
ADD_8cto8b	6.22	1289.5	04Aug2013, 16:10	756.6
RT_HC-8b	6.22	1286.7	04Aug2013, 16:15	754.3
HC-8a	0.09	80.6	04Aug2013, 13:25	11.4
ADD_8bto8a	6.31	1296.1	04Aug2013, 16:15	765.7
RT_HC-8a	6.31	1102.4	04Aug2013, 17:50	675.5
MHB	3.01	1123.6	04Aug2013, 16:00	474.8
ADD MHB	3.01	1123.6	04Aug2013, 22:40	323.6
E. 10th	9.32	1810.8	04Aug2013, 22:25	999.1
HC-9	0.18	102	04Aug2013, 14:00	22.7
RT_HC-9	0.18	101.6	04Aug2013, 14:05	22.6
ADD_8a&9a	9.5	1817.1	04Aug2013, 22:25	1021.8
RT_HC-8-9	9.5	1807.5	04Aug2013, 22:50	976.1
OUTLET	9.5	1807.5	04Aug2013, 22:50	976.1

25-YEAR EXISTING				
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-1b	0.59	248.8	04Aug2013, 16:25	121.8
HC-1a	0.57	254.6	04Aug2013, 16:25	124.2
RT_HC-1a	0.57	250.5	04Aug2013, 17:00	122.7
Add_1b	1.16	494.1	04Aug2013, 16:45	244.5
RT_HC-1b	1.16	488.6	04Aug2013, 17:05	241.8
HC-1c	0.6	203.9	04Aug2013, 17:20	113.1
Add_1c	1.76	692.1	04Aug2013, 17:10	354.9
RT_HC-1c	1.76	673.8	04Aug2013, 18:00	342.7
HC-1d	0.19	161.8	04Aug2013, 14:00	35
Add_1d	1.95	693.2	04Aug2013, 18:00	377.7
RT_HC-1(a-d)	1.95	690.3	04Aug2013, 18:20	371.8
HC-2a	0.43	454.9	04Aug2013, 13:55	94.1
RT_2a	0.43	408.1	04Aug2013, 14:05	92.8
HC-2b	0.35	351.5	04Aug2013, 13:55	74.5
Add_2b	0.78	755.2	04Aug2013, 14:00	167.3
RT_HC-2b	0.78	720.2	04Aug2013, 14:10	166.6
HC-2c	0.48	381	04Aug2013, 14:20	101.5
Add_2c	1.26	1098.6	04Aug2013, 14:15	268
RT_HC-2c	1.26	1074	04Aug2013, 14:35	266
ADD_2c&1d	3.21	1262.8	04Aug2013, 14:35	637.8
HC-3a	0.75	310.9	04Aug2013, 16:15	147.4
RT_HC-3a	0.75	308.9	04Aug2013, 16:50	145.7
HC-3b	0.25	138.8	04Aug2013, 14:40	42.7
Add_HC-3b	1	366.4	04Aug2013, 16:35	188.4
RT_HC-3b	1	365.9	04Aug2013, 16:50	187.3
HC-3c	0.2	211.9	04Aug2013, 13:30	31.6
Add_3c	1.2	388.5	04Aug2013, 16:45	218.9
Add_2c&3c	4.41	1508.1	04Aug2013, 14:35	856.7
RT_HC-3c	4.41	1479.5	04Aug2013, 15:00	844.4
US End	4.41	1479.5	04Aug2013, 15:00	844.4
HC-5a	0.16	78.8	04Aug2013, 14:50	26.3
Add_5a	4.57	1557.9	04Aug2013, 15:00	870.7
RT_5a	4.57	1543.5	04Aug2013, 15:10	864.9
ADD_5a&5b	4.57	1543.5	04Aug2013, 15:10	864.9
HC-4a	0.3	284.4	04Aug2013, 13:55	60.4
HC-4b	0.25	144.5	04Aug2013, 14:55	49.4
Add_4b	0.55	372.5	04Aug2013, 14:05	109.8
RT_HC-4b	0.55	371.3	04Aug2013, 14:10	100.9
ADD_5c	0.55	371.3	04Aug2013, 14:10	100.9
HC-5c	0.18	132.1	04Aug2013, 14:05	31.1
RT_HC-5c	0.73	491.6	04Aug2013, 14:20	131.6
ADD_5cto5b	0.73	491.6	04Aug2013, 14:20	131.6
ADD_5a&cto5b	5.3	1884.3	04Aug2013, 15:05	996.5
HC-5b	0.06	62.4	04Aug2013, 13:40	10.5
Add_5b	0.06	62.4	04Aug2013, 13:40	10.5
RT_5b	5.36	1861.2	04Aug2013, 15:15	1000.7
Portertown Road	5.36	1861.2	04Aug2013, 15:15	1000.7
HCUT-1	0.08	26	04Aug2013, 17:55	15.4
HCUT-2	0.02	6.1	04Aug2013, 16:25	3
ADD_HCUT2-1	0.1	30.9	04Aug2013, 17:35	18.4
HCUT-3	0.04	30.7	04Aug2013, 14:00	6.7
ADD_HCUT-3-2	0.14	36.3	04Aug2013, 14:05	25.1
RT_HCUT-2-3	0.14	35.6	04Aug2013, 17:15	21.9
Cardinal Road Culvert	0.14	35.6	04Aug2013, 17:15	21.9
HCUT-4	0.03	15.9	04Aug2013, 14:20	4.3
RT_HCUT-4	0.03	15.9	04Aug2013, 14:20	4.1

25-YEAR EXISTING				
Hydrologic Element	**Drainage Area (mi^2)**	**Peak Discharge (CFS)**	**Time of Peak**	**Volume (AC-FT)**
ADD_HCUT-4-3	0.17	42.7	04Aug2013, 14:50	26
RT_HCUT-3-5	0.17	42.5	04Aug2013, 14:50	26
King George Rd Culvert	0.17	42.5	04Aug2013, 14:50	26
HCUT-5	0.02	17.2	04Aug2013, 13:35	2.7
ADD_HCUT-5-4	0.19	46.6	04Aug2013, 14:50	28.7
RT_HCUT-4-5	0.19	46.6	04Aug2013, 14:50	28.2
HCUT01 Outlet	0.19	46.6	04Aug2013, 14:50	28.2
HC-6	0.14	111.8	04Aug2013, 13:50	22.8
HCUT1_HC_Confl	5.69	1940.8	04Aug2013, 15:15	1051.7
RT_HC-6	5.69	1924.8	04Aug2013, 15:25	1040.9
Railroad	5.69	1924.8	04Aug2013, 15:25	1040.9
HC-7b	0.14	51.7	04Aug2013, 16:35	25.7
RT_HC-7b	0.14	50.5	04Aug2013, 17:20	24.6
ADD_6to7b	5.83	1946.9	04Aug2013, 15:25	1065.5
HC-7c	0.04	11.5	04Aug2013, 15:05	4.3
Add_7bto7c	5.87	1958.1	04Aug2013, 15:25	1069.8
RT_HC-7c	5.87	1941.4	04Aug2013, 15:30	1066.4
HC-7a	0.13	26.1	04Aug2013, 16:40	13.2
RT_HC-7a	0.13	26.1	04Aug2013, 16:50	13.1
HC-8c	0.13	113.7	04Aug2013, 13:50	21.9
ADD_HC-7a&cto8c	6.13	1988.1	04Aug2013, 15:30	1101.4
RT_HC-8c	6.13	1918.5	04Aug2013, 15:50	1082.8
HC-8b	0.09	118.5	04Aug2013, 13:35	19.3
RT_HC-8	0.09	107.9	04Aug2013, 13:50	19.1
ADD_8cto8b	6.22	1937.7	04Aug2013, 15:50	1101.9
RT_HC-8b	6.22	1934.6	04Aug2013, 15:55	1099
HC-8a	0.09	120	04Aug2013, 13:25	16.7
ADD_8bto8a	6.31	1948.6	04Aug2013, 15:55	1115.8
RT_HC-8a	6.31	1697.4	04Aug2013, 16:50	1019.8
MHB	3.01	1556.6	04Aug2013, 15:50	662.4
ADD MHB	3.01	1556.6	04Aug2013, 22:30	472.2
E. 10th	9.32	2515.9	04Aug2013, 22:10	1492
HC-9	0.18	151.7	04Aug2013, 14:00	33.2
RT_HC-9	0.18	151.2	04Aug2013, 14:05	33.1
ADD_8a&9a	9.5	2524.7	04Aug2013, 22:10	1525.1
RT_HC-8-9	9.5	2515.5	04Aug2013, 22:30	1468.1
OUTLET	9.5	2515.5	04Aug2013, 22:30	1468.1

50-YEAR EXISTING				
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-1b	0.59	315.7	04Aug2013, 16:25	154.5
HC-1a	0.57	320.5	04Aug2013, 16:20	156.4
RT_HC-1a	0.57	315.1	04Aug2013, 16:55	154.6
Add_1b	1.16	624.4	04Aug2013, 16:40	309.1
RT_HC-1b	1.16	617.4	04Aug2013, 17:05	305.6
HC-1c	0.6	261	04Aug2013, 17:15	144.7
Add_1c	1.76	877.4	04Aug2013, 17:05	450.3
RT_HC-1c	1.76	855.5	04Aug2013, 17:55	435.8
HC-1d	0.19	210.6	04Aug2013, 13:55	45.3
Add_1d	1.95	880.1	04Aug2013, 17:55	481.1
RT_HC-1(a-d)	1.95	877	04Aug2013, 18:15	474.1
HC-2a	0.43	575	04Aug2013, 13:55	119
RT_2a	0.43	518.8	04Aug2013, 14:05	117.7
HC-2b	0.35	446.8	04Aug2013, 13:55	94.6
Add_2b	0.78	961	04Aug2013, 14:00	212.3
RT_HC-2b	0.78	921.8	04Aug2013, 14:10	211.4
HC-2c	0.48	484.6	04Aug2013, 14:20	128.9
Add_2c	1.26	1397.9	04Aug2013, 14:10	340.3
RT_HC-2c	1.26	1368.8	04Aug2013, 14:30	338.2
ADD_2c&1d	3.21	1623.8	04Aug2013, 14:30	812.3
HC-3a	0.75	397.9	04Aug2013, 16:15	188.3
RT_HC-3a	0.75	395.2	04Aug2013, 16:45	186.3
HC-3b	0.25	182.8	04Aug2013, 14:40	55.8
Add_HC-3b	1	470.3	04Aug2013, 16:30	242.1
RT_HC-3b	1	469.3	04Aug2013, 16:45	240.6
HC-3c	0.2	283.2	04Aug2013, 13:30	41.8
Add_3c	1.2	498.2	04Aug2013, 16:40	282.3
Add_2c&3c	4.41	1942	04Aug2013, 14:35	1094.7
RT_HC-3c	4.41	1909.2	04Aug2013, 14:55	1080.1
US End	4.41	1909.2	04Aug2013, 14:55	1080.1
HC-5a	0.16	104.6	04Aug2013, 14:50	34.5
Add_5a	4.57	2013.6	04Aug2013, 14:55	1114.6
RT_5a	4.57	1997	04Aug2013, 15:05	1107.2
ADD_5a&5b	4.57	1997	04Aug2013, 15:05	1107.2
HC-4a	0.3	364.9	04Aug2013, 13:55	77.3
HC-4b	0.25	185.7	04Aug2013, 14:55	63.2
Add_4b	0.55	479.3	04Aug2013, 14:05	140.5
RT_HC-4b	0.55	478.7	04Aug2013, 14:05	130.6
ADD_5c	0.55	478.7	04Aug2013, 14:05	130.6
HC-5c	0.18	174	04Aug2013, 14:05	40.6
RT_HC-5c	0.73	650.7	04Aug2013, 14:10	170.7
ADD_5cto5b	0.73	650.7	04Aug2013, 14:10	170.7
ADD_5a&cto5b	5.3	2451.3	04Aug2013, 15:00	1277.9
HC-5b	0.06	82	04Aug2013, 13:35	13.6
Add_5b	0.06	82	04Aug2013, 13:35	13.6
RT_5b	5.36	2427.3	04Aug2013, 15:10	1283.9
Portertown Road	5.36	2427.3	04Aug2013, 15:10	1283.9
HCUT-1	0.08	33	04Aug2013, 17:55	19.6
HCUT-2	0.02	8.2	04Aug2013, 16:20	3.9
ADD_HCUT2-1	0.1	39.6	04Aug2013, 17:30	23.5
HCUT-3	0.04	40.6	04Aug2013, 14:00	8.8
ADD_HCUT-3-2	0.14	48.5	04Aug2013, 14:00	32.3
RT_HCUT-2-3	0.14	45.7	04Aug2013, 17:10	29.1
Cardinal Road Culvert	0.14	45.7	04Aug2013, 17:10	29.1
HCUT-4	0.03	21.6	04Aug2013, 14:20	5.8
RT_HCUT-4	0.03	21.5	04Aug2013, 14:20	5.5

50-YEAR EXISTING				
Hydrologic Element	**Drainage Area (mi^2)**	**Peak Discharge (CFS)**	**Time of Peak**	**Volume (AC-FT)**
ADD_HCUT-4-3	0.17	65	04Aug2013, 14:25	34.6
RT_HCUT-3-5	0.17	64.5	04Aug2013, 14:30	34.6
King George Rd Culvert	0.17	64.5	04Aug2013, 14:30	34.6
HCUT-5	0.02	23.6	04Aug2013, 13:35	3.7
ADD_HCUT-5-4	0.19	71.8	04Aug2013, 14:25	38.3
RT_HCUT-4-5	0.19	71.8	04Aug2013, 14:25	37.7
HCUT01 Outlet	0.19	71.8	04Aug2013, 14:25	37.7
HC-6	0.14	149	04Aug2013, 13:50	29.9
HCUT1_HC_Confl	5.69	2536.8	04Aug2013, 15:05	1351.5
RT_HC-6	5.69	2517	04Aug2013, 15:15	1338.6
Railroad	5.69	2517	04Aug2013, 15:15	1338.6
HC-7b	0.14	66.7	04Aug2013, 16:30	33.1
RT_HC-7b	0.14	65.3	04Aug2013, 17:15	31.8
ADD_6to7b	5.83	2543.8	04Aug2013, 15:15	1370.4
HC-7c	0.04	16.5	04Aug2013, 15:05	5.9
Add_7bto7c	5.87	2560.1	04Aug2013, 15:15	1376.3
RT_HC-7c	5.87	2539.1	04Aug2013, 15:20	1372.2
HC-7a	0.13	37.2	04Aug2013, 16:30	18.5
RT_HC-7a	0.13	37.2	04Aug2013, 16:45	18.3
HC-8c	0.13	150.6	04Aug2013, 13:45	28.7
ADD_HC-7a&cto8c	6.13	2603.4	04Aug2013, 15:20	1419.2
RT_HC-8c	6.13	2518.3	04Aug2013, 15:40	1397
HC-8b	0.09	150.5	04Aug2013, 13:35	24.4
RT_HC-8	0.09	136	04Aug2013, 13:50	24.2
ADD_8cto8b	6.22	2543.7	04Aug2013, 15:40	1421.2
RT_HC-8b	6.22	2538.1	04Aug2013, 15:45	1417.9
HC-8a	0.09	156.1	04Aug2013, 13:25	21.6
ADD_8bto8a	6.31	2556.3	04Aug2013, 15:45	1439.6
RT_HC-8a	6.31	2256.9	04Aug2013, 16:30	1338.7
MHB	3.01	1936.5	04Aug2013, 15:45	832.6
ADD MHB	3.01	1936.5	04Aug2013, 22:25	608.5
E. 10th	9.32	3123.7	04Aug2013, 22:05	1947.2
HC-9	0.18	197.3	04Aug2013, 14:00	42.9
RT_HC-9	0.18	196.8	04Aug2013, 14:00	42.9
ADD_8a&9a	9.5	3134.6	04Aug2013, 22:05	1990.1
RT_HC-8-9	9.5	3125.7	04Aug2013, 22:25	1924
OUTLET	9.5	3125.7	04Aug2013, 22:25	1924

100-YEAR EXISTING				
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-1b	0.59	391	04Aug2013, 16:25	191.6
HC-1a	0.57	394.4	04Aug2013, 16:20	192.9
RT_HC-1a	0.57	387.6	04Aug2013, 16:55	190.5
Add_1b	1.16	771.2	04Aug2013, 16:40	382.1
RT_HC-1b	1.16	762.6	04Aug2013, 17:00	378
HC-1c	0.6	325.7	04Aug2013, 17:15	180.8
Add_1c	1.76	1086.9	04Aug2013, 17:05	558.8
RT_HC-1c	1.76	1060.8	04Aug2013, 17:50	542
HC-1d	0.19	266.5	04Aug2013, 13:55	57.2
Add_1d	1.95	1091.3	04Aug2013, 17:50	599.2
RT_HC-1(a-d)	1.95	1088.2	04Aug2013, 18:05	591
HC-2a	0.43	709.9	04Aug2013, 13:50	147.3
RT_2a	0.43	644	04Aug2013, 14:00	145.8
HC-2b	0.35	553.9	04Aug2013, 13:55	117.4
Add_2b	0.78	1191.2	04Aug2013, 14:00	263.2
RT_HC-2b	0.78	1147.8	04Aug2013, 14:10	262.2
HC-2c	0.48	601	04Aug2013, 14:20	160
Add_2c	1.26	1740.2	04Aug2013, 14:10	422.3
RT_HC-2c	1.26	1703.7	04Aug2013, 14:30	419.6
ADD_2c&1d	3.21	2036.6	04Aug2013, 14:30	1010.6
HC-3a	0.75	496.4	04Aug2013, 16:10	234.9
RT_HC-3a	0.75	493.1	04Aug2013, 16:45	232.6
HC-3b	0.25	233.3	04Aug2013, 14:35	70.8
Add_HC-3b	1	588.5	04Aug2013, 16:25	303.4
RT_HC-3b	1	587.5	04Aug2013, 16:40	301.5
HC-3c	0.2	365.3	04Aug2013, 13:30	53.6
Add_3c	1.2	623.9	04Aug2013, 16:35	355.1
Add_2c&3c	4.41	2439	04Aug2013, 14:30	1365.7
RT_HC-3c	4.41	2397.3	04Aug2013, 14:50	1349
US End	4.41	2397.3	04Aug2013, 14:50	1349
HC-5a	0.16	134.2	04Aug2013, 14:50	44
Add_5a	4.57	2531.5	04Aug2013, 14:50	1393
RT_5a	4.57	2512.6	04Aug2013, 15:00	1383.9
ADD_5a&5b	4.57	2512.6	04Aug2013, 15:00	1383.9
HC-4a	0.3	455.8	04Aug2013, 13:55	96.5
HC-4b	0.25	232.4	04Aug2013, 14:55	79
Add_4b	0.55	600.3	04Aug2013, 14:05	175.5
RT_HC-4b	0.55	600.1	04Aug2013, 14:05	164.6
ADD_5c	0.55	600.1	04Aug2013, 14:05	164.6
HC-5c	0.18	221.9	04Aug2013, 14:05	51.5
RT_HC-5c	0.73	819.7	04Aug2013, 14:10	215.6
ADD_5cto5b	0.73	819.7	04Aug2013, 14:10	215.6
ADD_5a&cto5b	5.3	3096.6	04Aug2013, 14:55	1599.5
HC-5b	0.06	104.6	04Aug2013, 13:35	17.3
Add_5b	0.06	104.6	04Aug2013, 13:35	17.3
RT_5b	5.36	3071	04Aug2013, 15:00	1607.3
Portertown Road	5.36	3071	04Aug2013, 15:00	1607.3
HCUT-1	0.08	40.9	04Aug2013, 17:50	24.4
HCUT-2	0.02	10.6	04Aug2013, 16:15	5
ADD_HCUT2-1	0.1	49.5	04Aug2013, 17:25	29.4
HCUT-3	0.04	52.1	04Aug2013, 13:55	11.2
ADD_HCUT-3-2	0.14	62.6	04Aug2013, 14:00	40.6
RT_HCUT-2-3	0.14	60.5	04Aug2013, 14:15	37.4
Cardinal Road Culvert	0.14	60.5	04Aug2013, 14:15	37.4
HCUT-4	0.03	28.2	04Aug2013, 14:20	7.5
RT_HCUT-4	0.03	28.2	04Aug2013, 14:20	7.2

100-YEAR EXISTING				
Hydrologic Element	**Drainage Area (mi^2)**	**Peak Discharge (CFS)**	**Time of Peak**	**Volume (AC-FT)**
ADD_HCUT-4-3	0.17	88.5	04Aug2013, 14:15	44.6
RT_HCUT-3-5	0.17	88	04Aug2013, 14:20	44.6
King George Rd Culvert	0.17	88	04Aug2013, 14:20	44.6
HCUT-5	0.02	31.1	04Aug2013, 13:30	4.8
ADD_HCUT-5-4	0.19	100	04Aug2013, 14:15	49.3
RT_HCUT-4-5	0.19	99.9	04Aug2013, 14:15	48.7
HCUT01 Outlet	0.19	99.9	04Aug2013, 14:15	48.7
HC-6	0.14	191.8	04Aug2013, 13:50	38.3
HCUT1_HC_Confl	5.69	3218.5	04Aug2013, 15:00	1694.3
RT_HC-6	5.69	3188.2	04Aug2013, 15:10	1679.6
Railroad	5.69	3188.2	04Aug2013, 15:10	1679.6
HC-7b	0.14	83.9	04Aug2013, 16:30	41.6
RT_HC-7b	0.14	82.1	04Aug2013, 17:10	40.1
ADD_6to7b	5.83	3222.5	04Aug2013, 15:10	1719.7
HC-7c	0.04	22.5	04Aug2013, 15:00	7.9
Add_7bto7c	5.87	3244.9	04Aug2013, 15:10	1727.7
RT_HC-7c	5.87	3219.7	04Aug2013, 15:15	1722.8
HC-7a	0.13	50.6	04Aug2013, 16:25	24.7
RT_HC-7a	0.13	50.6	04Aug2013, 16:40	24.6
HC-8c	0.13	193	04Aug2013, 13:45	36.5
ADD_HC-7a&cto8c	6.13	3304.9	04Aug2013, 15:15	1783.8
RT_HC-8c	6.13	3229.8	04Aug2013, 15:30	1759.5
HC-8b	0.09	186.3	04Aug2013, 13:35	30.3
RT_HC-8	0.09	169.3	04Aug2013, 13:45	30.1
ADD_8cto8b	6.22	3263	04Aug2013, 15:30	1789.6
RT_HC-8b	6.22	3254.3	04Aug2013, 15:35	1785.9
HC-8a	0.09	197.1	04Aug2013, 13:25	27.3
ADD_8bto8a	6.31	3277.8	04Aug2013, 15:30	1813.2
RT_HC-8a	6.31	2858.5	04Aug2013, 16:20	1706.9
MHB	3.01	2357.1	04Aug2013, 15:40	1025.4
ADD MHB	3.01	2357.1	04Aug2013, 22:20	764.5
E. 10th	9.32	3794.3	04Aug2013, 21:55	2471.4
HC-9	0.18	249.2	04Aug2013, 14:00	54.1
RT_HC-9	0.18	249.3	04Aug2013, 14:00	54.1
ADD_8a&9a	9.5	3807.7	04Aug2013, 21:55	2525.4
RT_HC-8-9	9.5	3798.1	04Aug2013, 22:15	2450.7
OUTLET	9.5	3798.1	04Aug2013, 22:15	2450.7

PRIMARY SYSTEM FUTURE CONDITIONS: HEC-HMS OUTPUT

2-YEAR FUTURE				
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-1b	0.59	95.5	04Aug2013, 16:35	47.4
HC-1a	0.57	97.1	04Aug2013, 16:30	47.9
RT_HC-1a	0.57	95.9	04Aug2013, 17:10	47.1
Add_1b	1.16	189	04Aug2013, 16:55	94.6
RT_HC-1b	1.16	187.3	04Aug2013, 17:20	93.6
HC-1c	0.6	67.9	04Aug2013, 17:35	38.4
Add_1c	1.76	254.9	04Aug2013, 17:25	132
RT_HC-1c	1.76	250.3	04Aug2013, 18:15	126.9
HC-1d	0.19	41.5	04Aug2013, 14:05	10
Add_1d	1.95	256.9	04Aug2013, 18:15	136.9
RT_HC-1(a-d)	1.95	255.6	04Aug2013, 18:40	134.5
HC-2a	0.43	192.9	04Aug2013, 13:55	40.3
RT_2a	0.43	171.3	04Aug2013, 14:10	39.6
HC-2b	0.35	125.8	04Aug2013, 14:00	27.5
Add_2b	0.78	294.2	04Aug2013, 14:05	67.1
RT_HC-2b	0.78	274.9	04Aug2013, 14:25	66.4
HC-2c	0.48	115.4	04Aug2013, 14:25	32.5
Add_2c	1.26	390.2	04Aug2013, 14:25	98.9
RT_HC-2c	1.26	377.5	04Aug2013, 14:55	97.5
ADD_2c&1d	3.21	419.1	04Aug2013, 14:55	232
HC-3a	0.75	97.4	04Aug2013, 16:30	47.9
RT_HC-3a	0.75	96.9	04Aug2013, 17:10	47.3
HC-3b	0.25	38.1	04Aug2013, 14:50	12.9
Add_HC-3b	1	113.8	04Aug2013, 17:00	60.2
RT_HC-3b	1	113.6	04Aug2013, 17:20	59.7
HC-3c	0.2	52.2	04Aug2013, 13:35	8.9
Add_3c	1.2	120.4	04Aug2013, 17:15	68.6
Add_2c&3c	4.41	499.9	04Aug2013, 15:00	300.7
RT_HC-3c	4.41	492.8	04Aug2013, 15:30	295.7
US End	4.41	492.8	04Aug2013, 15:30	295.7
HC-5a	0.16	21	04Aug2013, 15:05	7.8
Add_5a	4.57	512.7	04Aug2013, 15:25	303.5
RT_5a	4.57	507.3	04Aug2013, 15:45	301.5
ADD_5a&5b	4.57	507.3	04Aug2013, 15:45	301.5
HC-4a	0.3	86.4	04Aug2013, 14:00	19.5
HC-4b	0.25	46.3	04Aug2013, 15:05	16.7
Add_4b	0.55	113.2	04Aug2013, 14:10	36.2
RT_HC-4b	0.55	54.1	04Aug2013, 16:15	31
ADD_5c	0.55	54.1	04Aug2013, 16:15	31
HC-5c	0.18	33.7	04Aug2013, 14:10	8.9
RT_HC-5c	0.73	66.8	04Aug2013, 16:00	39.6
ADD_5cto5b	0.73	66.8	04Aug2013, 16:00	39.6
ADD_5a&cto5b	5.3	573.9	04Aug2013, 15:45	341.1
HC-5b	0.06	14.9	04Aug2013, 13:40	2.8
Add_5b	0.06	14.9	04Aug2013, 13:40	2.8
RT_5b	5.36	564.4	04Aug2013, 16:00	341.3
Portertown Road	5.36	564.4	04Aug2013, 16:00	341.3
HCUT-1	0.08	8.2	04Aug2013, 18:15	4.9
HCUT-2	0.02	1.3	04Aug2013, 16:50	0.7
ADD_HCUT2-1	0.1	9.3	04Aug2013, 18:00	5.6
HCUT-3	0.04	7	04Aug2013, 14:05	1.8
ADD_HCUT-3-2	0.14	10.7	04Aug2013, 17:45	7.4
RT_HCUT-2-3	0.14	7.6	04Aug2013, 20:35	4.7
Cardinal Road Culvert	0.14	7.6	04Aug2013, 20:35	4.7
HCUT-4	0.03	3.9	04Aug2013, 14:30	1.2
RT_HCUT-4	0.03	4.2	04Aug2013, 14:55	1.1

2-YEAR FUTURE				
Hydrologic Element	**Drainage Area (mi^2)**	**Peak Discharge (CFS)**	**Time of Peak**	**Volume (AC-FT)**
ADD_HCUT-4-3	0.17	8.6	04Aug2013, 20:35	5.8
RT_HCUT-3-5	0.17	8.6	04Aug2013, 20:40	5.8
King George Rd Culvert	0.17	8.6	04Aug2013, 20:40	5.8
HCUT-5	0.02	3.8	04Aug2013, 13:40	0.7
ADD_HCUT-5-4	0.19	8.9	04Aug2013, 20:40	6.5
RT_HCUT-4-5	0.19	8.7	04Aug2013, 20:55	6
HCUT01 Outlet	0.19	8.7	04Aug2013, 20:55	6
HC-6	0.14	26.3	04Aug2013, 14:00	6.2
HCUT1_HC_Confl	5.69	577.9	04Aug2013, 16:00	353.5
RT_HC-6	5.69	574	04Aug2013, 16:15	347.9
Railroad	5.69	574	04Aug2013, 16:15	347.9
HC-7b	0.14	26.8	04Aug2013, 16:35	13.3
RT_HC-7b	0.14	26.2	04Aug2013, 17:30	12.7
ADD_6to7b	5.83	593.9	04Aug2013, 16:15	360.5
HC-7c	0.04	2.1	04Aug2013, 15:30	1
Add_7bto7c	5.87	595.8	04Aug2013, 16:15	361.5
RT_HC-7c	5.87	592.8	04Aug2013, 16:20	360
HC-7a	0.13	4.1	04Aug2013, 17:25	2.4
RT_HC-7a	0.13	4.1	04Aug2013, 17:45	2.4
HC-8c	0.13	25.8	04Aug2013, 13:55	5.8
ADD_HC-7a&cto8c	6.13	602.6	04Aug2013, 16:20	368.1
RT_HC-8c	6.13	587	04Aug2013, 16:50	359.5
HC-8b	0.09	38.2	04Aug2013, 13:40	6.5
RT_HC-8	0.09	34.3	04Aug2013, 13:55	6.4
ADD_8cto8b	6.22	592.7	04Aug2013, 16:50	365.9
RT_HC-8b	6.22	591.9	04Aug2013, 16:50	364.2
HC-8a	0.09	31.3	04Aug2013, 13:30	4.8
ADD_8bto8a	6.31	595.8	04Aug2013, 16:50	369
RT_HC-8a	6.31	509.1	04Aug2013, 20:15	287
MHB	3.01	546.9	04Aug2013, 16:05	236.1
ADD MHB	3.01	546.9	04Aug2013, 22:45	158.2
E. 10th	9.32	925.3	04Aug2013, 22:40	445.3
HC-9	0.18	60	04Aug2013, 14:00	13.5
RT_HC-9	0.18	59.8	04Aug2013, 14:05	13.5
ADD_8a&9a	9.5	929.2	04Aug2013, 22:40	458.8
RT_HC-8-9	9.5	906.7	04Aug2013, 23:15	433.2
OUTLET	9.5	906.7	04Aug2013, 23:15	433.2

10-YEAR FUTURE				
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-1b	0.59	199.4	04Aug2013, 16:25	97.6
HC-1a	0.57	199.4	04Aug2013, 16:25	97.3
RT_HC-1a	0.57	196.4	04Aug2013, 17:00	96
Add_1b	1.16	391.5	04Aug2013, 16:45	193.6
RT_HC-1b	1.16	387.2	04Aug2013, 17:10	191.6
HC-1c	0.6	151.8	04Aug2013, 17:20	84.4
Add_1c	1.76	538.4	04Aug2013, 17:10	276
RT_HC-1c	1.76	523.3	04Aug2013, 18:05	266.1
HC-1d	0.19	108.8	04Aug2013, 14:00	23.9
Add_1d	1.95	537.2	04Aug2013, 18:05	290.1
RT_HC-1(a-d)	1.95	535.2	04Aug2013, 18:25	285.4
HC-2a	0.43	386.3	04Aug2013, 13:55	79.9
RT_2a	0.43	346.2	04Aug2013, 14:05	78.8
HC-2b	0.35	272	04Aug2013, 13:55	57.7
Add_2b	0.78	614.6	04Aug2013, 14:00	136.6
RT_HC-2b	0.78	587.9	04Aug2013, 14:15	136
HC-2c	0.48	266.2	04Aug2013, 14:20	71.5
Add_2c	1.26	852.2	04Aug2013, 14:15	207.4
RT_HC-2c	1.26	830.8	04Aug2013, 14:40	205.7
ADD_2c&1d	3.21	959.4	04Aug2013, 14:40	491
HC-3a	0.75	223.3	04Aug2013, 16:20	106.4
RT_HC-3a	0.75	222	04Aug2013, 16:55	105.1
HC-3b	0.25	99.6	04Aug2013, 14:40	31
Add_HC-3b	1	263.9	04Aug2013, 16:35	136.1
RT_HC-3b	1	263.6	04Aug2013, 16:50	135.2
HC-3c	0.2	149.3	04Aug2013, 13:30	22.7
Add_3c	1.2	280.5	04Aug2013, 16:45	157.9
Add_2c&3c	4.41	1145.7	04Aug2013, 14:40	648.9
RT_HC-3c	4.41	1120.7	04Aug2013, 15:05	639
US End	4.41	1120.7	04Aug2013, 15:05	639
HC-5a	0.16	56.3	04Aug2013, 14:55	19
Add_5a	4.57	1176.3	04Aug2013, 15:05	658
RT_5a	4.57	1166.2	04Aug2013, 15:15	653.6
ADD_5a&5b	4.57	1166.2	04Aug2013, 15:15	653.6
HC-4a	0.3	203.2	04Aug2013, 13:55	43.5
HC-4b	0.25	106.9	04Aug2013, 15:00	36.7
Add_4b	0.55	268.3	04Aug2013, 14:05	80.3
RT_HC-4b	0.55	231.6	04Aug2013, 14:35	72.4
ADD_5c	0.55	231.6	04Aug2013, 14:35	72.4
HC-5c	0.18	90.9	04Aug2013, 14:05	21.8
RT_HC-5c	0.73	296.3	04Aug2013, 14:45	93.9
ADD_5cto5b	0.73	296.3	04Aug2013, 14:45	93.9
ADD_5a&cto5b	5.3	1403.2	04Aug2013, 15:15	747.5
HC-5b	0.06	41.3	04Aug2013, 13:40	7.1
Add_5b	0.06	41.3	04Aug2013, 13:40	7.1
RT_5b	5.36	1381.8	04Aug2013, 15:25	749.8
Portertown Road	5.36	1381.8	04Aug2013, 15:25	749.8
HCUT-1	0.08	18.3	04Aug2013, 18:00	10.9
HCUT-2	0.02	3.9	04Aug2013, 16:30	1.9
ADD_HCUT2-1	0.1	21.5	04Aug2013, 17:45	12.8
HCUT-3	0.04	20.1	04Aug2013, 14:00	4.5
ADD_HCUT-3-2	0.14	24.7	04Aug2013, 17:20	17.3
RT_HCUT-2-3	0.14	24.7	04Aug2013, 17:25	14.1
Cardinal Road Culvert	0.14	24.7	04Aug2013, 17:25	14.1
HCUT-4	0.03	11.5	04Aug2013, 14:25	3.2
RT_HCUT-4	0.03	11.6	04Aug2013, 14:20	3

10-YEAR FUTURE				
Hydrologic Element	**Drainage Area (mi^2)**	**Peak Discharge (CFS)**	**Time of Peak**	**Volume (AC-FT)**
ADD_HCUT-4-3	0.17	27.9	04Aug2013, 17:05	17.1
RT_HCUT-3-5	0.17	27.9	04Aug2013, 17:05	17.1
King George Rd Culvert	0.17	27.9	04Aug2013, 17:05	17.1
HCUT-5	0.02	12.4	04Aug2013, 13:35	2
ADD_HCUT-5-4	0.19	29.4	04Aug2013, 16:55	19.1
RT_HCUT-4-5	0.19	30.4	04Aug2013, 16:00	18.6
HCUT01 Outlet	0.19	30.4	04Aug2013, 16:00	18.6
HC-6	0.14	75.8	04Aug2013, 13:55	15.8
HCUT1_HC_Confl	5.69	1421.5	04Aug2013, 15:25	784.1
RT_HC-6	5.69	1407.4	04Aug2013, 15:35	774.8
Railroad	5.69	1407.4	04Aug2013, 15:35	774.8
HC-7b	0.14	52.4	04Aug2013, 16:30	26
RT_HC-7b	0.14	51.2	04Aug2013, 17:15	25
ADD_6to7b	5.83	1437.3	04Aug2013, 15:35	799.8
HC-7c	0.04	8	04Aug2013, 15:10	3
Add_7bto7c	5.87	1444.9	04Aug2013, 15:35	802.8
RT_HC-7c	5.87	1429.3	04Aug2013, 15:40	800.2
HC-7a	0.13	16.1	04Aug2013, 16:45	8.4
RT_HC-7a	0.13	16.1	04Aug2013, 17:00	8.3
HC-8c	0.13	74.5	04Aug2013, 13:50	14.7
ADD_HC-7a&cto8c	6.13	1459.3	04Aug2013, 15:40	823.2
RT_HC-8c	6.13	1406.4	04Aug2013, 16:05	808.3
HC-8b	0.09	86	04Aug2013, 13:35	14
RT_HC-8	0.09	78	04Aug2013, 13:50	13.9
ADD_8cto8b	6.22	1419.7	04Aug2013, 16:05	822.2
RT_HC-8b	6.22	1416.4	04Aug2013, 16:05	819.7
HC-8a	0.09	80.6	04Aug2013, 13:25	11.4
ADD_8bto8a	6.31	1426.2	04Aug2013, 16:05	831.2
RT_HC-8a	6.31	1214.6	04Aug2013, 17:30	740.2
MHB	3.01	1194.9	04Aug2013, 15:30	486.5
ADD MHB	3.01	1194.9	04Aug2013, 22:10	360.4
E. 10th	9.32	2004.5	04Aug2013, 21:50	1100.5
HC-9	0.18	132.1	04Aug2013, 14:00	28.8
RT_HC-9	0.18	131.7	04Aug2013, 14:00	28.7
ADD_8a&9a	9.5	2012.1	04Aug2013, 21:50	1129.3
RT_HC-8-9	9.5	2006.7	04Aug2013, 22:15	1086.3
OUTLET	9.5	2006.7	04Aug2013, 22:15	1086.3

25-YEAR FUTURE				
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-1b	0.59	276.2	04Aug2013, 16:25	135.2
HC-1a	0.57	274.5	04Aug2013, 16:20	134
RT_HC-1a	0.57	270	04Aug2013, 16:55	132.4
Add_1b	1.16	540.5	04Aug2013, 16:40	267.7
RT_HC-1b	1.16	534.4	04Aug2013, 17:05	264.9
HC-1c	0.6	215.9	04Aug2013, 17:15	119.7
Add_1c	1.76	749.4	04Aug2013, 17:10	384.6
RT_HC-1c	1.76	730	04Aug2013, 18:00	371.9
HC-1d	0.19	161.8	04Aug2013, 14:00	35
Add_1d	1.95	749.8	04Aug2013, 17:55	406.9
RT_HC-1(a-d)	1.95	746.8	04Aug2013, 18:20	400.8
HC-2a	0.43	525.9	04Aug2013, 13:50	109.2
RT_2a	0.43	474.7	04Aug2013, 14:00	108
HC-2b	0.35	380.7	04Aug2013, 13:55	80.6
Add_2b	0.78	851.5	04Aug2013, 14:00	188.6
RT_HC-2b	0.78	817.4	04Aug2013, 14:10	187.9
HC-2c	0.48	381	04Aug2013, 14:20	101.5
Add_2c	1.26	1190.4	04Aug2013, 14:10	289.3
RT_HC-2c	1.26	1165.1	04Aug2013, 14:35	287.5
ADD_2c&1d	3.21	1369.2	04Aug2013, 14:35	688.2
HC-3a	0.75	320	04Aug2013, 16:15	151.6
RT_HC-3a	0.75	318	04Aug2013, 16:50	149.9
HC-3b	0.25	148.6	04Aug2013, 14:40	45.5
Add_HC-3b	1	379	04Aug2013, 16:30	195.4
RT_HC-3b	1	378.3	04Aug2013, 16:50	194.2
HC-3c	0.2	228.3	04Aug2013, 13:30	33.8
Add_3c	1.2	402	04Aug2013, 16:45	228
Add_2c&3c	4.41	1629.1	04Aug2013, 14:35	916.3
RT_HC-3c	4.41	1597.4	04Aug2013, 14:55	903.6
US End	4.41	1597.4	04Aug2013, 14:55	903.6
HC-5a	0.16	84.7	04Aug2013, 14:50	28.1
Add_5a	4.57	1682	04Aug2013, 14:55	931.7
RT_5a	4.57	1664.5	04Aug2013, 15:05	925.6
ADD_5a&5b	4.57	1664.5	04Aug2013, 15:05	925.6
HC-4a	0.3	292.9	04Aug2013, 13:55	62.1
HC-4b	0.25	153.3	04Aug2013, 14:55	52.2
Add_4b	0.55	387.6	04Aug2013, 14:05	114.4
RT_HC-4b	0.55	386.2	04Aug2013, 14:10	105.4
ADD_5c	0.55	386.2	04Aug2013, 14:10	105.4
HC-5c	0.18	136.8	04Aug2013, 14:05	32.1
RT_HC-5c	0.73	512.9	04Aug2013, 14:20	137.1
ADD_5cto5b	0.73	512.9	04Aug2013, 14:20	137.1
ADD_5a&cto5b	5.3	2026.1	04Aug2013, 15:05	1062.6
HC-5b	0.06	62.4	04Aug2013, 13:40	10.5
Add_5b	0.06	62.4	04Aug2013, 13:40	10.5
RT_5b	5.36	2003.6	04Aug2013, 15:10	1066.6
Portertown Road	5.36	2003.6	04Aug2013, 15:10	1066.6
HCUT-1	0.08	26	04Aug2013, 17:55	15.4
HCUT-2	0.02	6.1	04Aug2013, 16:25	3
ADD_HCUT2-1	0.1	30.9	04Aug2013, 17:35	18.4
HCUT-3	0.04	30.7	04Aug2013, 14:00	6.7
ADD_HCUT-3-2	0.14	36.3	04Aug2013, 14:05	25.1
RT_HCUT-2-3	0.14	35.6	04Aug2013, 17:15	21.9
Cardinal Road Culvert	0.14	35.6	04Aug2013, 17:15	21.9
HCUT-4	0.03	17.9	04Aug2013, 14:20	4.8
RT_HCUT-4	0.03	17.9	04Aug2013, 14:20	4.6

25-YEAR FUTURE				
Hydrologic Element	**Drainage Area (mi^2)**	**Peak Discharge (CFS)**	**Time of Peak**	**Volume (AC-FT)**
ADD_HCUT-4-3	0.17	44.3	04Aug2013, 14:45	26.5
RT_HCUT-3-5	0.17	44.1	04Aug2013, 14:50	26.5
King George Rd Culvert	0.17	44.1	04Aug2013, 14:50	26.5
HCUT-5	0.02	19.5	04Aug2013, 13:35	3.1
ADD_HCUT-5-4	0.19	48.6	04Aug2013, 14:50	29.5
RT_HCUT-4-5	0.19	48.6	04Aug2013, 14:50	29
HCUT01 Outlet	0.19	48.6	04Aug2013, 14:50	29
HC-6	0.14	116.1	04Aug2013, 13:50	23.5
HCUT1_HC_Confl	5.69	2088.6	04Aug2013, 15:10	1119.1
RT_HC-6	5.69	2070.3	04Aug2013, 15:20	1108.1
Railroad	5.69	2070.3	04Aug2013, 15:20	1108.1
HC-7b	0.14	70.9	04Aug2013, 16:25	35.3
RT_HC-7b	0.14	69.3	04Aug2013, 17:10	34
ADD_6to7b	5.83	2106.5	04Aug2013, 15:20	1142.2
HC-7c	0.04	13.4	04Aug2013, 15:05	4.9
Add_7bto7c	5.87	2119.7	04Aug2013, 15:20	1147
RT_HC-7c	5.87	2100.2	04Aug2013, 15:25	1143.5
HC-7a	0.13	27.5	04Aug2013, 16:35	13.9
RT_HC-7a	0.13	27.5	04Aug2013, 16:50	13.7
HC-8c	0.13	113.7	04Aug2013, 13:50	21.9
ADD_HC-7a&cto8c	6.13	2148.5	04Aug2013, 15:25	1179.2
RT_HC-8c	6.13	2074.5	04Aug2013, 15:50	1160.1
HC-8b	0.09	121.8	04Aug2013, 13:35	19.8
RT_HC-8	0.09	110.9	04Aug2013, 13:50	19.6
ADD_8cto8b	6.22	2094	04Aug2013, 15:50	1179.7
RT_HC-8b	6.22	2091	04Aug2013, 15:50	1176.8
HC-8a	0.09	120	04Aug2013, 13:25	16.7
ADD_8bto8a	6.31	2105.3	04Aug2013, 15:50	1193.5
RT_HC-8a	6.31	1840	04Aug2013, 16:45	1096.7
MHB	3.01	1634.3	04Aug2013, 15:25	677.9
ADD MHB	3.01	1634.3	04Aug2013, 22:05	515.5
E. 10th	9.32	2722.6	04Aug2013, 21:45	1612.1
HC-9	0.18	185.9	04Aug2013, 13:55	40.4
RT_HC-9	0.18	186	04Aug2013, 14:00	40.3
ADD_8a&9a	9.5	2732.6	04Aug2013, 21:45	1652.5
RT_HC-8-9	9.5	2725.9	04Aug2013, 22:05	1598.1
OUTLET	9.5	2725.9	04Aug2013, 22:05	1598.1

50-YEAR FUTURE				
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-1b	0.59	344.9	04Aug2013, 16:20	169.2
HC-1a	0.57	341.6	04Aug2013, 16:20	167.1
RT_HC-1a	0.57	335.7	04Aug2013, 16:55	165.2
Add_1b	1.16	673.7	04Aug2013, 16:40	334.4
RT_HC-1b	1.16	666.2	04Aug2013, 17:00	330.8
HC-1c	0.6	274	04Aug2013, 17:15	152
Add_1c	1.76	938.9	04Aug2013, 17:05	482.8
RT_HC-1c	1.76	915.3	04Aug2013, 17:55	468
HC-1d	0.19	210.6	04Aug2013, 13:55	45.3
Add_1d	1.95	940.3	04Aug2013, 17:50	513.3
RT_HC-1(a-d)	1.95	937.1	04Aug2013, 18:10	506
HC-2a	0.43	650	04Aug2013, 13:50	135.4
RT_2a	0.43	589	04Aug2013, 14:00	134
HC-2b	0.35	477.6	04Aug2013, 13:55	101.3
Add_2b	0.78	1060.8	04Aug2013, 14:00	235.3
RT_HC-2b	0.78	1022	04Aug2013, 14:10	234.6
HC-2c	0.48	484.6	04Aug2013, 14:20	128.9
Add_2c	1.26	1498.1	04Aug2013, 14:10	363.4
RT_HC-2c	1.26	1466.2	04Aug2013, 14:30	361.3
ADD_2c&1d	3.21	1738.7	04Aug2013, 14:30	867.3
HC-3a	0.75	407.8	04Aug2013, 16:15	192.9
RT_HC-3a	0.75	405.1	04Aug2013, 16:45	190.9
HC-3b	0.25	193.6	04Aug2013, 14:40	58.9
Add_HC-3b	1	483.9	04Aug2013, 16:30	249.8
RT_HC-3b	1	483	04Aug2013, 16:45	248.3
HC-3c	0.2	301.4	04Aug2013, 13:30	44.3
Add_3c	1.2	513	04Aug2013, 16:40	292.6
Add_2c&3c	4.41	2069	04Aug2013, 14:35	1159.9
RT_HC-3c	4.41	2033.6	04Aug2013, 14:50	1145
US End	4.41	2033.6	04Aug2013, 14:50	1145
HC-5a	0.16	111.1	04Aug2013, 14:50	36.5
Add_5a	4.57	2144.7	04Aug2013, 14:50	1181.5
RT_5a	4.57	2127.1	04Aug2013, 15:00	1173.9
ADD_5a&5b	4.57	2127.1	04Aug2013, 15:00	1173.9
HC-4a	0.3	374	04Aug2013, 13:55	79.2
HC-4b	0.25	195.2	04Aug2013, 14:55	66.4
Add_4b	0.55	495.8	04Aug2013, 14:05	145.5
RT_HC-4b	0.55	495.2	04Aug2013, 14:05	135.6
ADD_5c	0.55	495.2	04Aug2013, 14:05	135.6
HC-5c	0.18	179.2	04Aug2013, 14:05	41.7
RT_HC-5c	0.73	672.2	04Aug2013, 14:10	176.9
ADD_5cto5b	0.73	672.2	04Aug2013, 14:10	176.9
ADD_5a&cto5b	5.3	2603	04Aug2013, 15:00	1350.8
HC-5b	0.06	82	04Aug2013, 13:35	13.6
Add_5b	0.06	82	04Aug2013, 13:35	13.6
RT_5b	5.36	2581.3	04Aug2013, 15:05	1356.4
Portertown Road	5.36	2581.3	04Aug2013, 15:05	1356.4
HCUT-1	0.08	33	04Aug2013, 17:55	19.6
HCUT-2	0.02	8.2	04Aug2013, 16:20	3.9
ADD_HCUT2-1	0.1	39.6	04Aug2013, 17:30	23.5
HCUT-3	0.04	40.6	04Aug2013, 14:00	8.8
ADD_HCUT-3-2	0.14	48.5	04Aug2013, 14:00	32.3
RT_HCUT-2-3	0.14	45.7	04Aug2013, 17:10	29.1
Cardinal Road Culvert	0.14	45.7	04Aug2013, 17:10	29.1
HCUT-4	0.03	23.9	04Aug2013, 14:20	6.4
RT_HCUT-4	0.03	23.9	04Aug2013, 14:20	6.1

50-YEAR FUTURE				
Hydrologic Element	**Drainage Area (mi^2)**	**Peak Discharge (CFS)**	**Time of Peak**	**Volume (AC-FT)**
ADD_HCUT-4-3	0.17	67.3	04Aug2013, 14:25	35.2
RT_HCUT-3-5	0.17	66.7	04Aug2013, 14:30	35.1
King George Rd Culvert	0.17	66.7	04Aug2013, 14:30	35.1
HCUT-5	0.02	26.2	04Aug2013, 13:30	4.1
ADD_HCUT-5-4	0.19	74.7	04Aug2013, 14:25	39.2
RT_HCUT-4-5	0.19	74.6	04Aug2013, 14:25	38.6
HCUT01 Outlet	0.19	74.6	04Aug2013, 14:25	38.6
HC-6	0.14	153.8	04Aug2013, 13:50	30.8
HCUT1_HC_Confl	5.69	2695.8	04Aug2013, 15:05	1425.9
RT_HC-6	5.69	2673.5	04Aug2013, 15:15	1412.6
Railroad	5.69	2673.5	04Aug2013, 15:15	1412.6
HC-7b	0.14	87.2	04Aug2013, 16:25	43.6
RT_HC-7b	0.14	85.3	04Aug2013, 17:05	42.2
ADD_6to7b	5.83	2717.9	04Aug2013, 15:15	1454.8
HC-7c	0.04	18.8	04Aug2013, 15:00	6.7
Add_7bto7c	5.87	2736.4	04Aug2013, 15:15	1461.5
RT_HC-7c	5.87	2711.6	04Aug2013, 15:20	1457.2
HC-7a	0.13	38.9	04Aug2013, 16:30	19.2
RT_HC-7a	0.13	38.9	04Aug2013, 16:40	19.1
HC-8c	0.13	150.6	04Aug2013, 13:45	28.7
ADD_HC-7a&cto8c	6.13	2777.5	04Aug2013, 15:20	1504.9
RT_HC-8c	6.13	2688.3	04Aug2013, 15:40	1482.2
HC-8b	0.09	153.9	04Aug2013, 13:35	25
RT_HC-8	0.09	139.2	04Aug2013, 13:50	24.8
ADD_8cto8b	6.22	2714	04Aug2013, 15:40	1507
RT_HC-8b	6.22	2709.7	04Aug2013, 15:40	1503.6
HC-8a	0.09	156.1	04Aug2013, 13:25	21.6
ADD_8bto8a	6.31	2728.3	04Aug2013, 15:40	1525.3
RT_HC-8a	6.31	2398.2	04Aug2013, 16:30	1423.5
MHB	3.01	2006.4	04Aug2013, 15:25	851.4
ADD MHB	3.01	2006.4	04Aug2013, 22:05	657.6
E. 10th	9.32	3331.4	04Aug2013, 21:40	2081.2
HC-9	0.18	234.5	04Aug2013, 13:55	50.9
RT_HC-9	0.18	234.3	04Aug2013, 14:00	50.8
ADD_8a&9a	9.5	3343.7	04Aug2013, 21:40	2132
RT_HC-8-9	9.5	3335.4	04Aug2013, 22:00	2068.7
OUTLET	9.5	3335.4	04Aug2013, 22:00	2068.7

100-YEAR FUTURE				
Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
HC-1b	0.59	421.8	04Aug2013, 16:20	207.5
HC-1a	0.57	416.3	04Aug2013, 16:20	204.4
RT_HC-1a	0.57	409.2	04Aug2013, 16:50	201.9
Add_1b	1.16	822.9	04Aug2013, 16:35	409.3
RT_HC-1b	1.16	813.4	04Aug2013, 17:00	405.1
HC-1c	0.6	339.6	04Aug2013, 17:15	188.7
Add_1c	1.76	1151.3	04Aug2013, 17:00	593.8
RT_HC-1c	1.76	1123.9	04Aug2013, 17:50	576.8
HC-1d	0.19	266.5	04Aug2013, 13:55	57.2
Add_1d	1.95	1154.9	04Aug2013, 17:45	633.9
RT_HC-1(a-d)	1.95	1151.7	04Aug2013, 18:05	625.6
HC-2a	0.43	787.6	04Aug2013, 13:50	164.9
RT_2a	0.43	715.8	04Aug2013, 14:00	163.3
HC-2b	0.35	585.8	04Aug2013, 13:55	124.7
Add_2b	0.78	1294.1	04Aug2013, 13:55	288
RT_HC-2b	0.78	1248.3	04Aug2013, 14:05	287
HC-2c	0.48	601	04Aug2013, 14:20	160
Add_2c	1.26	1838.9	04Aug2013, 14:10	447
RT_HC-2c	1.26	1797.4	04Aug2013, 14:25	444.3
ADD_2c&1d	3.21	2151.2	04Aug2013, 14:30	1069.9
HC-3a	0.75	507	04Aug2013, 16:10	240
RT_HC-3a	0.75	503.6	04Aug2013, 16:45	237.6
HC-3b	0.25	245.2	04Aug2013, 14:35	74.3
Add_HC-3b	1	603.1	04Aug2013, 16:25	311.9
RT_HC-3b	1	602.2	04Aug2013, 16:40	310
HC-3c	0.2	385	04Aug2013, 13:30	56.4
Add_3c	1.2	639.9	04Aug2013, 16:35	366.4
Add_2c&3c	4.41	2571.8	04Aug2013, 14:30	1436.2
RT_HC-3c	4.41	2527.2	04Aug2013, 14:50	1419.1
US End	4.41	2527.2	04Aug2013, 14:50	1419.1
HC-5a	0.16	141.2	04Aug2013, 14:50	46.3
Add_5a	4.57	2668.4	04Aug2013, 14:50	1465.3
RT_5a	4.57	2647.8	04Aug2013, 15:00	1455.9
ADD_5a&5b	4.57	2647.8	04Aug2013, 15:00	1455.9
HC-4a	0.3	465.4	04Aug2013, 13:55	98.6
HC-4b	0.25	242.4	04Aug2013, 14:55	82.4
Add_4b	0.55	617.8	04Aug2013, 14:05	181
RT_HC-4b	0.55	617.6	04Aug2013, 14:05	170
ADD_5c	0.55	617.6	04Aug2013, 14:05	170
HC-5c	0.18	227.5	04Aug2013, 14:05	52.8
RT_HC-5c	0.73	843	04Aug2013, 14:10	222.2
ADD_5cto5b	0.73	843	04Aug2013, 14:10	222.2
ADD_5a&cto5b	5.3	3255.5	04Aug2013, 14:55	1678.2
HC-5b	0.06	104.6	04Aug2013, 13:35	17.3
Add_5b	0.06	104.6	04Aug2013, 13:35	17.3
RT_5b	5.36	3235.5	04Aug2013, 15:00	1685.9
Portertown Road	5.36	3235.5	04Aug2013, 15:00	1685.9
HCUT-1	0.08	40.9	04Aug2013, 17:50	24.4
HCUT-2	0.02	10.6	04Aug2013, 16:15	5
ADD_HCUT2-1	0.1	49.5	04Aug2013, 17:25	29.4
HCUT-3	0.04	52.1	04Aug2013, 13:55	11.2
ADD_HCUT-3-2	0.14	62.6	04Aug2013, 14:00	40.6
RT_HCUT-2-3	0.14	60.5	04Aug2013, 14:15	37.4
Cardinal Road Culvert	0.14	60.5	04Aug2013, 14:15	37.4
HCUT-4	0.03	30.7	04Aug2013, 14:20	8.1
RT_HCUT-4	0.03	30.7	04Aug2013, 14:20	7.9

100-YEAR FUTURE				
Hydrologic Element	**Drainage Area (mi^2)**	**Peak Discharge (CFS)**	**Time of Peak**	**Volume (AC-FT)**
ADD_HCUT-4-3	0.17	91	04Aug2013, 14:15	45.2
RT_HCUT-3-5	0.17	90.6	04Aug2013, 14:20	45.2
King George Rd Culvert	0.17	90.6	04Aug2013, 14:20	45.2
HCUT-5	0.02	34.1	04Aug2013, 13:30	5.2
ADD_HCUT-5-4	0.19	103.5	04Aug2013, 14:15	50.4
RT_HCUT-4-5	0.19	103.8	04Aug2013, 14:15	49.8
HCUT01 Outlet	0.19	103.8	04Aug2013, 14:15	49.8
HC-6	0.14	197	04Aug2013, 13:50	39.3
HCUT1_HC_Confl	5.69	3386.5	04Aug2013, 15:00	1774.9
RT_HC-6	5.69	3356.7	04Aug2013, 15:10	1760.1
Railroad	5.69	3356.7	04Aug2013, 15:10	1760.1
HC-7b	0.14	105.3	04Aug2013, 16:25	52.9
RT_HC-7b	0.14	103.1	04Aug2013, 17:00	51.3
ADD_6to7b	5.83	3409.6	04Aug2013, 15:10	1811.4
HC-7c	0.04	25.2	04Aug2013, 15:00	8.8
Add_7bto7c	5.87	3434.6	04Aug2013, 15:10	1820.1
RT_HC-7c	5.87	3404.6	04Aug2013, 15:15	1815.2
HC-7a	0.13	52.6	04Aug2013, 16:25	25.6
RT_HC-7a	0.13	52.6	04Aug2013, 16:35	25.5
HC-8c	0.13	193	04Aug2013, 13:45	36.5
ADD_HC-7a&cto8c	6.13	3491.5	04Aug2013, 15:15	1877.1
RT_HC-8c	6.13	3416.4	04Aug2013, 15:30	1852.3
HC-8b	0.09	189.9	04Aug2013, 13:35	31
RT_HC-8	0.09	172.6	04Aug2013, 13:45	30.7
ADD_8cto8b	6.22	3449.9	04Aug2013, 15:30	1883
RT_HC-8b	6.22	3444.9	04Aug2013, 15:30	1879.2
HC-8a	0.09	197.1	04Aug2013, 13:25	27.3
ADD_8bto8a	6.31	3468.7	04Aug2013, 15:30	1906.5
RT_HC-8a	6.31	3021.4	04Aug2013, 16:20	1799.4
MHB	3.01	2423.1	04Aug2013, 15:20	1047.1
ADD MHB	3.01	2423.1	04Aug2013, 22:00	818.4
E. 10th	9.32	4005.4	04Aug2013, 21:30	2617.8
HC-9	0.18	288.8	04Aug2013, 13:55	62.8
RT_HC-9	0.18	288.5	04Aug2013, 14:00	62.8
ADD_8a&9a	9.5	4020.2	04Aug2013, 21:30	2680.6
RT_HC-8-9	9.5	4013.3	04Aug2013, 21:50	2609.5
OUTLET	9.5	4013.3	04Aug2013, 21:50	2609.5

PRIMARY SYSTEM EXISTING CONDITIONS: HEC-RAS OUTPUT

HARDEE CREEK MAIN BRANCH

HEC-RAS Plan: Hardee Cr - Ex River: Hardee Creek Reach: MB1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	1861	2-Year	777.00	-2.36	2.25	0.25	2.28	0.000700	1.99	1446.52	2437.67	0.17
MB1	1861	10-Year	2032.00	-2.36	3.28	1.33	3.31	0.000700	2.32	4016.84	2517.21	0.18
MB1	1861	25-Year	2516.00	-2.36	3.57	2.15	3.60	0.000700	2.41	4747.59	2539.63	0.18
MB1	1861	50-Year	3124.00	-2.36	3.90	1.83	3.93	0.000701	2.51	5578.95	2564.99	0.18
MB1	1861	100-Year	3794.00	-2.36	4.26	2.52	4.29	0.000701	2.61	6532.81	2695.05	0.19
MB1	2483	2-Year	777.00	-0.12	3.15		3.25	0.005493	4.21	704.52	630.98	0.45
MB1	2483	10-Year	2032.00	-0.12	4.18		4.30	0.005712	5.32	1409.37	737.56	0.48
MB1	2483	25-Year	2516.00	-0.12	4.46		4.60	0.005870	5.66	1627.30	767.36	0.50
MB1	2483	50-Year	3124.00	-0.12	4.79		4.93	0.006040	6.05	1881.38	800.71	0.51
MB1	2483	100-Year	3794.00	-0.12	5.14		5.29	0.005987	6.34	2169.62	836.93	0.51
MB1	3095	2-Year	777.00	0.08	5.10		5.11	0.001992	1.53	1192.78	789.79	0.15
MB1	3095	10-Year	2032.00	0.08	6.29		6.30	0.002218	1.95	2159.17	831.43	0.17
MB1	3095	25-Year	2516.00	0.08	6.63		6.66	0.002279	2.07	2449.55	836.79	0.17
MB1	3095	50-Year	3124.00	0.08	7.03		7.05	0.002351	2.21	2778.97	842.82	0.18
MB1	3095	100-Year	3794.00	0.08	7.41		7.44	0.002428	2.35	3107.22	848.79	0.19
MB1	3500.0	2-Year	777.00	3.29	6.19		6.37	0.005015	3.49	275.96	360.02	0.42
MB1	3500.0	10-Year	2032.00	3.29	7.39		7.59	0.004448	4.23	1080.85	766.06	0.42
MB1	3500.0	25-Year	2516.00	3.29	7.73		7.93	0.004157	4.37	1338.87	775.78	0.41
MB1	3500.0	50-Year	3124.00	3.29	8.11		8.31	0.003898	4.54	1636.66	786.85	0.41
MB1	3500.0	100-Year	3794.00	3.29	8.49		8.70	0.003701	4.71	1939.06	797.31	0.40
MB1	4000.0	2-Year	777.00	3.59	7.44		7.51	0.001265	2.13	609.48	491.86	0.22
MB1	4000.0	10-Year	2032.00	3.59	8.77		8.88	0.001652	3.14	1276.33	513.59	0.27
MB1	4000.0	25-Year	2516.00	3.59	9.11		9.25	0.001803	3.45	1455.85	517.87	0.29
MB1	4000.0	50-Year	3124.00	3.59	9.50		9.66	0.001964	3.81	1658.93	522.67	0.30
MB1	4000.0	100-Year	3794.00	3.59	9.89		10.07	0.002114	4.16	1863.07	527.45	0.32
MB1	4739.1	2-Year	777.00	2.59	8.56	5.48	8.75	0.002069	3.50	222.91	211.73	0.29
MB1	4739.1	10-Year	2032.00	2.59	10.38	7.75	10.97	0.004231	6.25	385.77	324.52	0.45
MB1	4739.1	25-Year	2516.00	2.59	10.87	8.41	11.61	0.004873	7.06	441.62	350.67	0.48
MB1	4739.1	50-Year	3124.00	2.59	11.11	9.20	11.38	0.002597	5.28	1341.45	363.42	0.36
MB1	4739.1	100-Year	3794.00	2.59	11.62	10.05	11.94	0.002830	5.78	1534.46	390.68	0.38
MB1	4793.6		Culvert									

HEC-RAS Plan: Hardee Cr - Ex River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	4848.1	2-Year	777.00	2.81	10.05	5.70	10.16	0.000869	2.66	327.51	292.10	0.20
MB1	4848.1	10-Year	2032.00	2.81	16.08	7.96	16.19	0.000378	2.86	1039.88	534.43	0.15
MB1	4848.1	25-Year	2516.00	2.81	18.27	8.63	18.35	0.000254	2.63	1961.28	615.86	0.12
MB1	4848.1	50-Year	3124.00	2.81	19.76	9.42	19.85	0.000249	2.79	2449.13	663.80	0.13
MB1	4848.1	100-Year	3794.00	2.81	20.27	10.26	20.38	0.000317	3.22	2622.15	674.11	0.14
MB1	5340.0	2-Year	501.00	3.45	10.44		10.48	0.000378	1.62	631.91	336.39	0.13
MB1	5340.0	10-Year	1285.00	3.45	16.28		16.29	0.000065	1.13	2806.30	407.96	0.06
MB1	5340.0	25-Year	1925.00	3.45	18.42		18.43	0.000068	1.31	3706.84	433.96	0.06
MB1	5340.0	50-Year	2517.00	3.45	19.92		19.93	0.000073	1.47	4369.01	452.12	0.07
MB1	5340.0	100-Year	3188.00	3.45	20.47		20.49	0.000101	1.76	4621.62	458.86	0.08
MB1	5550.0	2-Year	501.00	3.72	10.53		10.57	0.000521	1.85	464.95	276.45	0.15
MB1	5550.0	10-Year	1285.00	3.72	16.30		16.31	0.000078	1.22	2575.47	409.45	0.07
MB1	5550.0	25-Year	1925.00	3.72	18.44		18.45	0.000077	1.37	3473.90	431.82	0.07
MB1	5550.0	50-Year	2517.00	3.72	19.93		19.95	0.000082	1.53	4135.85	455.25	0.07
MB1	5550.0	100-Year	3188.00	3.72	20.49		20.52	0.000111	1.83	4393.74	465.48	0.08
MB1	6136.0	2-Year	501.00	4.63	10.91		11.00	0.000983	2.34	216.44	79.25	0.20
MB1	6136.0	10-Year	1285.00	4.63	16.34		16.39	0.000242	2.04	1131.07	220.64	0.12
MB1	6136.0	25-Year	1925.00	4.63	18.48		18.54	0.000230	2.27	1645.28	258.79	0.12
MB1	6136.0	50-Year	2517.00	4.63	19.97		20.04	0.000235	2.49	2047.40	281.39	0.12
MB1	6136.0	100-Year	3188.00	4.63	20.55		20.64	0.000316	2.97	2213.86	299.61	0.14
MB1	6693.0	2-Year	501.00	5.75	11.53		11.57	0.001076	2.41	556.46	232.42	0.21
MB1	6693.0	10-Year	1285.00	5.75	16.50		16.52	0.000205	1.79	2105.71	363.83	0.10
MB1	6693.0	25-Year	1925.00	5.75	18.63		18.65	0.000177	1.92	2909.36	390.97	0.10
MB1	6693.0	50-Year	2517.00	5.75	20.14		20.16	0.000175	2.07	3511.10	410.12	0.10
MB1	6693.0	100-Year	3188.00	5.75	20.77		20.79	0.000228	2.44	3772.30	418.16	0.12
MB1	7182.0	2-Year	501.00	6.73	12.22		12.32	0.002211	3.29	363.93	164.64	0.30
MB1	7182.0	10-Year	1285.00	6.73	16.63		16.69	0.000550	2.74	1185.06	207.40	0.17
MB1	7182.0	25-Year	1925.00	6.73	18.74		18.80	0.000495	3.03	1643.28	227.80	0.17
MB1	7182.0	50-Year	2517.00	6.73	20.24		20.31	0.000494	3.32	1994.92	242.28	0.17
MB1	7182.0	100-Year	3188.00	6.73	20.89		20.99	0.000639	3.91	2156.44	248.66	0.20
MB1	7869.0	2-Year	501.00	8.11	13.66		13.75	0.001954	3.12	386.87	171.73	0.28
MB1	7869.0	10-Year	1285.00	8.11	17.09		17.15	0.000844	3.14	1051.70	218.20	0.21

HEC-RAS Plan: Hardee Cr - Ex River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	7869.0	25-Year	1925.00	8.11	19.13		19.20	0.000664	3.28	1520.48	239.68	0.19
MB1	7869.0	50-Year	2517.00	8.11	20.61		20.68	0.000614	3.48	1886.41	253.38	0.19
MB1	7869.0	100-Year	3188.00	8.11	21.37		21.46	0.000745	4.01	2080.71	260.36	0.21
MB1	8107.4	2-Year	501.00	8.59	14.15		14.27	0.002396	3.46	312.25	123.44	0.31
MB1	8107.4	10-Year	1285.00	8.59	17.30		17.45	0.001593	4.20	786.41	216.42	0.28
MB1	8107.4	25-Year	1925.00	8.59	19.29		19.42	0.001127	4.18	1322.75	311.71	0.25
MB1	8107.4	50-Year	2517.00	8.59	20.76		20.87	0.000889	4.11	1788.50	320.96	0.22
MB1	8107.4	100-Year	3188.00	8.59	21.55		21.68	0.000995	4.56	2043.38	325.91	0.24
MB1	8676.0	2-Year	501.00	9.65	15.06		15.09	0.000940	2.11	574.82	200.98	0.19
MB1	8676.0	10-Year	1285.00	9.65	17.97		18.01	0.000657	2.60	1168.34	206.11	0.18
MB1	8676.0	25-Year	1925.00	9.65	19.83		19.88	0.000595	2.92	1553.45	209.31	0.18
MB1	8676.0	50-Year	2517.00	9.65	21.22		21.28	0.000587	3.21	1847.01	211.71	0.18
MB1	8676.0	100-Year	3188.00	9.65	22.08		22.15	0.000699	3.70	2028.17	213.18	0.20
MB1	9162.0	2-Year	501.00	10.56	15.66		15.72	0.001823	2.78	511.28	276.70	0.27
MB1	9162.0	10-Year	1285.00	10.56	18.33		18.37	0.000813	2.73	1287.85	304.11	0.20
MB1	9162.0	25-Year	1925.00	10.56	20.13		20.17	0.000610	2.81	1847.24	316.40	0.18
MB1	9162.0	50-Year	2517.00	10.56	21.51		21.56	0.000543	2.95	2291.98	328.71	0.17
MB1	9162.0	100-Year	3188.00	10.56	22.42		22.47	0.000604	3.32	2595.10	342.04	0.18
MB1	9756.0	2-Year	501.00	11.70	16.85		16.93	0.002290	3.14	426.17	224.15	0.30
MB1	9756.0	10-Year	1285.00	11.70	18.97		19.06	0.001688	3.71	924.68	248.75	0.28
MB1	9756.0	25-Year	1925.00	11.70	20.60		20.69	0.001267	3.82	1340.81	259.97	0.25
MB1	9756.0	50-Year	2517.00	11.70	21.93		22.01	0.001087	3.96	1689.77	268.23	0.24
MB1	9756.0	100-Year	3188.00	11.70	22.86		22.97	0.001147	4.36	1944.29	274.09	0.25
MB1	10329.5	2-Year	501.00	12.86	18.08	15.75	18.19	0.002059	2.67	187.88	57.14	0.26
MB1	10329.5	10-Year	1285.00	12.86	20.09	17.18	20.36	0.002730	4.15	333.76	98.85	0.32
MB1	10329.5	25-Year	1925.00	12.86	21.49	18.06	21.82	0.002604	4.75	485.47	120.09	0.33
MB1	10329.5	50-Year	2517.00	12.86	22.67	18.74	23.05	0.002412	5.11	628.09	141.61	0.32
MB1	10329.5	100-Year	3188.00	12.86	23.63	19.44	24.08	0.002504	5.63	749.38	173.13	0.34
MB1	10344.5		Bridge									
MB1	10359.5	2-Year	501.00	13.40	18.72	16.29	18.82	0.001885	2.59	193.61	57.70	0.25
MB1	10359.5	10-Year	1285.00	13.40	20.80	17.72	21.04	0.002446	4.01	350.21	101.35	0.31

HEC-RAS Plan: Hardee Cr - Ex River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	10359.5	25-Year	1925.00	13.40	22.20	18.61	22.52	0.002368	4.61	505.55	122.72	0.31
MB1	10359.5	50-Year	2517.00	13.40	23.38	19.28	23.74	0.002224	4.98	649.48	147.26	0.31
MB1	10359.5	100-Year	3188.00	13.40	24.20	19.98	24.65	0.002469	5.60	753.50	174.20	0.33
MB1	10647.0	2-Year	491.00	13.59	19.31		19.38	0.001928	2.90	422.93	219.60	0.26
MB1	10647.0	10-Year	1260.00	13.59	21.55		21.62	0.001420	3.35	979.21	270.47	0.24
MB1	10647.0	25-Year	1861.00	13.59	22.99		23.06	0.001198	3.53	1387.02	299.49	0.22
MB1	10647.0	50-Year	2427.00	13.59	24.18		24.26	0.001083	3.69	1767.79	336.15	0.22
MB1	10647.0	100-Year	3071.00	13.59	25.12		25.21	0.001097	3.98	2095.68	358.05	0.22
MB1	11268.0	2-Year	491.00	14.02	20.43		20.54	0.001764	3.09	355.66	165.56	0.25
MB1	11268.0	10-Year	1260.00	14.02	22.53		22.68	0.001972	4.17	737.69	198.35	0.28
MB1	11268.0	25-Year	1861.00	14.02	23.85		24.01	0.001905	4.62	1012.60	218.51	0.29
MB1	11268.0	50-Year	2427.00	14.02	24.97		25.15	0.001809	4.90	1267.37	235.65	0.28
MB1	11268.0	100-Year	3071.00	14.02	25.92		26.12	0.001873	5.32	1498.11	250.29	0.29
MB1	11882.0	2-Year	491.00	14.44	21.48		21.62	0.001740	3.33	262.01	105.94	0.25
MB1	11882.0	10-Year	1260.00	14.44	23.76		24.02	0.002308	4.87	535.96	129.16	0.31
MB1	11882.0	25-Year	1861.00	14.44	25.08		25.39	0.002490	5.62	712.20	139.39	0.33
MB1	11882.0	50-Year	2427.00	14.44	26.16		26.52	0.002573	6.16	867.30	147.80	0.34
MB1	11882.0	100-Year	3071.00	14.44	27.15		27.56	0.002742	6.78	1017.34	155.50	0.36
MB1	12295.0	2-Year	491.00	14.72	21.99		22.03	0.000614	2.11	639.25	252.05	0.15
MB1	12295.0	10-Year	1260.00	14.72	24.44		24.48	0.000623	2.67	1340.15	317.03	0.16
MB1	12295.0	25-Year	1861.00	14.72	25.82		25.87	0.000613	2.93	1793.09	335.87	0.17
MB1	12295.0	50-Year	2427.00	14.72	26.94		27.00	0.000600	3.12	2176.37	345.12	0.17
MB1	12295.0	100-Year	3071.00	14.72	28.01		28.06	0.000610	3.34	2547.95	354.96	0.17
MB1	12608.0	2-Year	491.00	14.94	22.18		22.22	0.000576	2.03	609.73	271.78	0.15
MB1	12608.0	10-Year	1260.00	14.94	24.63		24.67	0.000557	2.52	1357.50	338.75	0.15
MB1	12608.0	25-Year	1861.00	14.94	26.01		26.05	0.000537	2.74	1851.72	375.15	0.15
MB1	12608.0	50-Year	2427.00	14.94	27.13		27.17	0.000518	2.89	2286.42	400.18	0.15
MB1	12608.0	100-Year	3071.00	14.94	28.19		28.24	0.000515	3.07	2724.51	421.31	0.16
MB1	12762.5	2-Year	491.00	15.04	22.27	18.62	22.30	0.000473	1.42	352.34	115.19	0.13
MB1	12762.5	10-Year	1260.00	15.04	24.70	20.12	24.77	0.000549	2.13	727.48	197.60	0.15
MB1	12762.5	25-Year	1861.00	15.04	26.07	20.80	26.16	0.000568	2.47	1068.46	330.82	0.16
MB1	12762.5	50-Year	2427.00	15.04	27.19	21.27	27.28	0.000539	2.63	1459.18	369.72	0.16

HEC-RAS Plan: Hardee Cr - Ex River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	12762.5	100-Year	3071.00	15.04	28.25	21.77	28.35	0.000523	2.80	1872.59	409.85	0.16
MB1	12785.5		Bridge									
MB1	12808.5	2-Year	491.00	16.43	23.73	20.01	23.76	0.000446	1.39	360.58	116.56	0.12
MB1	12808.5	10-Year	1260.00	16.43	25.21	21.52	25.31	0.000978	2.56	518.79	163.92	0.20
MB1	12808.5	25-Year	1861.00	16.43	26.83	22.19	26.94	0.000791	2.75	889.29	247.73	0.18
MB1	12808.5	50-Year	2427.00	16.43	28.01	22.66	28.13	0.000720	2.91	1255.67	350.00	0.18
MB1	12808.5	100-Year	3071.00	16.43	28.91	23.16	29.04	0.000734	3.15	1584.11	381.60	0.18
MB1	12951.0	2-Year	491.00	17.76	23.81		23.90	0.001871	3.15	377.86	200.58	0.26
MB1	12951.0	10-Year	1260.00	17.76	25.39		25.55	0.002553	4.46	741.79	243.76	0.31
MB1	12951.0	25-Year	1861.00	17.76	26.99		27.11	0.001736	4.28	1146.10	265.27	0.27
MB1	12951.0	50-Year	2427.00	17.76	28.15		28.27	0.001503	4.36	1466.37	282.62	0.26
MB1	12951.0	100-Year	3071.00	17.76	29.06		29.19	0.001530	4.69	1727.60	296.02	0.26
MB1	13353.0	2-Year	443.00	18.60	24.57		24.68	0.002004	3.22	299.25	143.41	0.26
MB1	13353.0	10-Year	1070.00	18.60	26.39		26.56	0.002450	4.44	620.92	210.65	0.31
MB1	13353.0	25-Year	1558.00	18.60	27.71		27.88	0.002096	4.65	934.44	264.10	0.29
MB1	13353.0	50-Year	2014.00	18.60	28.78		28.94	0.001830	4.74	1240.61	306.02	0.28
MB1	13353.0	100-Year	2532.00	18.60	29.69		29.85	0.001763	4.97	1533.42	340.94	0.28
MB1	13575.0	2-Year	443.00	19.07	24.84		24.85	0.000343	1.29	979.65	373.29	0.11
MB1	13575.0	10-Year	1070.00	19.07	26.73		26.75	0.000364	1.69	1711.78	398.98	0.12
MB1	13575.0	25-Year	1558.00	19.07	28.03		28.05	0.000338	1.84	2241.66	416.60	0.12
MB1	13575.0	50-Year	2014.00	19.07	29.08		29.10	0.000325	1.97	2686.93	430.84	0.12
MB1	13575.0	100-Year	2532.00	19.07	29.99		30.01	0.000341	2.16	3087.31	452.99	0.12
MB1	13928.0	2-Year	426.00	19.82	24.99		25.00	0.000611	1.57	891.94	537.84	0.14
MB1	13928.0	10-Year	1019.00	19.82	26.87		26.87	0.000361	1.57	2036.15	676.03	0.12
MB1	13928.0	25-Year	1480.00	19.82	28.15		28.15	0.000263	1.54	2913.96	695.52	0.10
MB1	13928.0	50-Year	1909.00	19.82	29.19		29.20	0.000222	1.55	3647.08	711.38	0.10
MB1	13928.0	100-Year	2397.00	19.82	30.10		30.11	0.000212	1.62	4302.54	729.06	0.10
MB1	14299.0	2-Year	426.00	20.60	25.24		25.25	0.000706	1.53	929.21	644.42	0.15
MB1	14299.0	10-Year	1019.00	20.60	27.00		27.01	0.000362	1.45	2124.35	699.70	0.11
MB1	14299.0	25-Year	1480.00	20.60	28.24		28.25	0.000261	1.43	3005.99	719.33	0.10
MB1	14299.0	50-Year	1909.00	20.60	29.27		29.28	0.000218	1.44	3752.53	735.54	0.09

HEC-RAS Plan: Hardee Cr - Ex River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	14299.0	100-Year	2397.00	20.60	30.18		30.18	0.000206	1.52	4425.84	749.86	0.09
MB1	14885.5	2-Year	426.00	21.83	25.97		26.02	0.003134	2.88	373.98	217.35	0.30
MB1	14885.5	10-Year	1019.00	21.83	27.41		27.49	0.002827	3.61	701.03	235.29	0.31
MB1	14885.5	25-Year	1480.00	21.83	28.53		28.61	0.002256	3.77	972.65	249.20	0.29
MB1	14885.5	50-Year	1909.00	21.83	29.50		29.59	0.001919	3.89	1220.19	261.24	0.27
MB1	14885.5	100-Year	2397.00	21.83	30.39		30.48	0.001798	4.10	1456.38	272.23	0.27

HARDEE CREEK UT1

HEC-RAS Plan: HCUT1 - Ex River: Hardee Creek Reach: UT1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
UT1	10	2-Year	9.00	19.53	20.35	20.00	20.37	0.003002	0.90	10.01	24.30	0.25
UT1	10	10-Year	28.00	19.53	20.79	20.27	20.81	0.003003	1.19	23.44	37.19	0.27
UT1	10	25-year	43.00	19.53	21.03	20.41	21.05	0.003006	1.29	33.35	47.19	0.27
UT1	10	50-Year	65.00	19.53	21.34	20.57	21.37	0.003005	1.18	54.86	88.18	0.26
UT1	10	100-Year	88.00	19.53	21.51	20.70	21.54	0.003004	1.23	71.30	107.83	0.27
UT1	298	2-Year	9.00	22.00	22.49	22.46	22.58	0.046416	2.49	3.61	14.83	0.89
UT1	298	10-Year	28.00	22.00	22.78	22.73	22.92	0.035971	3.01	9.31	23.81	0.85
UT1	298	25-year	43.00	22.00	22.95	22.86	23.10	0.030504	3.15	13.66	28.84	0.81
UT1	298	50-Year	65.00	22.00	23.15		23.31	0.024910	3.24	20.09	34.98	0.75
UT1	298	100-Year	88.00	22.00	23.29		23.48	0.024274	3.46	25.46	39.38	0.76
UT1	529	2-Year	9.00	26.95	27.48		27.51	0.012182	1.36	6.63	24.91	0.46
UT1	529	10-Year	28.00	26.95	27.75		27.80	0.013826	1.89	14.82	37.23	0.53
UT1	529	25-year	43.00	26.95	27.87		27.94	0.015229	2.18	19.71	42.94	0.57
UT1	529	50-Year	65.00	26.95	28.00		28.10	0.017428	2.54	25.55	48.89	0.62
UT1	529	100-Year	88.00	26.95	28.12		28.24	0.017637	2.76	31.93	54.65	0.64
UT1	658	2-Year	9.00	28.67	29.41	29.26	29.50	0.019296	2.40	3.75	8.27	0.63
UT1	658	10-Year	28.00	28.67	29.87	29.69	30.04	0.021128	3.34	8.39	12.04	0.71
UT1	658	25-year	43.00	28.67	30.10	29.91	30.32	0.021213	3.77	11.42	14.17	0.73
UT1	658	50-Year	65.00	28.67	30.34	30.16	30.64	0.020706	4.40	15.30	18.45	0.75
UT1	658	100-Year	88.00	28.67	30.52	30.39	30.91	0.022120	5.04	18.87	21.65	0.79
UT1	690		Culvert									
UT1	763	2-Year	9.00	29.01	31.33	29.80	31.34	0.000537	0.78	11.61	8.48	0.12
UT1	763	10-Year	28.00	29.01	32.94	30.42	32.95	0.000252	0.87	46.20	46.11	0.09
UT1	763	25-year	43.00	29.01	34.24	30.75	34.25	0.000118	0.76	82.71	80.78	0.07
UT1	763	50-Year	65.00	29.01	35.13	31.14	35.13	0.000070	0.67	216.01	99.92	0.05
UT1	763	100-Year	88.00	29.01	35.27	31.47	35.28	0.000110	0.85	230.22	102.92	0.07
UT1	882	2-Year	8.00	29.90	31.44		31.48	0.003826	1.57	5.09	5.29	0.28
UT1	882	10-Year	25.00	29.90	32.98		33.02	0.001730	1.60	15.93	11.73	0.20
UT1	882	25-year	36.00	29.90	34.26		34.27	0.000385	1.06	67.43	111.12	0.11
UT1	882	50-Year	46.00	29.90	35.14		35.14	0.000085	0.59	170.91	124.88	0.05
UT1	882	100-Year	61.00	29.90	35.29		35.29	0.000115	0.70	189.36	128.09	0.06

HEC-RAS Plan: HCUT1 - Ex River: Hardee Creek Reach: UT1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
UT1	967	2-Year	8.00	29.83	31.54		31.55	0.000265	0.52	15.47	12.88	0.08
UT1	967	10-Year	25.00	29.83	33.06		33.07	0.000196	0.67	37.41	16.03	0.08
UT1	967	25-year	36.00	29.83	34.28		34.29	0.000115	0.61	58.61	19.24	0.06
UT1	967	50-Year	46.00	29.83	35.15		35.15	0.000087	0.61	81.57	34.05	0.05
UT1	967	100-Year	61.00	29.83	35.29		35.30	0.000135	0.77	86.80	36.59	0.07
UT1	976		Culvert									
UT1	1033	2-Year	8.00	33.17	34.41	33.79	34.43	0.002695	1.23	6.53	8.63	0.25
UT1	1033	10-Year	25.00	33.17	35.69	34.26	35.70	0.000617	0.84	41.68	50.35	0.13
UT1	1033	25-year	36.00	33.17	36.27	34.47	36.27	0.000280	0.72	80.99	78.00	0.09
UT1	1033	50-Year	46.00	33.17	36.44	34.64	36.45	0.000313	0.81	95.09	83.09	0.10
UT1	1033	100-Year	61.00	33.17	36.54	34.87	36.55	0.000454	1.01	103.06	85.83	0.12
UT1	1046		Inl Struct									
UT1	1639	2-Year	9.00	41.94	42.29	42.21	42.33	0.020019	1.61	5.59	23.60	0.58
UT1	1639	10-Year	22.00	41.94	42.48	42.36	42.55	0.018257	2.07	10.60	28.51	0.60
UT1	1639	25-year	31.00	41.94	42.59	42.44	42.67	0.017374	2.28	13.62	30.68	0.60
UT1	1639	50-Year	40.00	41.94	42.68	42.51	42.77	0.016701	2.43	16.45	32.59	0.60
UT1	1639	100-Year	50.00	41.94	42.76	42.58	42.87	0.016159	2.57	19.43	34.48	0.60
UT1	1658		Bridge									
UT1	1712	2-Year	9.00	43.39	43.84	43.59	43.84	0.001443	0.58	15.58	42.30	0.17
UT1	1712	10-Year	22.00	43.39	44.04	43.67	44.05	0.002049	0.91	24.13	42.87	0.21
UT1	1712	25-year	31.00	43.39	44.15	43.72	44.17	0.002276	1.08	28.82	43.19	0.23
UT1	1712	50-Year	40.00	43.39	44.24	43.77	44.26	0.002474	1.22	32.85	43.45	0.25
UT1	1712	100-Year	50.00	43.39	44.33	43.82	44.35	0.002733	1.37	36.55	43.70	0.26
UT1	1834	2-Year	8.00	43.47	44.07		44.08	0.002919	0.94	8.49	18.69	0.25
UT1	1834	10-Year	18.00	43.47	44.34		44.36	0.003332	1.31	13.70	20.17	0.28
UT1	1834	25-year	26.00	43.47	44.48		44.52	0.003802	1.56	16.69	20.98	0.31
UT1	1834	50-Year	33.00	43.47	44.60		44.64	0.004019	1.72	19.19	21.63	0.32
UT1	1834	100-Year	41.00	43.47	44.71		44.77	0.004271	1.89	21.72	22.27	0.34

PRIMARY SYSTEM FUTURE CONDITIONS: HEC-RAS OUTPUT

HARDEE CREEK MAIN BRANCH

HEC-RAS Plan: Fut_Base River: Hardee Creek Reach: MB1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	1861	2-Year	925.00	-2.36	2.42	0.43	2.45	0.000700	2.05	1866.21	2450.81	0.18
MB1	1861	10-Year	2005.00	-2.36	3.27	1.31	3.30	0.000700	2.32	3973.74	2515.89	0.18
MB1	1861	25-Year	2723.00	-2.36	3.69	1.70	3.72	0.000700	2.44	5040.44	2548.65	0.18
MB1	1861	50-Year	3331.00	-2.36	4.04	2.42	4.07	0.000701	2.55	5959.48	2685.80	0.19
MB1	1861	100-Year	4005.00	-2.36	4.35	2.59	4.38	0.000701	2.64	6784.60	2699.11	0.19
MB1	2483	2-Year	925.00	-0.12	3.31		3.41	0.005373	4.33	810.64	648.35	0.45
MB1	2483	10-Year	2005.00	-0.12	4.16		4.28	0.005702	5.29	1396.75	735.79	0.48
MB1	2483	25-Year	2723.00	-0.12	4.58		4.71	0.005933	5.80	1715.70	779.12	0.50
MB1	2483	50-Year	3331.00	-0.12	4.93		5.07	0.005841	6.07	1993.77	815.03	0.50
MB1	2483	100-Year	4005.00	-0.12	5.23		5.39	0.006045	6.45	2247.83	846.49	0.52
MB1	3095	2-Year	925.00	0.08	5.27		5.28	0.002040	1.60	1329.27	796.90	0.15
MB1	3095	10-Year	2005.00	0.08	6.27		6.28	0.002215	1.94	2142.06	831.11	0.17
MB1	3095	25-Year	2723.00	0.08	6.77		6.79	0.002304	2.12	2565.60	838.92	0.17
MB1	3095	50-Year	3331.00	0.08	7.15		7.17	0.002378	2.26	2882.52	844.71	0.18
MB1	3095	100-Year	4005.00	0.08	7.53		7.56	0.002451	2.39	3205.14	850.56	0.19
MB1	3500.0	2-Year	925.00	3.29	6.39		6.59	0.005194	3.69	362.87	510.80	0.43
MB1	3500.0	10-Year	2005.00	3.29	7.37		7.58	0.004467	4.22	1065.78	765.49	0.42
MB1	3500.0	25-Year	2723.00	3.29	7.86		8.06	0.004058	4.43	1443.15	779.67	0.41
MB1	3500.0	50-Year	3331.00	3.29	8.23		8.43	0.003831	4.59	1732.39	790.33	0.41
MB1	3500.0	100-Year	4005.00	3.29	8.60		8.81	0.003662	4.77	2027.55	800.27	0.40
MB1	4000.0	2-Year	925.00	3.59	7.67		7.74	0.001283	2.26	721.74	496.97	0.23
MB1	4000.0	10-Year	2005.00	3.59	8.75		8.86	0.001643	3.12	1265.70	513.33	0.27
MB1	4000.0	25-Year	2723.00	3.59	9.25		9.39	0.001861	3.58	1527.37	519.56	0.29
MB1	4000.0	50-Year	3331.00	3.59	9.63		9.79	0.002009	3.92	1725.36	524.23	0.31
MB1	4000.0	100-Year	4005.00	3.59	10.01		10.20	0.002158	4.26	1923.24	528.85	0.32
MB1	4739.1	2-Year	925.00	2.59	8.85	5.80	9.09	0.002404	3.89	241.40	229.01	0.32
MB1	4739.1	10-Year	2005.00	2.59	10.35	7.70	10.93	0.004194	6.20	382.51	322.95	0.44
MB1	4739.1	25-Year	2723.00	2.59	11.08	8.69	11.29	0.002011	4.63	1330.25	361.78	0.31
MB1	4739.1	50-Year	3331.00	2.59	11.27	9.46	11.56	0.002671	5.44	1402.43	372.23	0.36
MB1	4739.1	100-Year	4005.00	2.59	11.77	10.25	12.10	0.002894	5.93	1594.00	398.69	0.38
MB1	4793.6		Culvert									

HEC-RAS Plan: Fut_Base River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	4848.1	2-Year	925.00	2.81	10.79	6.02	10.90	0.000782	2.74	407.18	334.74	0.19
MB1	4848.1	10-Year	2005.00	2.81	15.96	7.92	16.07	0.000383	2.86	1025.71	532.53	0.15
MB1	4848.1	25-Year	2723.00	2.81	18.98	8.91	19.07	0.000243	2.67	2188.56	656.56	0.12
MB1	4848.1	50-Year	3331.00	2.81	19.95	9.68	20.05	0.000267	2.92	2514.53	665.61	0.13
MB1	4848.1	100-Year	4005.00	2.81	20.41	10.47	20.53	0.000340	3.35	2671.68	679.07	0.15
MB1	5340.0	2-Year	574.00	3.45	11.14		11.16	0.000257	1.46	868.14	345.45	0.11
MB1	5340.0	10-Year	1407.00	3.45	16.17		16.18	0.000081	1.26	2760.16	406.59	0.07
MB1	5340.0	25-Year	2070.00	3.45	19.13		19.15	0.000063	1.30	4018.29	442.59	0.06
MB1	5340.0	50-Year	2674.00	3.45	20.12		20.14	0.000078	1.53	4462.07	454.61	0.07
MB1	5340.0	100-Year	3357.00	3.45	20.63		20.65	0.000107	1.83	4694.18	460.78	0.08
MB1	5550.0	2-Year	574.00	3.72	11.19		11.23	0.000367	1.70	659.08	306.90	0.13
MB1	5550.0	10-Year	1407.00	3.72	16.19		16.20	0.000098	1.36	2530.54	408.26	0.07
MB1	5550.0	25-Year	2070.00	3.72	19.15		19.16	0.000070	1.36	3783.59	441.06	0.07
MB1	5550.0	50-Year	2674.00	3.72	20.14		20.16	0.000087	1.59	4230.12	459.01	0.07
MB1	5550.0	100-Year	3357.00	3.72	20.65		20.68	0.000118	1.90	4468.02	468.39	0.09
MB1	6136.0	2-Year	574.00	4.63	11.47		11.55	0.000822	2.33	282.94	128.20	0.19
MB1	6136.0	10-Year	1407.00	4.63	16.25		16.31	0.000303	2.26	1109.68	218.75	0.13
MB1	6136.0	25-Year	2070.00	4.63	19.18		19.24	0.000207	2.24	1830.71	267.44	0.11
MB1	6136.0	50-Year	2674.00	4.63	20.18		20.25	0.000249	2.58	2106.61	287.56	0.12
MB1	6136.0	100-Year	3357.00	4.63	20.71		20.81	0.000334	3.07	2262.81	304.96	0.14
MB1	6693.0	2-Year	574.00	5.75	11.99		12.03	0.000872	2.33	666.66	244.55	0.19
MB1	6693.0	10-Year	1407.00	5.75	16.45		16.47	0.000253	1.98	2084.64	363.09	0.12
MB1	6693.0	25-Year	2070.00	5.75	19.32		19.34	0.000158	1.88	3182.39	399.77	0.10
MB1	6693.0	50-Year	2674.00	5.75	20.35		20.38	0.000183	2.14	3600.85	412.90	0.11
MB1	6693.0	100-Year	3357.00	5.75	20.94		20.97	0.000239	2.52	3845.50	420.38	0.12
MB1	7182.0	2-Year	574.00	6.73	12.57		12.66	0.001960	3.28	421.39	168.01	0.28
MB1	7182.0	10-Year	1407.00	6.73	16.61		16.67	0.000668	3.02	1179.29	207.14	0.19
MB1	7182.0	25-Year	2070.00	6.73	19.42		19.48	0.000444	3.00	1799.69	234.35	0.16
MB1	7182.0	50-Year	2674.00	6.73	20.46		20.53	0.000518	3.44	2048.99	244.44	0.17
MB1	7182.0	100-Year	3357.00	6.73	21.07		21.18	0.000670	4.04	2201.34	250.40	0.20
MB1	7869.0	2-Year	574.00	8.11	13.91		14.00	0.001931	3.24	430.47	174.71	0.28
MB1	7869.0	10-Year	1407.00	8.11	17.15		17.23	0.000978	3.40	1064.72	218.97	0.22

HEC-RAS Plan: Fut_Base River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	7869.0	25-Year	2070.00	8.11	19.76		19.83	0.000583	3.21	1674.44	245.54	0.18
MB1	7869.0	50-Year	2674.00	8.11	20.85		20.93	0.000633	3.59	1946.94	255.57	0.19
MB1	7869.0	100-Year	3357.00	8.11	21.57		21.67	0.000769	4.13	2132.95	262.20	0.21
MB1	8107.4	2-Year	574.00	8.59	14.40		14.53	0.002427	3.63	343.11	124.84	0.32
MB1	8107.4	10-Year	1407.00	8.59	17.39		17.56	0.001810	4.52	806.55	221.43	0.30
MB1	8107.4	25-Year	2070.00	8.59	19.90		20.01	0.000927	3.96	1515.69	315.58	0.23
MB1	8107.4	50-Year	2674.00	8.59	21.00		21.12	0.000895	4.18	1866.53	322.48	0.23
MB1	8107.4	100-Year	3357.00	8.59	21.75		21.89	0.001010	4.65	2110.62	327.20	0.24
MB1	8676.0	2-Year	574.00	9.65	15.32		15.35	0.000940	2.21	627.23	201.54	0.20
MB1	8676.0	10-Year	1407.00	9.65	18.15		18.19	0.000717	2.76	1203.67	206.41	0.19
MB1	8676.0	25-Year	2070.00	9.65	20.37		20.42	0.000550	2.92	1666.66	210.24	0.17
MB1	8676.0	50-Year	2674.00	9.65	21.47		21.54	0.000605	3.31	1899.84	212.14	0.18
MB1	8676.0	100-Year	3357.00	9.65	22.29		22.37	0.000722	3.81	2074.30	213.55	0.20
MB1	9162.0	2-Year	574.00	10.56	15.90		15.96	0.001691	2.80	578.97	279.38	0.26
MB1	9162.0	10-Year	1407.00	10.56	18.53		18.57	0.000849	2.85	1347.97	305.45	0.20
MB1	9162.0	25-Year	2070.00	10.56	20.65		20.68	0.000544	2.77	2010.96	319.90	0.17
MB1	9162.0	50-Year	2674.00	10.56	21.77		21.82	0.000550	3.03	2377.12	332.51	0.17
MB1	9162.0	100-Year	3357.00	10.56	22.64		22.70	0.000614	3.39	2672.93	345.38	0.19
MB1	9756.0	2-Year	574.00	11.70	17.05		17.13	0.002292	3.26	470.54	226.03	0.30
MB1	9756.0	10-Year	1407.00	11.70	19.19		19.28	0.001713	3.84	979.01	250.25	0.28
MB1	9756.0	25-Year	2070.00	11.70	21.07		21.15	0.001133	3.76	1461.64	262.87	0.24
MB1	9756.0	50-Year	2674.00	11.70	22.19		22.28	0.001087	4.04	1759.79	269.86	0.24
MB1	9756.0	100-Year	3357.00	11.70	23.10		23.20	0.001155	4.45	2007.93	275.54	0.25
MB1	10329.5	2-Year	574.00	12.86	18.31	15.91	18.44	0.002191	2.85	201.47	58.43	0.27
MB1	10329.5	10-Year	1407.00	12.86	20.33	17.36	20.61	0.002803	4.33	357.23	102.40	0.33
MB1	10329.5	25-Year	2070.00	12.86	21.86	18.25	22.20	0.002458	4.79	529.24	125.79	0.32
MB1	10329.5	50-Year	2674.00	12.86	22.93	18.91	23.32	0.002414	5.22	659.98	150.01	0.33
MB1	10329.5	100-Year	3357.00	12.86	23.86	19.64	24.32	0.002515	5.74	778.99	180.77	0.34
MB1	10344.5		Bridge									
MB1	10359.5	2-Year	574.00	13.40	18.96	16.45	19.08	0.001993	2.76	207.85	59.02	0.26
MB1	10359.5	10-Year	1407.00	13.40	21.04	17.90	21.30	0.002509	4.18	375.01	105.01	0.31

HEC-RAS Plan: Fut_Base River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	10359.5	25-Year	2070.00	13.40	22.57	18.79	22.89	0.002251	4.66	549.16	128.34	0.31
MB1	10359.5	50-Year	2674.00	13.40	23.64	19.45	24.02	0.002225	5.09	682.45	155.86	0.31
MB1	10359.5	100-Year	3357.00	13.40	24.46	20.17	24.92	0.002448	5.69	787.10	182.86	0.33
MB1	10647.0	2-Year	564.00	13.59	19.57		19.65	0.001842	2.96	482.64	228.66	0.25
MB1	10647.0	10-Year	1382.00	13.59	21.82		21.89	0.001404	3.42	1052.10	275.51	0.24
MB1	10647.0	25-Year	2004.00	13.59	23.34		23.41	0.001146	3.55	1493.94	310.34	0.22
MB1	10647.0	50-Year	2581.00	13.59	24.46		24.54	0.001071	3.75	1861.09	344.50	0.22
MB1	10647.0	100-Year	3236.00	13.59	25.39		25.48	0.001074	4.01	2192.80	362.58	0.22
MB1	11268.0	2-Year	564.00	14.02	20.68		20.79	0.001805	3.23	397.32	169.76	0.26
MB1	11268.0	10-Year	1382.00	14.02	22.79		22.95	0.001991	4.30	790.19	202.36	0.28
MB1	11268.0	25-Year	2004.00	14.02	24.17		24.33	0.001858	4.67	1082.57	223.34	0.28
MB1	11268.0	50-Year	2581.00	14.02	25.24		25.42	0.001802	4.99	1330.53	239.71	0.28
MB1	11268.0	100-Year	3236.00	14.02	26.18		26.38	0.001856	5.39	1562.41	255.25	0.29
MB1	11882.0	2-Year	564.00	14.44	21.77		21.92	0.001838	3.54	293.26	112.97	0.26
MB1	11882.0	10-Year	1382.00	14.44	24.04		24.31	0.002366	5.05	572.20	131.33	0.32
MB1	11882.0	25-Year	2004.00	14.44	25.37		25.70	0.002504	5.76	753.71	141.69	0.33
MB1	11882.0	50-Year	2581.00	14.44	26.42		26.79	0.002600	6.31	906.48	149.85	0.35
MB1	11882.0	100-Year	3236.00	14.44	27.39		27.82	0.002768	6.91	1055.86	157.42	0.36
MB1	12295.0	2-Year	564.00	14.72	22.31		22.35	0.000621	2.19	720.40	267.09	0.15
MB1	12295.0	10-Year	1382.00	14.72	24.74		24.78	0.000623	2.73	1435.22	323.61	0.16
MB1	12295.0	25-Year	2004.00	14.72	26.12		26.17	0.000608	2.98	1895.94	338.73	0.17
MB1	12295.0	50-Year	2581.00	14.72	27.22		27.27	0.000599	3.17	2272.31	347.61	0.17
MB1	12295.0	100-Year	3236.00	14.72	28.27		28.33	0.000610	3.39	2640.78	357.40	0.17
MB1	12608.0	2-Year	564.00	14.94	22.50		22.53	0.000569	2.09	696.63	283.52	0.15
MB1	12608.0	10-Year	1382.00	14.94	24.93		24.97	0.000554	2.57	1459.49	348.53	0.15
MB1	12608.0	25-Year	2004.00	14.94	26.31		26.35	0.000530	2.77	1966.50	381.92	0.15
MB1	12608.0	50-Year	2581.00	14.94	27.41		27.45	0.000515	2.93	2398.07	406.36	0.15
MB1	12608.0	100-Year	3236.00	14.94	28.45		28.50	0.000513	3.10	2835.01	425.79	0.16
MB1	12762.5	2-Year	564.00	15.04	22.58	18.84	22.61	0.000480	1.51	383.51	121.57	0.13
MB1	12762.5	10-Year	1382.00	15.04	25.00	20.29	25.07	0.000557	2.21	787.51	210.50	0.15
MB1	12762.5	25-Year	2004.00	15.04	26.37	20.93	26.46	0.000560	2.51	1169.73	341.33	0.16
MB1	12762.5	50-Year	2581.00	15.04	27.46	21.39	27.56	0.000533	2.67	1562.46	379.38	0.16

HEC-RAS Plan: Fut_Base River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	12762.5	100-Year	3236.00	15.04	28.51	21.89	28.61	0.000517	2.83	1980.42	419.39	0.16
MB1	12785.5		Bridge									
MB1	12808.5	2-Year	564.00	16.43	24.04	20.23	24.07	0.000452	1.48	393.07	123.06	0.13
MB1	12808.5	10-Year	1382.00	16.43	25.29	21.68	25.40	0.001120	2.77	527.49	166.93	0.21
MB1	12808.5	25-Year	2004.00	16.43	27.19	22.31	27.30	0.000756	2.78	985.22	288.50	0.18
MB1	12808.5	50-Year	2581.00	16.43	28.24	22.78	28.36	0.000722	2.97	1337.32	358.04	0.18
MB1	12808.5	100-Year	3236.00	16.43	29.13	23.28	29.26	0.000735	3.20	1668.09	390.04	0.19
MB1	12951.0	2-Year	564.00	17.76	24.12		24.22	0.001751	3.18	444.29	218.66	0.25
MB1	12951.0	10-Year	1382.00	17.76	25.50		25.67	0.002808	4.73	767.69	245.13	0.33
MB1	12951.0	25-Year	2004.00	17.76	27.34		27.46	0.001617	4.25	1241.77	270.57	0.26
MB1	12951.0	50-Year	2581.00	17.76	28.39		28.51	0.001505	4.44	1532.31	286.06	0.26
MB1	12951.0	100-Year	3236.00	17.76	29.28		29.41	0.001534	4.77	1792.49	299.26	0.26
MB1	13353.0	2-Year	513.00	18.60	24.86		24.98	0.002031	3.38	342.35	154.13	0.27
MB1	13353.0	10-Year	1176.00	18.60	26.57		26.76	0.002577	4.64	660.86	217.56	0.32
MB1	13353.0	25-Year	1682.00	18.60	28.02		28.19	0.002007	4.68	1019.11	276.69	0.29
MB1	13353.0	50-Year	2145.00	18.60	29.01		29.18	0.001821	4.81	1312.62	314.96	0.28
MB1	13353.0	100-Year	2668.00	18.60	29.91		30.07	0.001751	5.02	1608.80	349.90	0.28
MB1	13575.0	2-Year	513.00	19.07	25.13		25.14	0.000332	1.33	1090.06	377.27	0.11
MB1	13575.0	10-Year	1176.00	19.07	26.94		26.95	0.000380	1.76	1794.73	401.79	0.12
MB1	13575.0	25-Year	1682.00	19.07	28.34		28.35	0.000332	1.88	2369.51	420.73	0.12
MB1	13575.0	50-Year	2145.00	19.07	29.32		29.33	0.000330	2.02	2788.23	434.99	0.12
MB1	13575.0	100-Year	2668.00	19.07	30.21		30.23	0.000345	2.20	3187.38	459.58	0.12
MB1	13928.0	2-Year	493.00	19.82	25.28		25.29	0.000529	1.53	1047.48	560.04	0.13
MB1	13928.0	10-Year	1121.00	19.82	27.08		27.09	0.000359	1.61	2178.85	679.24	0.12
MB1	13928.0	25-Year	1597.00	19.82	28.45		28.46	0.000248	1.54	3124.72	700.11	0.10
MB1	13928.0	50-Year	2034.00	19.82	29.42		29.43	0.000220	1.57	3814.62	714.95	0.10
MB1	13928.0	100-Year	2527.00	19.82	30.32		30.33	0.000210	1.64	4463.44	733.67	0.10
MB1	14299.0	2-Year	493.00	20.60	25.49		25.50	0.000604	1.48	1091.09	655.23	0.14
MB1	14299.0	10-Year	1121.00	20.60	27.21		27.22	0.000357	1.48	2271.07	703.00	0.11
MB1	14299.0	25-Year	1597.00	20.60	28.54		28.55	0.000246	1.43	3219.81	724.01	0.10
MB1	14299.0	50-Year	2034.00	20.60	29.50		29.51	0.000215	1.47	3925.08	739.24	0.09

HEC-RAS Plan: Fut_Base River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	14299.0	100-Year	2527.00	20.60	30.40		30.40	0.000204	1.54	4590.71	753.33	0.09
MB1	14885.5	2-Year	493.00	21.83	26.14		26.20	0.003183	3.02	411.42	219.48	0.31
MB1	14885.5	10-Year	1121.00	21.83	27.61		27.70	0.002814	3.72	748.69	237.79	0.31
MB1	14885.5	25-Year	1597.00	21.83	28.81		28.89	0.002141	3.80	1042.03	252.63	0.28
MB1	14885.5	50-Year	2034.00	21.83	29.73		29.82	0.001891	3.95	1280.30	264.08	0.27
MB1	14885.5	100-Year	2527.00	21.83	30.61		30.70	0.001779	4.16	1515.39	274.90	0.27

HARDEE CREEK UT1

HEC-RAS Plan: Fut_Base River: Hardee Creek Reach: UT1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
UT1	10	2-Year	9.00	19.53	20.35	20.00	20.37	0.003002	0.90	10.01	24.30	0.25
UT1	10	10-Year	28.00	19.53	20.79	20.27	20.81	0.003003	1.19	23.44	37.19	0.27
UT1	10	25-year	43.00	19.53	21.03	20.41	21.05	0.003006	1.29	33.35	47.19	0.27
UT1	10	50-Year	65.00	19.53	21.34	20.57	21.37	0.003005	1.18	54.86	88.18	0.26
UT1	10	100-Year	88.00	19.53	21.51	20.70	21.54	0.003004	1.23	71.30	107.83	0.27
UT1	298	2-Year	9.00	22.00	22.49	22.46	22.58	0.046416	2.49	3.61	14.83	0.89
UT1	298	10-Year	28.00	22.00	22.78	22.73	22.92	0.035971	3.01	9.31	23.81	0.85
UT1	298	25-year	43.00	22.00	22.95	22.86	23.10	0.030504	3.15	13.66	28.84	0.81
UT1	298	50-Year	65.00	22.00	23.15		23.31	0.024910	3.24	20.09	34.98	0.75
UT1	298	100-Year	88.00	22.00	23.29		23.48	0.024274	3.46	25.46	39.38	0.76
UT1	529	2-Year	9.00	26.95	27.48		27.51	0.012182	1.36	6.63	24.91	0.46
UT1	529	10-Year	28.00	26.95	27.75		27.80	0.013826	1.89	14.82	37.23	0.53
UT1	529	25-year	43.00	26.95	27.87		27.94	0.015229	2.18	19.71	42.94	0.57
UT1	529	50-Year	65.00	26.95	28.00		28.10	0.017428	2.54	25.55	48.89	0.62
UT1	529	100-Year	88.00	26.95	28.12		28.24	0.017637	2.76	31.93	54.65	0.64
UT1	658	2-Year	9.00	28.67	29.41	29.26	29.50	0.019296	2.40	3.75	8.27	0.63
UT1	658	10-Year	28.00	28.67	29.87	29.69	30.04	0.021128	3.34	8.39	12.04	0.71
UT1	658	25-year	43.00	28.67	30.10	29.91	30.32	0.021213	3.77	11.42	14.17	0.73
UT1	658	50-Year	65.00	28.67	30.34	30.16	30.64	0.020706	4.40	15.30	18.45	0.75
UT1	658	100-Year	88.00	28.67	30.52	30.39	30.91	0.022120	5.04	18.87	21.65	0.79
UT1	690		Culvert									
UT1	763	2-Year	9.00	29.01	31.33	29.80	31.34	0.000537	0.78	11.61	8.48	0.12
UT1	763	10-Year	28.00	29.01	32.94	30.42	32.95	0.000252	0.87	46.20	46.11	0.09
UT1	763	25-year	43.00	29.01	34.24	30.75	34.25	0.000118	0.76	82.71	80.78	0.07
UT1	763	50-Year	65.00	29.01	35.13	31.14	35.13	0.000070	0.67	216.01	99.92	0.05
UT1	763	100-Year	88.00	29.01	35.27	31.47	35.28	0.000110	0.85	230.22	102.92	0.07
UT1	882	2-Year	8.00	29.90	31.44		31.48	0.003826	1.57	5.09	5.29	0.28
UT1	882	10-Year	25.00	29.90	32.98		33.02	0.001730	1.60	15.93	11.73	0.20
UT1	882	25-year	36.00	29.90	34.26		34.27	0.000385	1.06	67.43	111.12	0.11
UT1	882	50-Year	46.00	29.90	35.14		35.14	0.000085	0.59	170.91	124.88	0.05
UT1	882	100-Year	61.00	29.90	35.29		35.29	0.000115	0.70	189.36	128.09	0.06

HEC-RAS Plan: Fut_Base River: Hardee Creek Reach: UT1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
UT1	967	2-Year	8.00	29.83	31.54		31.55	0.000265	0.52	15.47	12.88	0.08
UT1	967	10-Year	25.00	29.83	33.06		33.07	0.000196	0.67	37.41	16.03	0.08
UT1	967	25-year	36.00	29.83	34.28		34.29	0.000115	0.61	58.61	19.24	0.06
UT1	967	50-Year	46.00	29.83	35.15		35.15	0.000087	0.61	81.57	34.05	0.05
UT1	967	100-Year	61.00	29.83	35.29		35.30	0.000135	0.77	86.80	36.59	0.07
UT1	976		Culvert									
UT1	1033	2-Year	8.00	33.17	34.41	33.79	34.43	0.002695	1.23	6.53	8.63	0.25
UT1	1033	10-Year	25.00	33.17	35.69	34.26	35.70	0.000617	0.84	41.68	50.35	0.13
UT1	1033	25-year	36.00	33.17	36.27	34.47	36.27	0.000280	0.72	80.99	78.00	0.09
UT1	1033	50-Year	46.00	33.17	36.44	34.64	36.45	0.000313	0.81	95.09	83.09	0.10
UT1	1033	100-Year	61.00	33.17	36.54	34.87	36.55	0.000454	1.01	103.06	85.83	0.12
UT1	1046		Inl Struct									
UT1	1639	2-Year	9.00	41.94	42.29	42.21	42.33	0.020019	1.61	5.59	23.60	0.58
UT1	1639	10-Year	22.00	41.94	42.48	42.36	42.55	0.018257	2.07	10.60	28.51	0.60
UT1	1639	25-year	31.00	41.94	42.59	42.44	42.67	0.017374	2.28	13.62	30.68	0.60
UT1	1639	50-Year	40.00	41.94	42.68	42.51	42.77	0.016701	2.43	16.45	32.59	0.60
UT1	1639	100-Year	50.00	41.94	42.76	42.58	42.87	0.016159	2.57	19.43	34.48	0.60
UT1	1658		Bridge									
UT1	1712	2-Year	9.00	43.39	43.84	43.59	43.84	0.001443	0.58	15.58	42.30	0.17
UT1	1712	10-Year	22.00	43.39	44.04	43.67	44.05	0.002049	0.91	24.13	42.87	0.21
UT1	1712	25-year	31.00	43.39	44.15	43.72	44.17	0.002276	1.08	28.82	43.19	0.23
UT1	1712	50-Year	40.00	43.39	44.24	43.77	44.26	0.002474	1.22	32.85	43.45	0.25
UT1	1712	100-Year	50.00	43.39	44.33	43.82	44.35	0.002733	1.37	36.55	43.70	0.26
UT1	1834	2-Year	8.00	43.47	44.07		44.08	0.002919	0.94	8.49	18.69	0.25
UT1	1834	10-Year	18.00	43.47	44.34		44.36	0.003332	1.31	13.70	20.17	0.28
UT1	1834	25-year	26.00	43.47	44.48		44.52	0.003802	1.56	16.69	20.98	0.31
UT1	1834	50-Year	33.00	43.47	44.60		44.64	0.004019	1.72	19.19	21.63	0.32
UT1	1834	100-Year	41.00	43.47	44.71		44.77	0.004271	1.89	21.72	22.27	0.34

PRIMARY SYSTEM ALTERNATIVE: HEC-RAS OUTPUT

HARDEE CREEK MAIN BRANCH

HEC-RAS Plan: FINAL ALT 1 River: Hardee Creek Reach: MB1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	1861	2-Year	925.00	-2.36	2.42	0.43	2.45	0.000700	2.05	1866.21	2450.81	0.18
MB1	1861	10-Year	2005.00	-2.36	3.27	1.29	3.30	0.000700	2.32	3973.85	2515.90	0.18
MB1	1861	25-Year	2723.00	-2.36	3.69	1.72	3.72	0.000700	2.44	5040.38	2548.65	0.18
MB1	1861	50-Year	3331.00	-2.36	4.04	2.42	4.07	0.000701	2.55	5959.48	2685.80	0.19
MB1	1861	100-Year	4005.00	-2.36	4.35	2.59	4.38	0.000701	2.64	6784.60	2699.11	0.19
MB1	2483	2-Year	925.00	-0.12	3.31		3.41	0.005373	4.33	810.64	648.35	0.45
MB1	2483	10-Year	2005.00	-0.12	4.16		4.28	0.005702	5.29	1396.75	735.79	0.48
MB1	2483	25-Year	2723.00	-0.12	4.58		4.71	0.005933	5.80	1715.70	779.12	0.50
MB1	2483	50-Year	3331.00	-0.12	4.93		5.07	0.005841	6.07	1993.77	815.03	0.50
MB1	2483	100-Year	4005.00	-0.12	5.23		5.39	0.006045	6.45	2247.83	846.49	0.52
MB1	3095	2-Year	925.00	0.08	5.27		5.28	0.002040	1.60	1329.27	796.90	0.15
MB1	3095	10-Year	2005.00	0.08	6.27		6.28	0.002215	1.94	2142.06	831.11	0.17
MB1	3095	25-Year	2723.00	0.08	6.77		6.79	0.002304	2.12	2565.60	838.92	0.17
MB1	3095	50-Year	3331.00	0.08	7.15		7.17	0.002378	2.26	2882.52	844.71	0.18
MB1	3095	100-Year	4005.00	0.08	7.53		7.56	0.002451	2.39	3205.14	850.56	0.19
MB1	3500.0	2-Year	925.00	3.29	6.39		6.59	0.005194	3.69	362.87	510.80	0.43
MB1	3500.0	10-Year	2005.00	3.29	7.37		7.58	0.004467	4.22	1065.78	765.49	0.42
MB1	3500.0	25-Year	2723.00	3.29	7.86		8.06	0.004058	4.43	1443.15	779.67	0.41
MB1	3500.0	50-Year	3331.00	3.29	8.23		8.43	0.003831	4.59	1732.39	790.33	0.41
MB1	3500.0	100-Year	4005.00	3.29	8.60		8.81	0.003662	4.77	2027.55	800.27	0.40
MB1	4000.0	2-Year	925.00	3.59	7.19		7.21	0.000522	1.44	1117.34	551.05	0.14
MB1	4000.0	10-Year	2005.00	3.59	8.26		8.29	0.000666	1.99	1717.00	567.91	0.17
MB1	4000.0	25-Year	2723.00	3.59	8.78		8.82	0.000753	2.28	2011.80	572.46	0.19
MB1	4000.0	50-Year	3331.00	3.59	9.16		9.21	0.000812	2.50	2234.99	575.88	0.20
MB1	4000.0	100-Year	4005.00	3.59	9.56		9.61	0.000869	2.72	2461.24	579.32	0.20
MB1	4739.1	2-Year	925.00	2.59	7.88	5.80	8.25	0.004674	4.91	188.55	186.06	0.44
MB1	4739.1	10-Year	2005.00	2.59	9.01	7.70	10.04	0.010118	8.16	252.21	239.13	0.66
MB1	4739.1	25-Year	2723.00	2.59	9.48	8.69	11.03	0.013477	10.03	291.95	269.65	0.77
MB1	4739.1	50-Year	3331.00	2.59	9.78	9.46	11.82	0.016540	11.54	322.00	288.70	0.87
MB1	4739.1	100-Year	4005.00	2.59	10.25	10.25	12.67	0.017786	12.63	371.53	317.60	0.91
MB1	4793.6		Culvert									

HEC-RAS Plan: FINAL ALT 1 River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	4848.1	2-Year	925.00	2.81	9.06	6.02	9.30	0.002361	3.95	233.90	228.05	0.32
MB1	4848.1	10-Year	2005.00	2.81	12.66	7.90	13.01	0.001650	4.81	438.34	434.06	0.29
MB1	4848.1	25-Year	2723.00	2.81	15.20	8.85	15.57	0.001232	4.97	584.97	520.27	0.27
MB1	4848.1	50-Year	3331.00	2.81	16.85	9.54	17.26	0.001143	5.25	679.97	546.82	0.26
MB1	4848.1	100-Year	4005.00	2.81	19.44	10.26	19.47	0.000134	2.02	5563.02	660.86	0.09
MB1	5340.0	2-Year	574.00	3.45	10.00		10.07	0.000797	2.20	483.70	330.05	0.19
MB1	5340.0	10-Year	1407.00	3.45	13.41		13.45	0.000307	2.00	1684.98	373.07	0.13
MB1	5340.0	25-Year	2070.00	3.45	15.87		15.90	0.000199	1.94	2639.57	402.97	0.11
MB1	5340.0	50-Year	2674.00	3.45	17.55		17.58	0.000175	2.01	3331.00	423.30	0.10
MB1	5340.0	100-Year	3357.00	3.45	19.51		19.54	0.000147	2.04	4186.56	447.19	0.10
MB1	5550.0	2-Year	574.00	3.72	10.17		10.26	0.000977	2.40	369.79	260.22	0.20
MB1	5550.0	10-Year	1407.00	3.72	13.48		13.53	0.000399	2.25	1463.52	378.93	0.14
MB1	5550.0	25-Year	2070.00	3.72	15.91		15.95	0.000238	2.09	2419.23	405.30	0.12
MB1	5550.0	50-Year	2674.00	3.72	17.58		17.62	0.000201	2.12	3109.49	421.59	0.11
MB1	5550.0	100-Year	3357.00	3.72	19.54		19.57	0.000163	2.12	3959.41	448.11	0.10
MB1	6136.0	2-Year	574.00	4.63	10.83		10.94	0.001381	2.74	210.84	58.48	0.24
MB1	6136.0	10-Year	1407.00	4.63	13.75		13.92	0.001066	3.46	624.64	170.84	0.23
MB1	6136.0	25-Year	2070.00	4.63	16.06		16.21	0.000714	3.43	1069.46	215.17	0.20
MB1	6136.0	50-Year	2674.00	4.63	17.70		17.84	0.000598	3.50	1447.00	246.75	0.19
MB1	6136.0	100-Year	3357.00	4.63	19.63		19.75	0.000469	3.45	1950.71	274.87	0.17
MB1	6693.0	2-Year	574.00	5.75	11.63		11.68	0.001262	2.65	580.42	235.11	0.23
MB1	6693.0	10-Year	1407.00	5.75	14.40		14.45	0.000820	3.00	1374.38	329.86	0.20
MB1	6693.0	25-Year	2070.00	5.75	16.51		16.56	0.000529	2.88	2109.12	363.95	0.17
MB1	6693.0	50-Year	2674.00	5.75	18.09		18.13	0.000427	2.88	2697.17	383.99	0.16
MB1	6693.0	100-Year	3357.00	5.75	19.94		19.98	0.000332	2.82	3432.77	407.68	0.14
MB1	7182.0	2-Year	574.00	6.73	12.41		12.52	0.002326	3.48	395.42	166.50	0.31
MB1	7182.0	10-Year	1407.00	6.73	14.91		15.04	0.001728	4.15	841.24	190.68	0.29
MB1	7182.0	25-Year	2070.00	6.73	16.84		16.97	0.001291	4.27	1228.13	209.41	0.26
MB1	7182.0	50-Year	2674.00	6.73	18.34		18.47	0.001116	4.44	1553.59	223.95	0.25
MB1	7182.0	100-Year	3357.00	6.73	20.14		20.26	0.000909	4.47	1970.40	241.30	0.23
MB1	7869.0	2-Year	574.00	8.11	13.90		13.99	0.001967	3.26	427.51	174.51	0.28
MB1	7869.0	10-Year	1407.00	8.11	16.13		16.26	0.001827	4.20	848.38	205.84	0.29

HEC-RAS Plan: FINAL ALT 1 River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	7869.0	25-Year	2070.00	8.11	17.79		17.92	0.001482	4.42	1207.70	227.23	0.28
MB1	7869.0	50-Year	2674.00	8.11	19.16		19.29	0.001264	4.54	1527.96	239.97	0.26
MB1	7869.0	100-Year	3357.00	8.11	20.80		20.92	0.001017	4.53	1933.70	255.09	0.24
MB1	8107.4	2-Year	574.00	8.59	14.39		14.52	0.002451	3.65	341.87	124.78	0.32
MB1	8107.4	10-Year	1407.00	8.59	16.59		16.83	0.002904	5.28	646.29	177.70	0.37
MB1	8107.4	25-Year	2070.00	8.59	18.15		18.41	0.002542	5.73	989.63	262.63	0.36
MB1	8107.4	50-Year	2674.00	8.59	19.46		19.69	0.001969	5.59	1377.38	312.81	0.33
MB1	8107.4	100-Year	3357.00	8.59	21.04		21.22	0.001385	5.22	1879.56	322.74	0.28
MB1	8676.0	2-Year	574.00	9.65	15.32		15.35	0.000943	2.21	626.50	201.54	0.20
MB1	8676.0	10-Year	1407.00	9.65	17.67		17.72	0.000941	3.01	1105.01	205.58	0.21
MB1	8676.0	25-Year	2070.00	9.65	19.18		19.25	0.000921	3.44	1417.78	208.19	0.22
MB1	8676.0	50-Year	2674.00	9.65	20.36		20.44	0.000921	3.78	1664.96	210.22	0.22
MB1	8676.0	100-Year	3357.00	9.65	21.75		21.84	0.000866	4.03	1958.38	212.61	0.22
MB1	9162.0	2-Year	574.00	10.56	15.90		15.96	0.001695	2.80	578.47	279.36	0.26
MB1	9162.0	10-Year	1407.00	10.56	18.16		18.21	0.001100	3.12	1237.17	302.78	0.23
MB1	9162.0	25-Year	2070.00	10.56	19.64		19.70	0.000921	3.31	1692.57	313.05	0.21
MB1	9162.0	50-Year	2674.00	10.56	20.81		20.87	0.000839	3.48	2063.90	321.03	0.21
MB1	9162.0	100-Year	3357.00	10.56	22.17		22.23	0.000739	3.61	2510.20	338.36	0.20
MB1	9756.0	2-Year	574.00	11.70	17.05		17.13	0.002289	3.26	470.76	226.04	0.30
MB1	9756.0	10-Year	1407.00	11.70	18.99		19.09	0.001996	4.04	929.19	248.88	0.30
MB1	9756.0	25-Year	2070.00	11.70	20.33		20.44	0.001721	4.34	1269.89	258.09	0.29
MB1	9756.0	50-Year	2674.00	11.70	21.43		21.55	0.001561	4.56	1558.64	265.16	0.28
MB1	9756.0	100-Year	3357.00	11.70	22.71		22.83	0.001359	4.69	1901.86	273.12	0.27
MB1	10329.5	2-Year	574.00	12.86	18.31	15.91	18.44	0.002191	2.85	201.48	58.43	0.27
MB1	10329.5	10-Year	1407.00	12.86	20.27	17.36	20.56	0.002916	4.39	351.08	101.48	0.33
MB1	10329.5	25-Year	2070.00	12.86	21.47	18.25	21.87	0.003033	5.12	483.97	119.90	0.35
MB1	10329.5	50-Year	2674.00	12.86	22.47	18.91	22.93	0.002999	5.60	603.38	135.14	0.36
MB1	10329.5	100-Year	3357.00	12.86	23.60	19.64	24.11	0.002807	5.95	746.18	172.31	0.36
MB1	10344.5		Bridge									
MB1	10359.5	2-Year	574.00	13.40	18.96	16.45	19.08	0.001993	2.76	207.85	59.02	0.26
MB1	10359.5	10-Year	1407.00	13.40	20.98	17.90	21.26	0.002597	4.23	369.41	104.20	0.32

HEC-RAS Plan: FINAL ALT 1 River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	10359.5	25-Year	2070.00	13.40	22.22	18.79	22.58	0.002710	4.94	507.81	123.02	0.34
MB1	10359.5	50-Year	2674.00	13.40	23.23	19.45	23.66	0.002694	5.41	630.73	142.31	0.34
MB1	10359.5	100-Year	3357.00	13.40	24.26	20.17	24.75	0.002665	5.85	761.55	176.27	0.35
MB1	10647.0	2-Year	564.00	13.59	19.37		19.39	0.000575	1.82	603.67	221.83	0.14
MB1	10647.0	10-Year	1382.00	13.59	21.63		21.66	0.000636	2.46	1166.24	271.91	0.16
MB1	10647.0	25-Year	2004.00	13.59	22.97		23.01	0.000634	2.75	1549.75	299.12	0.17
MB1	10647.0	50-Year	2581.00	13.59	24.06		24.11	0.000635	2.98	1893.75	332.47	0.17
MB1	10647.0	100-Year	3236.00	13.59	25.16		25.21	0.000624	3.18	2274.34	358.63	0.17
MB1	11268.0	2-Year	564.00	14.02	19.78		19.80	0.000764	1.91	472.74	154.17	0.16
MB1	11268.0	10-Year	1382.00	14.02	22.07		22.12	0.000874	2.72	870.88	191.35	0.19
MB1	11268.0	25-Year	2004.00	14.02	23.42		23.49	0.000895	3.11	1142.61	211.94	0.19
MB1	11268.0	50-Year	2581.00	14.02	24.51		24.58	0.000902	3.40	1382.22	228.56	0.20
MB1	11268.0	100-Year	3236.00	14.02	25.60		25.68	0.000910	3.68	1640.17	245.19	0.20
MB1	11882.0	2-Year	564.00	14.44	20.19		20.22	0.000601	1.84	521.17	172.56	0.15
MB1	11882.0	10-Year	1382.00	14.44	22.55		22.60	0.000673	2.53	995.27	220.03	0.17
MB1	11882.0	25-Year	2004.00	14.44	23.91		23.97	0.000683	2.86	1301.49	230.22	0.17
MB1	11882.0	50-Year	2581.00	14.44	25.01		25.07	0.000689	3.12	1557.82	238.41	0.18
MB1	11882.0	100-Year	3236.00	14.44	26.10		26.17	0.000699	3.37	1823.39	246.61	0.18
MB1	12295.0	2-Year	564.00	14.72	20.43		20.45	0.000511	1.65	668.95	262.88	0.13
MB1	12295.0	10-Year	1382.00	14.72	22.80		22.83	0.000473	2.07	1420.64	356.21	0.14
MB1	12295.0	25-Year	2004.00	14.72	24.16		24.19	0.000442	2.25	1917.11	373.26	0.14
MB1	12295.0	50-Year	2581.00	14.72	25.26		25.29	0.000424	2.39	2332.28	383.84	0.14
MB1	12295.0	100-Year	3236.00	14.72	26.36		26.39	0.000413	2.53	2759.63	392.75	0.14
MB1	12608.0	2-Year	564.00	14.94	20.53		20.54	0.000181	0.97	991.93	326.02	0.08
MB1	12608.0	10-Year	1382.00	14.94	22.90		22.91	0.000170	1.23	1885.06	410.74	0.08
MB1	12608.0	25-Year	2004.00	14.94	24.26		24.27	0.000166	1.37	2451.71	423.71	0.08
MB1	12608.0	50-Year	2581.00	14.94	25.36		25.37	0.000165	1.48	2923.49	437.88	0.08
MB1	12608.0	100-Year	3236.00	14.94	26.46		26.47	0.000164	1.59	3412.91	452.10	0.09
MB1	12762.5	2-Year	564.00	15.04	20.60	17.90	20.63	0.000898	1.66	371.04	240.86	0.16
MB1	12762.5	10-Year	1382.00	15.04	22.95	18.80	23.03	0.001036	2.36	629.74	253.90	0.17
MB1	12762.5	25-Year	2004.00	15.04	24.30	19.34	24.40	0.001095	2.75	802.83	293.29	0.18
MB1	12762.5	50-Year	2581.00	15.04	25.40	19.79	25.42	0.000263	1.47	2127.53	347.73	0.09

HEC-RAS Plan: FINAL ALT 1 River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	12762.5	100-Year	3236.00	15.04	26.50	20.24	26.53	0.000265	1.60	2570.70	440.81	0.09
MB1	12785.5		Bridge									
MB1	12808.5	2-Year	564.00	16.43	22.32	19.58	22.37	0.000733	2.09	373.52	253.05	0.17
MB1	12808.5	10-Year	1382.00	16.43	23.52	20.48	23.66	0.001885	3.86	484.66	268.06	0.27
MB1	12808.5	25-Year	2004.00	16.43	25.54	21.02	25.69	0.001349	3.95	673.16	297.98	0.24
MB1	12808.5	50-Year	2581.00	16.43	26.55	21.48	26.58	0.000320	2.08	2059.11	314.85	0.12
MB1	12808.5	100-Year	3236.00	16.43	27.58	21.95	27.61	0.000331	2.27	2392.68	335.03	0.13
MB1	12951.0	2-Year	564.00	17.76	22.31	22.09	22.94	0.015402	7.01	140.65	112.50	0.69
MB1	12951.0	10-Year	1382.00	17.76	23.81	23.53	24.52	0.013934	8.59	374.98	201.12	0.70
MB1	12951.0	25-Year	2004.00	17.76	25.80		26.05	0.004085	5.89	839.67	248.84	0.40
MB1	12951.0	50-Year	2581.00	17.76	26.55		26.80	0.003891	6.17	1028.99	258.63	0.40
MB1	12951.0	100-Year	3236.00	17.76	27.59		27.82	0.003177	6.08	1306.38	274.06	0.37
MB1	13353.0	2-Year	513.00	18.60	24.71		24.82	0.002005	3.29	320.69	148.92	0.27
MB1	13353.0	10-Year	1176.00	18.60	26.43		26.59	0.002313	4.34	631.68	212.65	0.30
MB1	13353.0	25-Year	1682.00	18.60	27.20		27.40	0.002698	5.05	806.79	243.39	0.33
MB1	13353.0	50-Year	2145.00	18.60	27.92		28.13	0.002724	5.40	990.93	272.87	0.34
MB1	13353.0	100-Year	2668.00	18.60	28.76		28.96	0.002503	5.53	1234.84	305.44	0.33
MB1	13575.0	2-Year	513.00	19.07	24.99		25.00	0.000387	1.41	1037.11	375.37	0.12
MB1	13575.0	10-Year	1176.00	19.07	26.77		26.79	0.000427	1.84	1728.19	399.54	0.13
MB1	13575.0	25-Year	1682.00	19.07	27.61		27.63	0.000504	2.17	2068.24	410.91	0.14
MB1	13575.0	50-Year	2145.00	19.07	28.35		28.37	0.000538	2.39	2373.89	420.88	0.15
MB1	13575.0	100-Year	2668.00	19.07	29.18		29.21	0.000545	2.57	2728.04	432.13	0.15
MB1	13928.0	2-Year	493.00	19.82	25.16		25.17	0.000629	1.64	983.10	550.96	0.14
MB1	13928.0	10-Year	1121.00	19.82	26.93		26.94	0.000412	1.69	2078.22	676.98	0.12
MB1	13928.0	25-Year	1597.00	19.82	27.78		27.79	0.000402	1.83	2662.36	689.99	0.13
MB1	13928.0	50-Year	2034.00	19.82	28.52		28.53	0.000383	1.92	3176.73	701.24	0.12
MB1	13928.0	100-Year	2527.00	19.82	29.35		29.36	0.000354	1.98	3762.42	713.84	0.12
MB1	14299.0	2-Year	493.00	20.60	25.41		25.42	0.000693	1.56	1039.02	651.77	0.15
MB1	14299.0	10-Year	1121.00	20.60	27.08		27.09	0.000404	1.55	2180.33	700.96	0.12
MB1	14299.0	25-Year	1597.00	20.60	27.93		27.94	0.000387	1.68	2781.60	714.38	0.12
MB1	14299.0	50-Year	2034.00	20.60	28.66		28.67	0.000366	1.77	3308.75	725.95	0.12

HEC-RAS Plan: FINAL ALT 1 River: Hardee Creek Reach: MB1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
MB1	14299.0	100-Year	2527.00	20.60	29.48		29.49	0.000337	1.83	3906.94	738.85	0.12
MB1	14885.5	2-Year	493.00	21.83	26.13		26.19	0.003222	3.04	409.69	219.38	0.31
MB1	14885.5	10-Year	1121.00	21.83	27.54		27.62	0.003031	3.81	730.17	236.82	0.32
MB1	14885.5	25-Year	1597.00	21.83	28.36		28.46	0.003010	4.26	928.92	247.01	0.33
MB1	14885.5	50-Year	2034.00	21.83	29.06		29.17	0.002920	4.57	1105.08	255.71	0.33
MB1	14885.5	100-Year	2527.00	21.83	29.83		29.96	0.002745	4.81	1307.22	265.34	0.33

HARDEE CREEK UT1

HEC-RAS Plan: FINAL ALT 1 River: Hardee Creek Reach: UT1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
UT1	10	2-Year	9.00	19.53	20.35	20.00	20.37	0.003002	0.90	10.01	24.30	0.25
UT1	10	10-Year	28.00	19.53	20.79	20.27	20.81	0.003003	1.19	23.44	37.19	0.27
UT1	10	25-year	43.00	19.53	21.03	20.41	21.05	0.003006	1.29	33.35	47.19	0.27
UT1	10	50-Year	65.00	19.53	21.34	20.57	21.37	0.003005	1.18	54.86	88.18	0.26
UT1	10	100-Year	88.00	19.53	21.51	20.70	21.54	0.003004	1.23	71.30	107.83	0.27
UT1	298	2-Year	9.00	22.00	22.49	22.46	22.58	0.046416	2.49	3.61	14.83	0.89
UT1	298	10-Year	28.00	22.00	22.78	22.73	22.92	0.035971	3.01	9.31	23.81	0.85
UT1	298	25-year	43.00	22.00	22.95	22.86	23.10	0.030504	3.15	13.66	28.84	0.81
UT1	298	50-Year	65.00	22.00	23.15		23.31	0.024910	3.24	20.09	34.98	0.75
UT1	298	100-Year	88.00	22.00	23.29		23.48	0.024274	3.46	25.46	39.38	0.76
UT1	529	2-Year	9.00	26.95	27.48		27.51	0.012182	1.36	6.63	24.91	0.46
UT1	529	10-Year	28.00	26.95	27.75		27.80	0.013826	1.89	14.82	37.23	0.53
UT1	529	25-year	43.00	26.95	27.87		27.94	0.015229	2.18	19.71	42.94	0.57
UT1	529	50-Year	65.00	26.95	28.00		28.10	0.017428	2.54	25.55	48.89	0.62
UT1	529	100-Year	88.00	26.95	28.12		28.24	0.017637	2.76	31.93	54.65	0.64
UT1	658	2-Year	9.00	28.67	29.41	29.26	29.50	0.019296	2.40	3.75	8.27	0.63
UT1	658	10-Year	28.00	28.67	29.87	29.69	30.04	0.021128	3.34	8.39	12.04	0.71
UT1	658	25-year	43.00	28.67	30.10	29.91	30.32	0.021213	3.77	11.42	14.17	0.73
UT1	658	50-Year	65.00	28.67	30.34	30.16	30.64	0.020706	4.40	15.30	18.45	0.75
UT1	658	100-Year	88.00	28.67	30.52	30.39	30.91	0.022120	5.04	18.87	21.65	0.79
UT1	690		Culvert									
UT1	763	2-Year	9.00	29.01	31.44	29.80	31.45	0.000423	0.72	12.64	9.64	0.10
UT1	763	10-Year	28.00	29.01	32.94	30.42	32.95	0.000249	0.87	46.42	46.30	0.09
UT1	763	25-year	43.00	29.01	34.71	30.75	34.71	0.000076	0.66	95.83	90.84	0.05
UT1	763	50-Year	65.00	29.01	35.17	31.14	35.18	0.000067	0.65	220.34	100.84	0.05
UT1	763	100-Year	88.00	29.01	35.29	31.47	35.29	0.000108	0.85	231.70	103.23	0.06
UT1	882	2-Year	8.00	29.90	31.53		31.56	0.002988	1.44	5.57	5.46	0.25
UT1	882	10-Year	25.00	29.90	32.99		33.03	0.001710	1.59	16.02	11.88	0.20
UT1	882	25-year	36.00	29.90	34.72		34.72	0.000123	0.66	120.07	117.04	0.06
UT1	882	50-Year	46.00	29.90	35.18		35.19	0.000079	0.57	176.25	125.82	0.05
UT1	882	100-Year	61.00	29.90	35.30		35.30	0.000112	0.69	191.17	128.40	0.06

HEC-RAS Plan: FINAL ALT 1 River: Hardee Creek Reach: UT1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
UT1	967	2-Year	8.00	29.83	31.61		31.62	0.000223	0.49	16.39	13.03	0.08
UT1	967	10-Year	25.00	29.83	33.07		33.07	0.000194	0.67	37.52	16.04	0.08
UT1	967	25-year	36.00	29.83	34.73		34.73	0.000076	0.54	68.82	26.86	0.05
UT1	967	50-Year	46.00	29.83	35.19		35.19	0.000084	0.60	83.02	34.77	0.05
UT1	967	100-Year	61.00	29.83	35.31		35.32	0.000133	0.77	87.31	36.82	0.07
UT1	976		Culvert									
UT1	1033	2-Year	8.00	33.17	34.51	33.79	34.52	0.001937	1.08	7.38	9.14	0.21
UT1	1033	10-Year	25.00	33.17	35.71	34.26	35.72	0.000593	0.83	42.44	50.65	0.13
UT1	1033	25-year	36.00	33.17	36.28	34.47	36.28	0.000275	0.72	81.59	78.22	0.09
UT1	1033	50-Year	46.00	33.17	36.42	34.64	36.43	0.000327	0.82	93.37	82.49	0.10
UT1	1033	100-Year	61.00	33.17	36.56	34.87	36.57	0.000436	1.00	104.83	86.43	0.12
UT1	1639	2-Year	9.00	41.94	42.21	42.21	42.30	0.064348	2.41	3.74	20.73	1.00
UT1	1639	10-Year	22.00	41.94	42.36	42.36	42.50	0.056563	3.03	7.27	25.90	1.01
UT1	1639	25-year	31.00	41.94	42.44	42.44	42.61	0.053178	3.33	9.32	27.54	1.01
UT1	1639	50-Year	40.00	41.94	42.51	42.51	42.70	0.050173	3.54	11.29	29.02	1.00
UT1	1639	100-Year	50.00	41.94	42.58	42.58	42.80	0.048395	3.76	13.30	30.46	1.00
UT1	1658		Bridge									
UT1	1712	2-Year	9.00	43.39	43.84	43.59	43.84	0.001421	0.58	15.65	42.30	0.17
UT1	1712	10-Year	22.00	43.39	44.04	43.67	44.05	0.002025	0.91	24.22	42.88	0.21
UT1	1712	25-year	31.00	43.39	44.15	43.72	44.17	0.002255	1.07	28.90	43.19	0.23
UT1	1712	50-Year	40.00	43.39	44.24	43.77	44.26	0.002496	1.22	32.76	43.45	0.25
UT1	1712	100-Year	50.00	43.39	44.33	43.82	44.36	0.002729	1.37	36.57	43.70	0.26
UT1	1834	2-Year	8.00	43.47	44.07		44.08	0.002920	0.94	8.49	18.69	0.25
UT1	1834	10-Year	18.00	43.47	44.34		44.36	0.003333	1.31	13.70	20.17	0.28
UT1	1834	25-year	26.00	43.47	44.48		44.52	0.003802	1.56	16.69	20.98	0.31
UT1	1834	50-Year	33.00	43.47	44.60		44.64	0.004020	1.72	19.18	21.63	0.32
UT1	1834	100-Year	41.00	43.47	44.71		44.77	0.004270	1.89	21.72	22.27	0.34

SECONDARY SYSTEM EXISTING CONDITIONS: SWMM INPUT

Project: Hardee Creek Watershed Master Plan
Location: Quail Hollow/Fox Haven (Existing)
Prepared by : MB
Checked by: DJK
Date: June 2015

SWMM Sub-Basin ID	Curve Number	Area (acres)	Area (sq. ft.)	Width (ft.)	Basin Slope (%)
SUB_HCMB010128	83	17.98	783,209	1599	2.50%
SUB_HCMB010125	67	22.06	960,934	2194	2.14%
SUB_HCMB010122	74	0.28	12,197	190	5.26%
SUB_HCMB010123	74	0.18	7,841	173	5.78%

Project: Hardee Creek Watershed Master Plan
Location: River Hills
Prepared by : MB
Checked by: DJK
Date: June 2015

SWMM Sub-Basin ID	Curve Number	Area (acres)	Area (sq. ft.)	Width (ft.)	Basin Slope (%)
SUB_HCMB010032	80	1.09	47,480	224	2.58
SUB_HCMB010034	83	8.55	372,521	320	0.94
SUB_HCMB010036	49	32.61	1,420,469	1732	2.66
SUB_HCMB010039	61	4.64	202,251	2056	2.68
SUB_HCMB010042	61	5.43	236,579	727	2.82
SUB_HCMB010043	61	11.81	514,529	1418	2.94
SUB_HCMB010057	80	4.10	178,568	345	3.92
SUB_HCMB010059	75	11.19	487,396	1389	3.17

SECONDARY SYSTEM EXISTING CONDITIONS: SWMM OUTPUT

Existing Conditions: Quail Hollow /Fox Haven (10-Year)

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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------

Existing Conditions: Quail Hollow /Fox Haven (10-Year)

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ MAY-20-2010 00:00:00
Ending Date .............. MAY-22-2010 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:10:00
Dry Time Step ............ 00:10:00
Routing Time Step ........ 30.00 sec


WARNING 04: minimum elevation drop used for Conduit 3_EX42CMP

WARNING 04: minimum elevation drop used for Conduit OVERLAND_3_EX42CMP

WARNING 02: maximum depth increased for Node HCMB010125

WARNING 02: maximum depth increased for Node HCMB010124

*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......        19.615         5.812
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         7.337         2.174
Surface Runoff ...........        12.141         3.597
Final Surface Storage ....         0.168         0.050
Continuity Error (%) .....        -0.152


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        12.141         3.956
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        12.044         3.925
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.093         0.030
Continuity Error (%) .....         0.030


*************************
Time-Step Critical Elements
```

Existing Conditions: Quail Hollow /Fox Haven (10-Year)

```
**************************
Link 1_EX18CMP (38.91%)
Link 3_EX42CMP (1.09%)


*******************************
Highest Flow Instability Indexes
*******************************
Link DUMMYCHANNEL (2)
Link 3_EX42CMP (2)
Link OVERLAND_3_EX42CMP (2)


************************
Routing Time Step Summary
************************
Minimum Time Step           :     1.23 sec
Average Time Step           :    24.56 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.13


*************************
Subcatchment Runoff Summary
*************************
```

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
SUB_HCMB010128	5.81	0.00	0.00	1.53	4.24	2.07	42.88	0.730
SUB_HCMB010125	5.81	0.00	0.00	2.70	3.07	1.84	37.06	0.529
SUB_HCMB010123	5.81	0.00	0.00	2.19	3.58	0.02	0.43	0.616
SUB_HCMB010122	5.81	0.00	0.00	2.20	3.58	0.03	0.66	0.616

```
******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
HCMB010125	JUNCTION	1.08	5.44	20.87	0 13:23
HCMB010123	JUNCTION	0.06	0.38	25.28	0 12:59
HCMB010122	JUNCTION	0.03	0.19	24.99	0 13:00
HCMB010128	JUNCTION	0.19	0.53	28.86	0 14:48
HCMB010124	JUNCTION	0.92	5.39	20.82	0 13:22
OUTFALL	OUTFALL	0.68	2.00	17.00	0 12:42
1	STORAGE	1.52	4.98	33.28	0 14:45

```
******************
Node Inflow Summary
******************
```

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
HCMB010125	JUNCTION	37.01	43.07	0 12:59	1.842	3.880
HCMB010123	JUNCTION	0.43	0.43	0 12:59	0.018	0.017
HCMB010122	JUNCTION	0.66	1.09	0 12:59	0.027	0.045
HCMB010128	JUNCTION	0.00	8.80	0 14:46	0.000	2.040
HCMB010124	JUNCTION	0.00	28.91	0 13:07	0.000	3.924

OUTFALL	OUTFALL	0.00	26.24	0	13:18	0.000	3.925
1	STORAGE	42.84	42.84	0	12:59	2.071	2.070

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	E&I Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
1	33.652	11	0	121.284	38	0 14:45	8.80

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
OUTFALL	86.00	5.80	26.24	3.925
System	86.00	5.80	26.24	3.925

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1_EX18CMP	CONDUIT	8.80	0 14:46	6.92	6.92	0.68
OVERLAND_1_EX18CMP	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
2_OPENCHANNEL	CONDUIT	8.80	0 14:48	1.25	0.01	0.49
3_EX42CMP	CONDUIT	25.37	0 12:59	2.87	11.92	1.00
OVERLAND_3_EX42CMP	CONDUIT	16.58	0 13:21	2.92	0.15	0.15
4_EX15CMP	CONDUIT	0.43	0 13:00	2.03	0.20	0.23
5_EX15CMP	CONDUIT	1.08	0 13:00	2.69	0.05	0.58
DUMMYCHANNEL	CONDUIT	26.24	0 13:18	3.75	1.54	1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change

Existing Conditions: Quail Hollow /Fox Haven (10-Year)

1_EX18CMP	3.22	0.12	0.02	0.00	0.64	0.22	0.00	0.00	0.55	0.0020
OVERLAND_1_EX18CMP	10.89	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
2_OPENCHANNEL	1.91	0.14	0.01	0.00	0.86	0.00	0.00	0.00	0.12	0.0000
3_EX42CMP	4.16	0.13	0.00	0.00	0.87	0.00	0.00	0.00	0.25	0.0061
OVERLAND_3_EX42CMP	4.49	0.94	0.00	0.00	0.04	0.00	0.00	0.01	0.04	0.0000
4_EX15CMP	7.50	0.13	0.00	0.00	0.87	0.00	0.00	0.00	0.24	0.0001
5_EX15CMP	22.48	0.13	0.36	0.00	0.48	0.02	0.00	0.00	0.10	0.0000
DUMMYCHANNEL	2.75	0.13	0.00	0.00	0.87	0.00	0.00	0.00	0.30	0.0048

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
1_EX18CMP	0.01	0.01	0.01	13.44	0.01
3_EX42CMP	2.04	2.04	2.05	13.66	2.04
DUMMYCHANNEL	2.79	2.79	2.82	3.04	2.79

Analysis begun on: Fri Nov 20 11:58:39 2015
Analysis ended on: Fri Nov 20 11:58:39 2015
Total elapsed time: < 1 sec

Existing Conditions: River Hills (10-Year)

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------

Existing Conditions: River Hills (10-Year)

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ MAY-20-2010 00:00:00
Ending Date .............. MAY-22-2010 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:10:00
Dry Time Step ............ 00:10:00
Routing Time Step ........ 30.00 sec


WARNING 02: maximum depth increased for Node HCMB010032

WARNING 02: maximum depth increased for Node HCMB010057

*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......        38.466         5.812
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........        19.728         2.981
Surface Runoff ...........        18.453         2.788
Final Surface Storage ....         0.327         0.049
Continuity Error (%) .....        -0.109


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        18.453         6.013
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        18.454         6.013
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....        -0.007


**************************
Time-Step Critical Elements
**************************
Link 11_EX36CMP (5.37%)
Link 12_EX42RCP (5.06%)


******************************
Highest Flow Instability Indexes
******************************
```

All links are stable.

****
Routing Time Step Summary
****

Minimum Time Step	:	2.15 sec
Average Time Step	:	28.66 sec
Maximum Time Step	:	30.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.01

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
SUB_HCMB010059	5.81	0.00	0.00	2.14	3.64	1.10	24.61	0.626
SUB_HCMB010057	5.81	0.00	0.00	1.77	4.01	0.45	9.53	0.689
SUB_HCMB010043	5.81	0.00	0.00	3.07	2.70	0.87	18.45	0.464
SUB_HCMB010042	5.81	0.00	0.00	3.07	2.70	0.40	8.64	0.465
SUB_HCMB010039	5.81	0.00	0.00	3.06	2.72	0.34	8.34	0.468
SUB_HCMB010036	5.81	0.00	0.00	3.78	1.99	1.76	26.14	0.342
SUB_HCMB010034	5.81	0.00	0.00	1.56	4.21	0.98	12.92	0.724
SUB_HCMB010032	5.81	0.00	0.00	1.76	4.02	0.12	2.76	0.691

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
HCMB010059	JUNCTION	0.24	3.14	24.25	0 13:02
HCMB010058	JUNCTION	0.22	2.86	23.79	0 13:03
HCMB010042	JUNCTION	0.39	4.43	20.11	0 13:09
HCMB010041	JUNCTION	0.53	5.02	19.92	0 13:13
HCMB010040	JUNCTION	0.39	4.49	19.41	0 13:17
HCMB010036	JUNCTION	0.59	6.30	19.34	0 13:19
HCMB010035	JUNCTION	0.71	6.36	18.87	0 13:20
HCMB010034	JUNCTION	0.72	5.85	18.19	0 13:21
HCMB010033	JUNCTION	0.60	3.97	16.05	0 13:21
HCMB010032	JUNCTION	0.46	3.23	15.23	0 13:22
HCMB010057	JUNCTION	0.13	1.26	21.27	0 13:01
HCMB010039	JUNCTION	0.53	5.39	19.37	0 13:18
HCMB010043	JUNCTION	0.29	2.90	20.32	0 13:07
HCMB010031	OUTFALL	0.28	1.61	13.11	0 13:23

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
HCMB010059	JUNCTION	24.58	24.58	0 13:00	1.105	1.105
HCMB010058	JUNCTION	0.00	22.35	0 13:01	0.000	1.105
HCMB010042	JUNCTION	8.63	53.37	0 13:01	0.398	2.816
HCMB010041	JUNCTION	0.00	49.62	0 13:03	0.000	2.815
HCMB010040	JUNCTION	0.00	40.59	0 13:10	0.000	2.817
HCMB010036	JUNCTION	26.13	60.36	0 13:12	1.760	4.919
HCMB010035	JUNCTION	0.00	58.47	0 13:17	0.000	4.916
HCMB010034	JUNCTION	12.92	67.73	0 13:18	0.977	5.894

HCMB010033	JUNCTION	0.00	67.16	0	13:21	0.000	5.894
HCMB010032	JUNCTION	2.75	68.09	0	13:22	0.119	6.013
HCMB010057	JUNCTION	9.52	30.97	0	13:00	0.446	1.551
HCMB010039	JUNCTION	8.33	42.73	0	13:11	0.343	3.159
HCMB010043	JUNCTION	18.43	49.00	0	13:00	0.866	2.417
HCMB010031	OUTFALL	0.00	68.12	0	13:23	0.000	6.013

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
HCMB010031	75.62	8.84	68.12	6.013
System	75.62	8.84	68.12	6.013

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1_EX24RCP	CONDUIT	19.27	0	12:53	6.13	0.95	1.00
OVERLAND_1_EX24RCP	CONDUIT	6.45	0	13:03	3.90	0.01	0.07
2_EX24RCP	CONDUIT	22.14	0	13:03	8.13	1.02	0.81
OVERLAND_2_EX24RCP	CONDUIT	0.01	0	13:03	0.00	0.00	0.00
3_OPENCHANNEL	CONDUIT	30.93	0	13:01	3.65	0.11	0.52
OVERLAND_3_OPENCHANNEL	CONDUIT	0.00	0	00:00	0.00	0.00	0.00
4_OPENCHANNEL	CONDUIT	45.29	0	13:01	3.02	0.33	0.86
5_EX36RCP	CONDUIT	40.16	0	12:55	5.68	0.61	1.00
OVERLAND_5_EX36RCP	CONDUIT	20.80	0	13:09	2.47	0.02	0.20
6_EX36RCP	CONDUIT	40.59	0	13:10	5.74	2.30	1.00
OVERLAND_6_EX36RCP	CONDUIT	0.00	0	00:00	0.00	0.00	0.13
7_EX36RCP	CONDUIT	34.77	0	12:52	5.15	0.39	1.00
OVERLAND_7_EX36RCP	CONDUIT	25.93	0	13:17	2.13	0.02	0.25
8_OPENCHANNEL	CONDUIT	39.82	0	13:16	2.29	0.20	0.95
9_EX42RCP	CONDUIT	55.57	0	13:11	5.78	0.34	1.00
OVERLAND_9_EX42RCP	CONDUIT	3.48	0	13:19	2.25	0.01	0.07
10_EX42RCP	CONDUIT	55.59	0	13:18	5.78	1.10	1.00
OVERLAND_10_EX42RCP	CONDUIT	2.26	0	13:20	1.10	0.00	0.07
11_EX36CMP	CONDUIT	62.09	0	13:19	8.78	2.00	1.00
OVERLAND_11_EX36CMP	CONDUIT	5.11	0	13:22	2.34	0.03	0.13
12_EX42RCP	CONDUIT	67.17	0	13:22	7.07	2.05	0.96
OVERLAND_12_EX42RCP	CONDUIT	0.00	0	00:00	0.00	0.00	0.00
13_EX42RCP	CONDUIT	68.12	0	13:23	9.61	0.43	0.69

****
Flow Classification Summary
****

Existing Conditions: River Hills (10-Year)

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
1_EX24RCP	13.88	0.53	0.00	0.00	0.31	0.16	0.00	0.00	0.42	0.0004
OVERLAND_1_EX24RCP	17.32	0.99	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.0000
2_EX24RCP	3.22	0.35	0.18	0.00	0.03	0.44	0.00	0.00	0.71	0.0003
OVERLAND_2_EX24RCP	8.57	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
3_OPENCHANNEL	4.39	0.15	0.20	0.00	0.65	0.00	0.00	0.00	0.23	0.0000
OVERLAND_3_OPENCHANNEL	4.81	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
4_OPENCHANNEL	1.16	0.15	0.00	0.00	0.85	0.00	0.00	0.00	0.23	0.0001
5_EX36RCP	5.19	0.16	0.04	0.00	0.80	0.00	0.00	0.00	0.31	0.0002
OVERLAND_5_EX36RCP	5.32	0.95	0.01	0.00	0.04	0.00	0.00	0.00	0.01	0.0000
6_EX36RCP	9.24	0.16	0.01	0.00	0.83	0.00	0.00	0.00	0.33	0.0009
OVERLAND_6_EX36RCP	30.26	0.95	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
7_EX36RCP	9.14	0.17	0.04	0.00	0.56	0.23	0.00	0.00	0.56	0.0002
OVERLAND_7_EX36RCP	9.32	0.95	0.01	0.00	0.04	0.00	0.00	0.00	0.01	0.0000
8_OPENCHANNEL	1.44	0.17	0.00	0.00	0.83	0.00	0.00	0.00	0.18	0.0001
9_EX42RCP	30.68	0.17	0.00	0.00	0.77	0.06	0.00	0.00	0.49	0.0001
OVERLAND_9_EX42RCP	19.99	0.98	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.0000
10_EX42RCP	5.02	0.17	0.04	0.00	0.79	0.00	0.00	0.00	0.20	0.0004
OVERLAND_10_EX42RCP	5.64	0.97	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.0000
11_EX36CMP	10.23	0.14	0.03	0.00	0.83	0.00	0.00	0.00	0.34	0.0007
OVERLAND_11_EX36CMP	9.86	0.97	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.0000
12_EX42RCP	3.98	0.14	0.00	0.00	0.86	0.00	0.00	0.00	0.48	0.0007
OVERLAND_12_EX42RCP	3.76	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
13_EX42RCP	28.20	0.17	0.00	0.00	0.16	0.67	0.00	0.00	1.10	0.0001

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
1_EX24RCP	0.39	0.39	0.39	0.01	0.39
2_EX24RCP	0.01	0.01	0.01	0.09	0.01
5_EX36RCP	1.24	1.24	1.25	0.01	0.10
6_EX36RCP	1.28	1.28	1.29	1.70	0.01
7_EX36RCP	1.28	1.28	1.29	0.01	0.01
9_EX42RCP	1.57	1.57	1.58	0.01	0.01
10_EX42RCP	1.66	1.66	1.66	0.75	1.66
11_EX36CMP	1.49	1.49	1.49	2.15	1.49
12_EX42RCP	0.01	0.01	0.01	2.05	0.01

Analysis begun on: Fri Nov 20 12:03:10 2015
Analysis ended on: Fri Nov 20 12:03:10 2015
Total elapsed time: < 1 sec

SECONDARY SYSTEM ALTERNATIVE: SWMM OUTPUT

Alternative: River Hills (10-Year)

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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------

Alternative: River Hills (10-Year)

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

***************
Analysis Options
***************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ MAY-20-2010 00:00:00
Ending Date .............. MAY-22-2010 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:10:00
Dry Time Step ............ 00:10:00
Routing Time Step ........ 30.00 sec


WARNING 02: maximum depth increased for Node HCMB010036

WARNING 02: maximum depth increased for Node HCMB010032

WARNING 02: maximum depth increased for Node HCMB010057

*************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
*************************     ---------       -------
Total Precipitation ......        38.466         5.812
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........        19.720         2.980
Surface Runoff ...........        18.463         2.790
Final Surface Storage ....         0.327         0.049
Continuity Error (%) .....        -0.113


*************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        18.463         6.016
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        18.463         6.017
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....        -0.005


**************************
Time-Step Critical Elements
**************************
Link 12_PROP48RCP (6.71%)


******************************
Highest Flow Instability Indexes
```

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*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :     0.86 sec
Average Time Step           :    29.26 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00


**************************
Subcatchment Runoff Summary
**************************
```

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
SUB_HCMB010059a	5.81	0.00	0.00	2.14	3.64	1.10	24.61	0.626
SUB_HCMB010057	5.81	0.00	0.00	1.77	4.01	0.45	9.53	0.689
SUB_HCMB010043	5.81	0.00	0.00	3.07	2.70	0.87	18.45	0.464
SUB_HCMB010042	5.81	0.00	0.00	3.07	2.70	0.40	8.64	0.465
SUB_HCMB010039	5.81	0.00	0.00	3.06	2.72	0.34	8.34	0.468
SUB_HCMB010036	5.81	0.00	0.00	3.78	1.99	1.76	26.14	0.342
SUB_HCMB010034	5.81	0.00	0.00	1.55	4.22	0.72	10.90	0.726
SUB_HCMB010032	5.81	0.00	0.00	1.76	4.02	0.12	2.76	0.691
SUB_HCMB010038	5.81	0.00	0.00	1.53	4.24	0.26	5.35	0.729

```
******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
HCMB010059	JUNCTION	0.21	2.46	23.57	0 13:00
HCMB010058	JUNCTION	0.19	2.02	22.95	0 13:00
HCMB010042	JUNCTION	0.31	4.45	20.13	0 13:08
HCMB010041	JUNCTION	0.37	4.66	19.56	0 13:08
HCMB010040	JUNCTION	0.30	4.39	19.19	0 13:09
HCMB010036	JUNCTION	0.43	5.46	18.50	0 13:09
HCMB010035	JUNCTION	0.56	5.50	18.01	0 13:09
HCMB010034	JUNCTION	0.51	4.75	17.09	0 13:08
HCMB010033	JUNCTION	0.54	4.23	16.31	0 13:09
HCMB010032	JUNCTION	0.40	3.41	15.41	0 13:09
HCMB010057	JUNCTION	0.12	1.31	21.32	0 13:01
HCMB010039	JUNCTION	0.41	4.62	18.60	0 13:09
HCMB010043	JUNCTION	0.25	2.91	20.33	0 13:07
HCMB010037	JUNCTION	0.08	0.93	18.57	0 13:06
HCMB010038	JUNCTION	0.10	0.95	18.89	0 13:00
HCMB010031	OUTFALL	0.27	1.87	13.37	0 13:10

```
*******************
Node Inflow Summary
*******************
```

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
HCMB010059	JUNCTION	24.56	24.56	0 12:59	1.106	1.105
HCMB010058	JUNCTION	0.00	24.49	0 13:00	0.000	1.105
HCMB010042	JUNCTION	8.62	55.43	0 12:57	0.398	2.816
HCMB010041	JUNCTION	0.00	48.24	0 12:56	0.000	2.815

HCMB010040	JUNCTION	0.00	46.56	0	12:56	0.000	2.815
HCMB010036	JUNCTION	26.10	72.34	0	13:01	1.760	4.918
HCMB010035	JUNCTION	0.00	74.33	0	13:09	0.000	5.176
HCMB010034	JUNCTION	10.88	83.37	0	13:09	0.722	5.897
HCMB010033	JUNCTION	0.00	83.41	0	13:09	0.000	5.897
HCMB010032	JUNCTION	2.75	84.83	0	13:09	0.119	6.016
HCMB010057	JUNCTION	9.51	33.57	0	13:00	0.446	1.551
HCMB010039	JUNCTION	8.33	52.06	0	13:00	0.343	3.157
HCMB010043	JUNCTION	18.40	51.50	0	13:00	0.866	2.417
HCMB010037	JUNCTION	0.00	5.26	0	13:00	0.000	0.259
HCMB010038	JUNCTION	5.33	5.33	0	12:59	0.259	0.259
HCMB010031	OUTFALL	0.00	84.86	0	13:10	0.000	6.016

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
HCMB010031	68.15	9.04	84.86	6.016
System	68.15	9.04	84.86	6.016

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1_PROP30RCP	CONDUIT	24.49	0 13:00	5.29	0.79	0.89
OVERLAND_1_EX24RCP	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
2_PROP30RCP	CONDUIT	24.36	0 13:01	7.05	0.73	0.67
OVERLAND_2_EX24RCP	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
3_OPENCHANNEL	CONDUIT	33.44	0 13:01	3.80	0.12	0.51
OVERLAND_3_OPENCHANNEL	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
4_OPENCHANNEL	CONDUIT	47.23	0 12:57	3.22	0.34	0.86
5_PROP42RCP	CONDUIT	48.24	0 12:56	5.12	0.57	1.00
OVERLAND_5_EX36RCP	CONDUIT	0.00	0 00:00	0.00	0.00	0.04
6_PROP42RCP	CONDUIT	46.56	0 12:56	5.03	0.93	1.00
OVERLAND_6_EX36RCP	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
7_PROP42RCP	CONDUIT	44.70	0 13:09	4.70	0.42	1.00
OVERLAND_7_EX36RCP	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
8_OPENCHANNEL	CONDUIT	48.52	0 13:11	2.49	0.24	0.84
9_PROP48RCP	CONDUIT	70.53	0 13:10	5.61	0.35	1.00
OVERLAND_9_EX42RCP	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
10_PROP48RCP	CONDUIT	74.47	0 13:10	5.93	1.22	1.00
OVERLAND_10_EX42RCP	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
11_PROP48RCP	CONDUIT	83.41	0 13:09	6.64	0.74	1.00
OVERLAND_11_EX36CMP	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
12_PROP48RCP	CONDUIT	83.44	0 13:10	6.87	2.11	0.93
OVERLAND_12_EX42RCP	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
13_PROP48RCP	CONDUIT	84.86	0 13:10	9.64	0.45	0.66
14_EX18RCP	CONDUIT	5.26	0 13:00	5.38	0.52	0.61

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15_EX18RCP           CONDUIT      4.92     0  12:56      3.60    0.40    0.81


**************************
Flow Classification Summary
**************************

-------------------------------------------------------------------------------------------------
                    Adjusted    --- Fraction of Time in Flow Class ----   Avg.     Avg.
                     /Actual         Up    Down  Sub   Sup   Up    Down   Froude   Flow
Conduit               Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit   Number   Change
-------------------------------------------------------------------------------------------------
1_PROP30RCP            14.68   0.54  0.00  0.00  0.45  0.01  0.00  0.00     0.38   0.0003
OVERLAND_1_EX24RCP     17.32   1.00  0.00  0.00  0.00  0.00  0.00  0.00     0.00   0.0000
2_PROP30RCP             3.40   0.35  0.19  0.00  0.03  0.43  0.00  0.00     0.62   0.0002
OVERLAND_2_EX24RCP      8.57   1.00  0.00  0.00  0.00  0.00  0.00  0.00     0.00   0.0000
3_OPENCHANNEL           4.39   0.15  0.20  0.00  0.65  0.00  0.00  0.00     0.23   0.0000
OVERLAND_3_OPENCHANNEL    4.81   1.00  0.00  0.00  0.00  0.00  0.00  0.00     0.00   0.0000
4_OPENCHANNEL           1.16   0.15  0.00  0.00  0.85  0.00  0.00  0.00     0.23   0.0001
5_PROP42RCP             5.24   0.16  0.00  0.00  0.83  0.00  0.00  0.00     0.45   0.0002
OVERLAND_5_EX36RCP      7.52   0.99  0.01  0.00  0.00  0.00  0.00  0.00     0.00   0.0000
6_PROP42RCP            11.89   0.16  0.00  0.00  0.61  0.23  0.00  0.00     0.50   0.0003
OVERLAND_6_EX36RCP     11.45   1.00  0.00  0.00  0.00  0.00  0.00  0.00     0.00   0.0000
7_PROP42RCP             8.82   0.16  0.07  0.00  0.66  0.10  0.00  0.00     0.49   0.0001
OVERLAND_7_EX36RCP     11.16   1.00  0.00  0.00  0.00  0.00  0.00  0.00     0.00   0.0000
8_OPENCHANNEL           1.44   0.17  0.00  0.00  0.83  0.00  0.00  0.00     0.19   0.0001
9_PROP48RCP            30.06   0.15  0.04  0.00  0.82  0.00  0.00  0.00     0.43   0.0001
OVERLAND_9_EX42RCP     28.36   1.00  0.00  0.00  0.00  0.00  0.00  0.00     0.00   0.0000
10_PROP48RCP            5.13   0.14  0.00  0.00  0.85  0.00  0.00  0.00     0.31   0.0004
OVERLAND_10_EX42RCP     5.64   1.00  0.00  0.00  0.00  0.00  0.00  0.00     0.00   0.0000
11_PROP48RCP           14.64   0.14  0.02  0.00  0.84  0.00  0.00  0.00     0.35   0.0002
OVERLAND_11_EX36CMP     9.86   1.00  0.00  0.00  0.00  0.00  0.00  0.00     0.00   0.0000
12_PROP48RCP            4.11   0.14  0.00  0.00  0.86  0.00  0.00  0.00     0.42   0.0007
OVERLAND_12_EX42RCP     3.76   1.00  0.00  0.00  0.00  0.00  0.00  0.00     0.00   0.0000
13_PROP48RCP           27.68   0.16  0.00  0.00  0.29  0.55  0.00  0.00     0.90   0.0002
14_EX18RCP             11.91   0.14  0.00  0.00  0.41  0.45  0.00  0.00     0.64   0.0002
15_EX18RCP              1.09   0.14  0.30  0.00  0.52  0.04  0.00  0.00     0.15   0.0001


************************
Conduit Surcharge Summary
************************

-------------------------------------------------------------------------
                                                    Hours       Hours
                      --------- Hours Full --------   Above Full  Capacity
Conduit               Both Ends  Upstream  Dnstream   Normal Flow  Limited
-------------------------------------------------------------------------
5_PROP42RCP                0.41      0.41      0.42      0.01        0.01
6_PROP42RCP                0.45      0.45      0.45      0.01        0.45
7_PROP42RCP                0.45      0.45      0.45      0.01        0.01
9_PROP48RCP                0.64      0.64      0.64      0.01        0.01
10_PROP48RCP               0.57      0.57      0.57      0.58        0.57
11_PROP48RCP               0.38      0.38      0.38      0.01        0.38
12_PROP48RCP               0.01      0.01      0.01      1.40        0.01


Analysis begun on:  Fri Nov 20 12:16:10 2015
Analysis ended on:  Fri Nov 20 12:16:10 2015
Total elapsed time: < 1 sec
```

SECONDARY SYSTEM ALTERNATIVE: HYDRAFLOW STORM SEWERS

(FOX HAVEN)

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	33.00	-15.05	Comb	0.00	0.28	0.55	5.0	17.68	9.61	20.85	18	Cir	0.013	0.50	28.56	Proposed 18 RCP_1
2	1	32.00	-5.89	Comb	0.00	0.18	0.55	5.0	21.85	0.50	22.01	18	Cir	0.013	1.42	28.41	Proposed 18 RCP_2
3	2	207.00	-69.05	Comb	0.00	0.47	0.55	5.0	23.01	2.43	28.04	18	Cir	0.013	1.50	36.58	Proposed 18 RCP_3
4	3	168.00	86.86	Comb	0.00	0.26	0.55	5.0	30.04	0.59	31.03	18	Cir	0.013	1.49	39.28	Proposed 18 RCP_4
5	4	150.00	-84.75	Comb	0.00	0.30	0.55	5.0	32.03	1.65	34.51	18	Cir	0.013	1.49	42.33	Proposed 18 RCP_5
6	5	30.00	84.44	Comb	0.00	0.28	0.55	5.0	35.51	0.50	35.66	18	Cir	0.013	1.00	42.88	Proposed 18 RCP_6
7	4	38.00	5.03	Comb	0.00	0.40	0.55	5.0	31.03	0.50	31.22	18	Cir	0.013	1.00	38.79	Proposed 18 RCP_7
8	5	145.00	-4.45	Comb	0.00	0.19	0.55	5.0	36.51	0.50	37.24	18	Cir	0.013	1.50	44.90	Proposed 18 RCP_8
9	8	31.01	90.71	Comb	0.00	0.16	0.55	5.0	37.24	0.48	37.39	18	Cir	0.013	1.00	45.41	Proposed 18 RCP_9

Project File: Proposed _Fox Haven.stm | Number of lines: 9 | Date: 11/20/2015

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	Proposed 18 RCP_1	7.43	18	Cir	33.00	17.68	20.85	9.606	19.18	21.91	n/a	22.64 i	End	Combination
2	Proposed 18 RCP_2	6.63	18	Cir	32.00	21.85	22.01	0.500	22.96	23.12	n/a	23.48 i	1	Combination
3	Proposed 18 RCP_3	6.26	18	Cir	207.00	23.01	28.04	2.430	23.65	28.68	n/a	31.38	2	Combination
4	Proposed 18 RCP_4	4.96	18	Cir	168.00	30.04	31.03	0.589	31.38	31.88	n/a	32.39	3	Combination
5	Proposed 18 RCP_5	3.03	18	Cir	150.00	32.03	34.51	1.653	32.51	34.99	n/a	36.29	4	Combination
6	Proposed 18 RCP_6	1.08	18	Cir	30.00	35.51	35.66	0.500	36.29	36.05	n/a	36.22	5	Combination
7	Proposed 18 RCP_7	1.55	18	Cir	38.00	31.03	31.22	0.500	32.39	31.68	n/a	31.90	4	Combination
8	Proposed 18 RCP_8	1.28	18	Cir	145.00	36.51	37.24	0.503	36.93	37.66	n/a	37.85	5	Combination
9	Proposed 18 RCP_9	0.62	18	Cir	31.01	37.24	37.39	0.484	37.85	37.85	n/a	37.88	8	Combination

Project File: Proposed _Fox Haven.stm | Number of lines: 9 | Run Date: 11/20/2015

NOTES: Return period = 10 Yrs. ; i - Inlet control.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	HCMB010122	1.08	0.00	1.08	0.00	Comb	6.0	3.00	2.80	3.00	2.00	Sag	2.00	0.050	0.031	0.013	0.19	4.87	0.36	4.87	2.0	Off
2	HCMB010123	0.70	0.23	0.92	0.00	Comb	6.0	3.00	6.00	3.00	2.00	Sag	2.00	0.050	0.031	0.013	0.18	4.42	0.34	4.42	2.0	Off
3	Proposed Inlet_1	1.82	0.00	1.59	0.23	Comb	6.0	3.00	0.00	3.00	2.00	0.050	2.00	0.050	0.031	0.013	0.17	4.29	0.25	1.62	2.0	2
4	Proposed Inlet_2	1.01	0.06	1.07	0.00	Comb	6.0	3.00	2.80	3.00	2.00	Sag	2.00	0.050	0.031	0.013	0.19	4.84	0.35	4.84	2.0	Off
5	Proposed Inlet_3	1.16	0.01	1.11	0.06	Comb	6.0	3.00	0.00	3.00	2.00	0.050	2.00	0.050	0.031	0.013	0.15	3.52	0.22	0.98	2.0	4
6	Proposed Inlet_4	1.08	0.00	1.04	0.05	Comb	6.0	3.00	0.00	3.00	2.00	0.050	2.00	0.050	0.031	0.013	0.14	3.39	0.21	0.90	2.0	7
7	Proposed Inlet_5	1.55	0.05	1.59	0.00	Comb	6.0	3.00	2.80	3.00	2.00	Sag	2.00	0.050	0.031	0.013	0.23	6.19	0.40	6.19	2.0	Off
8	Proposed Inlet_6	0.73	0.00	0.73	0.01	Comb	6.0	3.00	0.00	3.00	2.00	0.050	2.00	0.050	0.031	0.013	0.12	2.78	0.11	0.50	1.0	5
9	Proposed Inlet_7	0.62	0.00	0.62	0.00	Comb	6.0	3.00	0.00	3.00	2.00	0.050	2.00	0.050	0.020	0.013	0.12	2.86	0.17	0.00	2.0	6

Project File: Proposed _Fox Haven.stm

Number of lines: 9

Run Date: 11/20/2015

NOTES: Inlet N-Values = 0.016; Intensity = 84.35 / (Inlet time + 15.10) ^ 0.83; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are Horiz throat.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
(1)	(in) (2)	(cfs) (3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(ft) (12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(K) (23)	(ft) (24)
1	18	7.43	17.68	19.18	1.50	1.33	4.21	0.28	19.46	n/a	33.00	20.85	21.91 j	1.06**	1.33	5.59	0.49	22.39i	n/a	n/a	n/a	0.50	n/a
2	18	6.63	21.85	22.96	1.11*	1.40	4.75	0.35	23.31	n/a	32.00	22.01	23.12	1.11	1.40	4.75	0.35	23.47i	n/a	n/a	-0.191	1.42	n/a
3	18	6.26	23.01	23.65	0.00	0.00	8.64	0.00	23.65	0.000	207.00	28.04	28.68	0.00**	0.00	8.64	0.00	28.68	0.000	0.000	0.000	1.50	n/a
4	18	4.96	30.04	31.38	0.00	0.00	2.98	0.00	31.38	0.000	168.00	31.03	31.88	0.00**	0.00	4.80	0.00	31.88	0.000	0.000	0.000	1.49	n/a
5	18	3.03	32.03	32.51	0.00	0.00	6.16	0.00	32.51	0.000	150.00	34.51	34.99	0.00**	0.00	6.16	0.00	34.99	0.000	0.000	0.000	1.49	n/a
6	18	1.08	35.51	36.29	0.00	0.00	1.18	0.00	36.29	0.000	30.00	35.66	36.05	0.00**	0.00	2.99	0.00	36.05	0.000	0.000	0.000	1.00	n/a
7	18	1.55	31.03	32.39	0.00	0.00	0.92	0.00	32.39	0.000	38.00	31.22	31.68	0.00**	0.00	3.32	0.00	31.68	0.000	0.000	0.000	1.00	n/a
8	18	1.28	36.51	36.93	0.00	0.00	3.15	0.00	36.93	0.000	145.00	37.24	37.66	0.00**	0.00	3.15	0.00	37.66	0.000	0.000	0.000	1.50	n/a
9	18	0.62	37.24	37.85	0.00	0.00	0.91	0.00	37.85	0.000	31.01	37.39	37.85	0.00**	0.00	1.33	0.00	37.85	0.000	0.000	0.000	1.00	n/a

Project File: Proposed _Fox Haven.stm | Number of lines: 9 | Run Date: 11/20/2015

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

Hydraflow HGL Computation Procedure

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.The computed HGL is checked against inlet control.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 16 Cross-sectional area of the flow at the upstream end.

Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).

Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

Col. 21 The average of the downstream and upstream friction slopes.

Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

Appendix I:

BMP Conceptual Design and Nutrient Calculations

List of Contents:

Bioretention Pond - Willow Run

Project: City of Greenville - Watershed Master Plan
Prepared by: SMB
Checked by: TLM
Date: 10/26/15

DRAINAGE AREA INPUT PARAMETERS

Water Quality Event (in)	1.00		Input
Storm Intensity, 10-yr (in/hr)	8.04		Input
	Pervious	**Impervious**	
Drainage Area (sq ft)	88,727	38,026	Input
Sub-basin CN	39	93	Input
Runoff Coefficient, C	0.23	0.80	Input
S (in)	15.64	0.75	Calculated
R/O (in)	0.34	0.45	Calculated
Sub-basin WQ Volume (sf*in)	29740	17126	Calculated
Sub-basin WQ Volume (cf)	2478	1427	Calculated
Runoff Coefficient, C	0.23	0.80	Input
Summary Calculations			
Total Watershed area (sq ft)	126,753		Calculated
Total Watershed area (acres)	2.91		Calculated
Total WQ Runoff Volume (sf*in)	46,866		Calculated
Total WQ Runoff Volume (cf)	3,906		Calculated
Peak Flow Rate, cfs	9.38		Calculated
Pipe Diameter, ft	15.97	**18"**	Calculated
Surface area of bioretention			
Average depth of water (in)	10		Input
Surface area of bioretention, required (sf)	4,687		Calculated
Surface area of bioretention, required (ac)	0.11		Calculated
Surface area of bioretention, available (sf)	4,700		Input
Surface area of bioretention, available (ac)	0.11		Input

APPENDIX I
BMP CONCEPTUAL DESIGN

Regenerative Stormwater Conveyance - Pinebrook

Project: City of Greenville - Watershed Master Plan
Prepared by: SMB
Checked by:TLM
Date: 10/26/15

DRAINAGE AREA INPUT PARAMETERS

Water Quality Event (in)	1.00		Input
Storm Intensity, 10-yr (in/hr)	8.04		Input
	Pervious	**Impervious**	
Drainage Area (sq ft)	484,678	484,679	Input
Sub-basin CN	74	93	Input
S (in)	3.51	0.75	Calculated
R/O (in)	0.02	0.45	Calculated
Sub-basin WQ Volume (sf*in)	11241	218293	Calculated
Sub-basin WQ Volume (cf)	937	18191	Calculated
Runoff Coefficient, C	0.23	0.80	Input
Summary Calculations			
Total Watershed area (sq ft)	969,357		Calculated
Total Watershed area (acres)	22.25		Calculated
Total WQ Runoff Volume (sf*in)	229,534		Calculated
Total WQ Runoff Volume (cf)	19,128		Calculated
Peak Flow, cfs	92.14		Calculated
Surface area of RSC			
Length of Channel (ft)	250		Input
Riffle Top Width (ft)	50		Calculated
Riffle Depth (ft)	1		Calculated
Pool Depth (ft)	1.5		Calculated
Number of Pools	10		Calculated
Surface Area of RSC (sf)	12,500		Calculated

APPENDIX I
BMP CONCEPTUAL DESIGN

Regenerative Stormwater Conveyance - Oakhurst

Project: City of Greenville - Watershed Master Plan
Prepared by: SMB
Checked by: TLM
Date: 12/7/15

DRAINAGE AREA INPUT PARAMETERS

Water Quality Event (in)	1.00		Input
Storm Intensity, 10-yr (in/hr)	8.04		Input
	Pervious	**Impervious**	
Drainage Area (sq ft)	31,805	286,245	Input
Sub-basin CN	74	93	Input
S (in)	3.51	0.75	Calculated
R/O (in)	0.02	0.45	Calculated
Sub-basin WQ Volume (sf*in)	738	128921	Calculated
Sub-basin WQ Volume (cf)	49	10743	Calculated
Runoff Coefficient, C	0.23	0.80	Input
Summary Calculations			
Total Watershed area (sq ft)	318,050		Calculated
Total Watershed area (acres)	7.30		Calculated
Total WQ Runoff Volume (sf*in)	129,658		Calculated
Total WQ Runoff Volume (cf)	10,793		Calculated
Peak Flow, cfs	43.62		Calculated
Surface area of RSC			
Length of Channel (ft)	130		Input
Riffle Top Width (ft)	30		Calculated
Riffle Depth (ft)	1		Calculated
Pool Depth (ft)	2.0		Calculated
Number of Pools	5		Calculated
Surface Area of RSC (sf)	3,900		Calculated

APPENDIX I
BMP CONCEPTUAL DESIGN

Regenerative Stormwater Conveyance - Arbor Hills South

Project: City of Greenville - Watershed Master Plan
Prepared by: SMB
Checked by: TLM
Date: 10/26/15

DRAINAGE AREA INPUT PARAMETERS

Water Quality Event (in)	1.00		Input
Storm Intensity, 10-yr (in/hr)	8.04		Input
	Pervious	**Impervious**	
Drainage Area (sq ft)	597,875	149,469	Input
Sub-basin CN	80	93	Input
S (in)	2.50	0.75	Calculated
R/O (in)	0.08	0.45	Calculated
Sub-basin WQ Volume (sf*in)	49823	67319	Calculated
Sub-basin WQ Volume (cf)	4152	5610	Calculated
Runoff Coefficient, C	0.23	0.80	Input
Summary Calculations			
Total Watershed area (sq ft)	747,344		Calculated
Total Watershed area (acres)	17.16		Calculated
Total WQ Runoff Volume (sf*in)	117,142		Calculated
Total WQ Runoff Volume (cf)	9,762		Calculated
Peak Flow, cfs	47.45		Calculated
Surface area of RSC			
Length of Channel (ft)	200		Input
Riffle Top Width (ft)	30		Calculated
Riffle Depth (ft)	1		Calculated
Pool Depth (ft)	1.5		Calculated
Number of Pools	8		Calculated
Surface Area of RSC (sf)	6,000		Calculated

Coastal Plain of the Tar-Pamlico River Basin:

Includes Greenville and Washington as well as Pitt and Beaufort Counties

BMP Removal Calculation Worksheet (Automated)

Project Name: ***Willow Run Bioretention***
Date: ***11/30/2015***
By: ***SMB*** Checked By: ***TLM***

Directions:

> It may be advantageous to split the development into separate catchments to be handled by separate BMPs. The tables below allow the development to be split into as many as three catchments, and can be copied for greater than three. NOTE: Unless runoff flowing onto the development from offsite is routed separately around or through the site, the offsite catchment area draining in must be included in the acreage values of the appropriate land use(s) and treated.

> **Above each table:** Enter the catchment acreage in the top green blank. Based on a comparison of the post-development TN and TP export coefficients you calculated above to the rule requirements of 4.0 lb/ac/yr TN and 0.4 lb/ac/yr TP, select BMP(s) from the list for treating the catchment runoff. Enter the chosen BMP(s) nutrient removal rates in the green blanks. If more than one BMP is to be used in series, the combined removal rates will be calculated automatically in the blue blanks.

> **Catchment Tables:** Enter the acres of each type of land cover in the green boxes. The spreadsheet will calculate all of the light blue boxes. NOTE: Compare the Total Catchment Acreage for the Development (final table) to the value you established in the pre-BMP worksheet tables, and also to the site plans, for consistency. All of these values need to be the same

BMP Nutrient Removal Rates

	TN	TP	Design Standard
Wet Detention Pond	25	40	NC BMP Manual
Stormwater Wetland	40	35	NC BMP Manual
Sand Filter	35	45	NC BMP Manual
Bioretention	35	45	NC BMP Manual
Grass Swales	20	20	NC BMP Manual
Vegetated Filter Strip w/ Level Spreader	20	35	NC BMP Manual
RSC (Infiltration Device)	30	35	NC BMP Manual
Rainwater Harvesting	35	45	NC BMP Manual
Dry Detention	10	10	NC BMP Manual

Catchment 1:

Total acreage of catchment 1 = 2.91 ac

First BMP's TN removal rate =	35 %	First BMP's TP removal rate =	45 %
Second BMP's TN removal rate =	0 %	Second BMP's TP removal rate =	0 %
Third BMP's TN removal rate =	0 %	Third BMP's TP removal rate =	0 %
TOTAL TN REMOVAL RATE =	35 %	TOTAL TP REMOVAL RATE =	45 %

(1) Type of Land Cover	(2) Catchment Acreage	(3) S.M. Formula (0.51 + 9.1 I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (2) * (3) * (6)
Transportation impervious	0.88	3.26	2.60	7.46	0.19	0.55
Roof impervious	0.00	3.26	1.95	0.00	0.11	0.00
Managed pervious	1.93	3.26	1.42	8.94	0.28	1.76
Wooded pervious	0.00	3.26	0.94	0.00	0.14	0.00
Area taken up by BMP	0.10	3.26	1.95	0.64	0.11	0.04
Fraction Impervious (I) =	0.30		Pre-BMP TN Load (lb/yr) =	17.04	Pre-BMP TP Load (lb/yr) =	2.34
Total Area of Development =	2.91		Pre-BMP TN Export (lb/ac/yr)	5.86	Pre-BMP TP Export (lb/ac/yr)	0.81
			Post-BMP TN Load (lb/yr) =	11.08	Post-BMP TP Load (lb/yr) =	1.29
			Post-BMP TN Export (lb/ac/yr)	3.81	Post-BMP TP Export (lb/ac/yr)	0.44
			TN Nutrients Removed (lb/ac/yr)	2.05	TP Nutrients Removed (lb/ac/yr)	0.36

Coastal Plain of the Tar-Pamlico River Basin:

Includes Greenville and Washington as well as Pitt and Beaufort Counties

BMP Removal Calculation Worksheet (Automated)

Project Name: ***Pinebrook RSC***
Date: ***11/30/2015***
By: ***SMB*** Checked By: ***TLM***

Directions:

> It may be advantageous to split the development into separate catchments to be handled by separate BMPs. The tables below allow the development to be split into as many as three catchments, and can be copied for greater than three. NOTE: Unless runoff flowing onto the development from offsite is routed separately around or through the site, the offsite catchment area draining in must be included in the acreage values of the appropriate land use(s) and treated.

> **Above each table:** Enter the catchment acreage in the top green blank. Based on a comparison of the post-development TN and TP export coefficients you calculated above to the rule requirements of 4.0 lb/ac/yr TN and 0.4 lb/ac/yr TP, select BMP(s) from the list for treating the catchment runoff. Enter the chosen BMP(s) nutrient removal rates in the green blanks. If more than one BMP is to be used in series, the combined removal rates will be calculated automatically in the blue blanks.

> **Catchment Tables:** Enter the acres of each type of land cover in the green boxes. The spreadsheet will calculate all of the light blue boxes. NOTE: Compare the Total Catchment Acreage for the Development (final table) to the value you established in the pre-BMP worksheet tables, and also to the site plans, for consistency. All of these values need to be the same

BMP Nutrient Removal Rates

	TN	TP	Design Standard
Wet Detention Pond	25	40	NC BMP Manual
Stormwater Wetland	40	35	NC BMP Manual
Sand Filter	35	45	NC BMP Manual
Bioretention	35	45	NC BMP Manual
Grass Swales	20	20	NC BMP Manual
Vegetated Filter Strip w/ Level Spreader	20	35	NC BMP Manual
RSC (Infiltration Device)	30	35	NC BMP Manual
Rainwater Harvesting	35	45	NC BMP Manual
Dry Detention	10	10	NC BMP Manual

Catchment 1:

Total acreage of catchment 1 = 2.91 ac

First BMP's TN removal rate =	35 %	First BMP's TP removal rate =	45 %
Second BMP's TN removal rate =	0 %	Second BMP's TP removal rate =	0 %
Third BMP's TN removal rate =	0 %	Third BMP's TP removal rate =	0 %
TOTAL TN REMOVAL RATE =	30 %	TOTAL TP REMOVAL RATE =	35 %

(1) Type of Land Cover	(2) Catchment Acreage	(3) S.M. Formula (0.51 + 9.1 I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (2) * (3) * (6)
Transportation impervious	11.13	5.06	2.60	146.49	0.19	10.70
Roof impervious		5.06	1.95	0.00	0.11	0.00
Managed pervious		5.06	1.42	0.00	0.28	0.00
Wooded pervious	10.83	5.06	0.94	51.55	0.14	7.68
Area taken up by BMP	0.29	5.06	1.95	2.83	0.11	0.16
Fraction Impervious (I) =	0.50		Pre-BMP TN Load (lb/yr) =	200.87	Pre-BMP TP Load (lb/yr) =	18.54
Total Area of Development =	22.25		Pre-BMP TN Export (lb/ac/yr)	9.03	Pre-BMP TP Export (lb/ac/yr)	0.83
			Post-BMP TN Load (lb/yr) =	140.61	Post-BMP TP Load (lb/yr) =	12.05
			Post-BMP TN Export (lb/ac/yr)	6.32	Post-BMP TP Export (lb/ac/yr)	0.54
			TN Nutrients Removed (lb/ac/yr)	2.71	TP Nutrients Removed (lb/ac/yr)	0.29

Coastal Plain of the Tar-Pamlico River Basin:

Includes Greenville and Washington as well as Pitt and Beaufort Counties

BMP Removal Calculation Worksheet (Automated)

Project Name: ***Oakhurst RSC***
Date: ***11/30/2015***
By: ***SMB*** Checked By: ***TLM***

Directions:

> It may be advantageous to split the development into separate catchments to be handled by separate BMPs. The tables below allow the development to be split into as many as three catchments, and can be copied for greater than three. NOTE: Unless runoff flowing onto the development from offsite is routed separately around or through the site, the offsite catchment area draining in must be included in the acreage values of the appropriate land use(s) and treated.

> **Above each table:** Enter the catchment acreage in the top green blank. Based on a comparison of the post-development TN and TP export coefficients you calculated above to the rule requirements of 4.0 lb/ac/yr TN and 0.4 lb/ac/yr TP, select BMP(s) from the list for treating the catchment runoff. Enter the chosen BMP(s) nutrient removal rates in the green blanks. If more than one BMP is to be used in series, the combined removal rates will be calculated automatically in the blue blanks.

> **Catchment Tables:** Enter the acres of each type of land cover in the green boxes. The spreadsheet will calculate all of the light blue boxes. NOTE: Compare the Total Catchment Acreage for the Development (final table) to the value you established in the pre-BMP worksheet tables, and also to the site plans, for consistency. All of these values need to be the same

BMP Nutrient Removal Rates

	TN	TP	Design Standard
Wet Detention Pond	25	40	NC BMP Manual
Stormwater Wetland	40	35	NC BMP Manual
Sand Filter	35	45	NC BMP Manual
Bioretention	35	45	NC BMP Manual
Grass Swales	20	20	NC BMP Manual
Vegetated Filter Strip w/ Level Spreader	20	35	NC BMP Manual
RSC (Infiltration Device)	30	35	NC BMP Manual
Rainwater Harvesting	35	45	NC BMP Manual
Dry Detention	10	10	NC BMP Manual

Catchment 1:

Total acreage of catchment 1 =	2.91	ac			
First BMP's TN removal rate =	30	%	First BMP's TP removal rate =	35	%
Second BMP's TN removal rate =	0	%	Second BMP's TP removal rate =	0	%
Third BMP's TN removal rate =	0	%	Third BMP's TP removal rate =	0	%
TOTAL TN REMOVAL RATE =	30	%	TOTAL TP REMOVAL RATE =	35	%

(1) Type of Land Cover	(2) Catchment Acreage	(3) S.M. Formula (0.51 + 9.1 I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (2) * (3) * (6)
Transportation impervious	6.57	8.70	2.60	148.61	0.19	10.86
Roof impervious		8.70	1.95	0.00	0.11	0.00
Managed pervious	0.43	8.70	1.42	5.34	0.28	1.05
Wooded pervious		8.70	0.94	0.00	0.14	0.00
Area taken up by BMP	0.30	8.70	1.95	5.05	0.11	0.28
Fraction Impervious (I) =	0.90		Pre-BMP TN Load (lb/yr) =	159.00	Pre-BMP TP Load (lb/yr) =	12.20
Total Area of Development =	7.30		Pre-BMP TN Export (lb/ac/yr)	21.78	Pre-BMP TP Export (lb/ac/yr)	1.67
			Post-BMP TN Load (lb/yr) =	111.30	Post-BMP TP Load (lb/yr) =	7.93
			Post-BMP TN Export (lb/ac/yr)	15.25	Post-BMP TP Export (lb/ac/yr)	1.09
			TN Nutrients Removed (lb/ac/yr)	6.53	TP Nutrients Removed (lb/ac/yr)	0.58

Coastal Plain of the Tar-Pamlico River Basin:

Includes Greenville and Washington as well as Pitt and Beaufort Counties

BMP Removal Calculation Worksheet (Automated)

Project Name: ***Arbor Hills South RSC***
Date: ***11/30/2015***
By: ***SMB*** Checked By: ***TLM***

Directions:

> It may be advantageous to split the development into separate catchments to be handled by separate BMPs. The tables below allow the development to be split into as many as three catchments, and can be copied for greater than three. NOTE: Unless runoff flowing onto the development from offsite is routed separately around or through the site, the offsite catchment area draining in must be included in the acreage values of the appropriate land use(s) and treated.

> **Above each table:** Enter the catchment acreage in the top green blank. Based on a comparison of the post-development TN and TP export coefficients you calculated above to the rule requirements of 4.0 lb/ac/yr TN and 0.4 lb/ac/yr TP, select BMP(s) from the list for treating the catchment runoff. Enter the chosen BMP(s) nutrient removal rates in the green blanks. If more than one BMP is to be used in series, the combined removal rates will be calculated automatically in the blue blanks.

> **Catchment Tables:** Enter the acres of each type of land cover in the green boxes. The spreadsheet will calculate all of the light blue boxes. NOTE: Compare the Total Catchment Acreage for the Development (final table) to the value you established in the pre-BMP worksheet tables, and also to the site plans, for consistency. All of these values need to be the same

BMP Nutrient Removal Rates

	TN	TP	Design Standard
Wet Detention Pond	25	40	NC BMP Manual
Stormwater Wetland	40	35	NC BMP Manual
Sand Filter	35	45	NC BMP Manual
Bioretention	35	45	NC BMP Manual
Grass Swales	20	20	NC BMP Manual
Vegetated Filter Strip w/ Level Spreader	20	35	NC BMP Manual
RSC (Infiltration Device)	30	35	NC BMP Manual
Rainwater Harvesting	35	45	NC BMP Manual
Dry Detention	10	10	NC BMP Manual

Catchment 1:

Total acreage of catchment 1 =	2.91	ac			
First BMP's TN removal rate =	35	%	First BMP's TP removal rate =	45	%
Second BMP's TN removal rate =	0	%	Second BMP's TP removal rate =	0	%
Third BMP's TN removal rate =	0	%	Third BMP's TP removal rate =	0	%
TOTAL TN REMOVAL RATE =	30	%	TOTAL TP REMOVAL RATE =	35	%

(1) Type of Land Cover	(2) Catchment Acreage	(3) S.M. Formula (0.51 + 9.1 I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (2) * (3) * (6)
Transportation impervious	3.43	2.33	2.60	20.78	0.19	1.52
Roof impervious		2.33	1.95	0.00	0.11	0.00
Managed pervious	13.58	2.33	1.42	44.94	0.28	8.86
Wooded pervious		2.33	0.94	0.00	0.14	0.00
Area taken up by BMP	0.14	2.33	1.95	0.63	0.11	0.04
Fraction Impervious (I) =	0.20		Pre-BMP TN Load (lb/yr) =	66.34	Pre-BMP TP Load (lb/yr) =	10.41
Total Area of Development =	17.15		Pre-BMP TN Export (lb/ac/yr)	3.87	Pre-BMP TP Export (lb/ac/yr)	0.61
			Post-BMP TN Load (lb/yr) =	46.44	Post-BMP TP Load (lb/yr) =	6.77
			Post-BMP TN Export (lb/ac/yr)	2.71	Post-BMP TP Export (lb/ac/yr)	0.39
			TN Nutrients Removed (lb/ac/yr)	1.16	TP Nutrients Removed (lb/ac/yr)	0.21

Designer Engineer:	Stefani Barlow
Project Name:	Hardee Creek - Pinebrook RSC

*Note: This sheet is based of a RSC (SPSC) design model created by Anne Arundel County, MD.

Input values shaded in Grey

Calculated values are noted with dotted pattern

Check parameters in bold

Checking the Channel Conveyance for the design flood				
Design Return Period (Yr)	T	**100**	**10**	**1**
Time of Concentration in minutes (Before Development/Reference)	t_c	5.00		
Post development (No SPSC) Runoff Curve Number	RCN	85.00		
Pre development discharge (cfs)	Q_{pre}	92.14	92.14	92.14
Post development (No BMP) discharge (cfs)	Q_{post}	92.14	92.14	92.14
Total available length (ft)	L	250	**Cascade Design (maximum 5 ft drop per segment)**	
Elevation drop over length (ft)	delta E	8.0	Design Width (ft)	50.00
Total Cascade length for project (ft)	$L_{cascade}$	0.00	Design Depth (ft)	1.00
Cascade Slope (ft/ft)	$Slope_{cascade}$	0.50	Roughness	0.05
Water Quality slope (ft/ft)	Slope	0.03	A	33.33
Maximum Length of Riffle Channel/Weir (Not to exceed 8 ft)	L_{riffle}	8.0	q	0.08
Number of riffle segments/boulder weirs for project	N_{riffle}	10	P	0.00
Number of pool segments for project	N_{pool}	10	Rh	0.67
Minimum required length of pool (ft)	**L_{pool}**	16	Design Velocity (ft/sec)	16.47
Enter a trial median cobble diamater (ft)	**d_{50}**	**0.50**	Conveyed Q (cfs)	549.10
Minimum top width of SPSC riffle channel (ft)	W	50	Cascade is adequate,use 0 cascades	
Maximum depth of SPSC riffle channel 10H:1V cross-section (ft)	D	1.0	Minimum Pool Depth "Use 3 pools" following Cascade (ft)	0.80
SPSC (ft)	**h_f**	**1.5**	**ok**	
Enter desired pool depth (Maximum 3 ft)	h_i	2	subcritical/ok	
Check Riffle Side Slope, Must be > 10H:1V		**25.0**	Entrenchment ok	
Check the Froude Number to ensure subcritical flow conditions		**0.9**	Pool Depth Adequate	
Computed Roughness	n	0.05		
Riffle Cross Section Area (ft2), for parabola	A	33.33		
Theta - Intermediate step for solving	θ	0.08		
Riffle Hydraulic Perimeter (ft), for parabola	P	50.05		
Riffle Hydraulic Radius (ft), using Chow 1959	R_h	0.67		
Calculated Flow for design parameters (cfs)	Q	138.91		
Check Riffle Velocity (ft/sec)	**V**	**4.17**	**Number of Pools (This is a preliminary estimate based on**	10
			Provided cumulative pool depths (ft) =	12

Length of Channel, ft	250
Riffle Top Width, ft	50.0
Riffle Depth, ft	1.0
Pool Depth, ft	2.0
Number of Pools	10

Choose D50 Cobble size = 6 inches

Isbash curve for Stone Density = 165 lb/ft3

Cobble d50 size	**Allowable Velocity (Supercritical)**	**Allowable Velocity (Subcritical)**
[inches]	**[ft/sec]**	**[ft/sec]**
4	5.1	7.1
5	5.7	8.0
6	6.3	8.7
7	6.8	9.4
8	7.2	10.1
9	7.7	10.7
10	8.1	11.3
11	8.5	11.8
12	8.8	12.3
15	9.9	13.8
18	10.8	15.1

0.032

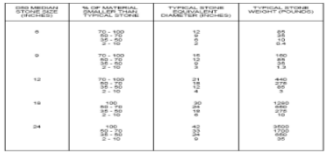
Adequate conveyance of design storm

Selected Cobble Size is Adequate for 100 year storm

Subcritical Flow is Predominant

Entrenchment Ok.

Cobble Gradation Table



Cascade Height (ft)	**Maximum Allowable Cascade Slope (ft/ft)**	**Minimum Required Cascade Length (ft)**
4	0.5	8
5	0.5	10
6	0.4	15
7	0.3	23
8	0.2	40
9	0.1	90
>10	0.1	>100

The cascade height is measured from the top of the cascade to the lowest point in the subsequent pool. Three full size pools are required at the bottom of a cascade.

WK DICKSON

Designer Engineer:	Stefani Barlow
Project Name:	Hardee Creek - Oakhurst RSC

*Note: This sheet is based of a RSC (SPSC) design model created by Anne Arundel County, MD.

Input values shaded in Grey

Calculated values are noted with dotted pattern

Check parameters in bold

Checking the Channel Conveyance for the design flood				
Design Return Period (Yr)	T	**100**	**10**	**1**
Time of Concentration in minutes (Before Development/Reference)	t_c	5.00		
Post development (No SPSC) Runoff Curve Number	RCN	85.00		
Pre development discharge (cfs)	Q_{pre}	43.62	43.62	43.62
Post development (No BMP) discharge (cfs)	Q_{post}	43.62	43.62	43.62
Total available length (ft)	L	170	**Cascade Design (maximum 5 ft drop per segment)**	
Elevation drop over length (ft)	delta E	2.0	Design Width (ft)	30.00
Total Cascade length for project (ft)	$L_{cascade}$	0.00	Design Depth (ft)	1.00
Cascade Slope (ft/ft)	$Slope_{cascade}$	0.50	Roughness	0.05
Water Quality slope (ft/ft)	Slope	0.01	A	20.00
Maximum Length of Riffle Channel/Weir (Not to exceed 8 ft)	L_{riffle}	8.0	q	0.13
Number of riffle segments/boulder weirs for project	N_{riffle}	7	P	0.00
Number of pool segments for project	N_{pool}	7	Rh	0.66
Minimum required length of pool (ft)	**L_{pool}**	16	Design Velocity (ft/sec)	16.45
Enter a trial median cobble diamater (ft)	**d_{50}**	**0.50**	Conveyed Q (cfs)	329.04
Minimum top width of SPSC riffle channel (ft)	W	30.0	Cascade is adequate,use 0 cascades	
Maximum depth of SPSC riffle channel 10H:1V cross-section (ft)	D	1.0	Minimum Pool Depth "Use 3 pools" following Cascade (ft)	0.80
SPSC (ft)	**h_f**	**1.5**	**ok**	
Enter desired pool depth (Maximum 3 ft)	h_i	2.0	subcritical/ok	
Check Riffle Side Slope, Must be > 10H:1V		**15.0**	Entrenchment ok	
Check the Froude Number to ensure subcritical flow conditions		**0.5**	Pool Depth Adequate	
Computed Roughness	n	0.05		
Riffle Cross Section Area (ft2), for parabola	A	20.00		
Theta - Intermediate step for solving	θ	0.13		
Riffle Hydraulic Perimeter (ft), for parabola	P	30.09		
Riffle Hydraulic Radius (ft), using Chow 1959	R_h	0.66		
Calculated Flow for design parameters (cfs)	Q	50.47		
Check Riffle Velocity (ft/sec)	**V**	**2.52**	**Number of Pools (This is a preliminary estimate based on**	7
			Provided cumulative pool depths (ft) =	9

Length of Channel, ft	170
Riffle Top Width, ft	30.0
Riffle Depth, ft	1.0
Pool Depth, ft	2.0
Number of Pools	7

5100

0.11707989

Choose D50 Cobble size = 6 inches

0.011764706

Isbash curve for Stone Density = 165 lb/ft3

Cobble d50 size	Allowable Velocity (Supercritical)	Allowable Velocity (Subcritical)
[inches]	[ft/sec]	[ft/sec]
4	5.1	7.1
5	5.7	8.0
6	6.3	8.7
7	6.8	9.4
8	7.2	10.1
9	7.7	10.7
10	8.1	11.3
11	8.5	11.8
12	8.8	12.3
15	9.9	13.8
18	10.8	15.1

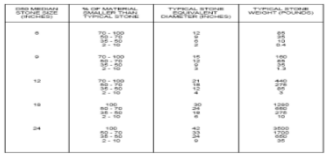
Adequate conveyance of design storm

Selected Cobble Size is Adequate for 100 year storm

Subcritical Flow is Predominant

Entrenchment Ok.

Cobble Gradation Table



Cascade Height (ft)	Maximum Allowable Cascade Slope (ft/ft)	Minimum Required Cascade Length (ft)
4	0.5	8
5	0.5	10
6	0.4	15
7	0.3	23
8	0.2	40
9	0.1	90
>10	0.1	>100

The cascade height is measured from the top of the cascade to the lowest point in the subsequent pool. Three full size pools are required at the bottom of a cascade.

WK DICKSON

Designer Engineer:	Stefani Barlow
Project Name:	Hardee Creek - Arbor Hills South RSC

*Note: This sheet is based of a RSC (SPSC) design model created by Anne Arundel County, MD.

Input values shaded in grey

Calculated values are shaded in blue

Check parameters in bold

Checking the Channel Conveyance for the design flood				
Design Return Period (Yr)	T	**100**	**10**	**1**
Time of Concentration in minutes (Before Development/Reference)	t_c	5.00		
Post development (No SPSC) Runoff Curve Number	RCN	85.00		
Pre development discharge (cfs)	Q_{pre}	47.45	47.45	47.45
Post development (No BMP) discharge (cfs)	Q_{post}	47.45	47.45	47.45
Total available length (ft)	L	200	**Cascade Design (maximum 5 ft drop per segment)**	
Elevation drop over length (ft)	delta E	3.0	Design Width (ft)	20.00
Total Cascade length for project (ft)	$L_{cascade}$	0.00	Design Depth (ft)	1.00
Cascade Slope (ft/ft)	$Slope_{cascade}$	0.50	Roughness	0.05
Water Quality slope (ft/ft)	Slope	0.02	A	13.33
Maximum Length of Riffle Channel/Weir (Not to exceed 8 ft)	L_{riffle}	8.0	q	0.20
Number of riffle segments/boulder weirs for project	N_{riffle}	8	P	0.00
Number of pool segments for project	N_{pool}	8	Rh	0.66
Minimum required length of pool (ft)	**L_{pool}**	16	Design Velocity (ft/sec)	16.41
Enter a trial median cobble diamater (ft)	**d_{50}**	**0.50**	Conveyed Q (cfs)	218.82
Minimum top width of SPSC riffle channel (ft)	W	30.0	Cascade is adequate,use 0 cascades	
Maximum depth of SPSC riffle channel 10H:1V cross-section (ft)	D	1.0	Minimum Pool Depth "Use 3 pools" following Cascade (ft)	0.80
SPSC (ft)	**h_f**	**1.5**	**ok**	
Enter desired pool depth (Maximum 3 ft)	h_f	1.5		
Check Riffle Side Slope, Must be > 10H:1V		**15.0**	subcritical/ok	
Check the Froude Number to ensure subcritical flow conditions		**0.6**	Entrenchment ok	
Computed Roughness	n	0.05		
Riffle Cross Section Area (ft2), for parabola	A	20.00	Pool Depth Adequate	
Theta - Intermediate step for solving	θ	0.13		
Riffle Hydraulic Perimeter (ft), for parabola	P	30.09		
Riffle Hydraulic Radius (ft), using Chow 1959	R_h	0.66		
Calculated Flow for design parameters (cfs)	Q	56.99		
Check Riffle Velocity (ft/sec)	**V**	**2.85**		

Number of Pools (This is a preliminary estimate based on	8
Provided cumulative pool depths (ft) =	10

Length of Channel, ft	200
Riffle Top Width, ft	30.0
Riffle Depth, ft	1.0
Pool Depth, ft	1.5
Number of Pools	8

Choose D50 Cobble size = 6 inches

Isbash curve for Stone Density = 165 lb/ft3

0.015	**Cobble d50 size**	**Allowable Velocity (Supercritical)**	**Allowable Velocity (Subcritical)**
	[inches]	**[ft/sec]**	**[ft/sec]**
	4	5.1	7.1
	5	5.7	8.0
	6	6.3	8.7
	7	6.8	9.4
	8	7.2	10.1
	9	7.7	10.7
	10	8.1	11.3
	11	8.5	11.8
	12	8.8	12.3
	15	9.9	13.8
	18	10.8	15.1

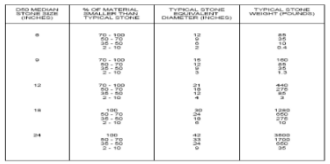
Adequate conveyance of design storm

Selected Cobble Size is Adequate for 100 year storm

Subcritical Flow is Predominant

Entrenchment Ok.

Cobble Gradation Table



Cascade Height (ft)	**Maximum Allowable Cascade Slope (ft/ft)**	**Minimum Required Cascade Length (ft)**
4	0.5	8
5	0.5	10
6	0.4	15
7	0.3	23
8	0.2	40
9	0.1	90
>10	0.1	>100

The cascade height is measured from the top of the cascade to the lowest point in the subsequent pool. Three full size pools are required at the bottom of a cascade.

Appendix J:

Digital Copy of Hydrologic and Hydraulic Models

List of Contents:

1. Primary System HEC-HMS Model (2-,10-,25-,50-, and 100-Year Storms)
    a. Existing Conditions
    b. Future Conditions

2. Primary System HEC-RAS Model (2-,10-,25-,50-, and 100-Year Storms)
    a. Existing Conditions
    b. Future Conditions
    c. Alternative

3. Secondary System SWMM Models (2-,10-,25-,50-, and 100-Year Storms)
    a. Existing Conditions
        i. Quail Hollow/Fox Haven
        ii. River Hills
    b. Alternative
        i. River Hills

4. Secondary System Hydraflow Storm Sewers (2-,10-,25-,50-, and 100-Year Storms)
    a. Alternative
        i. Quail Hollow/Fox Haven

DIGITAL COPY OF HYDROLOGIC AND HYDRAULIC MODELS TO BE PROVIDED ON CD

Appendix K:

Stream Assessment

List of Contents:

Assessment Number	BEHI Score	BEHI Rating	Stability Score	Stability Rating	Stream Reach
6	15.90	Low	22	Excellent	Hardee Creek- (8)
7	14.70	Low	22	Excellent	Hardee Creek (9)
13	16.60	Low	29	Excellent	UT1- HC (6)
14	16.80	Low	47	Good	UT1- HC (7)

Bank Erosion Hazard Rating Guide

Stream UT1-HC (6) **Assesment #** 13 **Date** 8/12/2014 **Crew** WAM

Bank Erosion Potential	Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
	VERY LOW	Value	1.0-1.1	1.00	1.0-0.9	1.00	100-80	80.00	0-20	10.00	100-80	95.00
		Index	1.0-1.9	1.00	1.0-1.9	1.00	1.0-1.9	1.90	1.0-1.9	1.45	1.0-1.9	1.23
	LOW	Value	1.11-1.19		0.89-0.5		79-55		21-60		79-55	
		Index	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00
	MODERATE	Value	1.2-1.5		0.49-0.3		54-30		61-80		54-30	
		Index	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00
	HIGH	Value	1.6-2.0		0.29-0.15		29-15		81-90		29-15	
		Index	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00
	VERY HIGH	Value	2.1-2.8		0.14-0.05		14-5.0		91-119		14-10	
		Index	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00
	EXTREME	Value	>2.8		<0.05		<5		>119		<10	
		Index	10	0.00	10	0.00	10	0.00	10	0.00	10	0.00
	V = value, I = index							SUB-TOTAL (Sum one index from each column):			**6.6**	

Bank Material Description:

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

BANK MATERIAL ADJUSTMENT: **10**

Stratification Comments:

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT:

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.5	10-19.5	20-29.5	30-39.5	40-45	46-50

Bank location description (circle one) Straight Reach Outside of Bend

GRAND TOTAL: **16.6**

BEHI RATING: **LOW**

Bank Erosion Hazard Rating Guide

Stream UT1-HC (7) **Assesment #** 14 **Date** 8/13/2014 **Crew** WAM

Bank Erosion Potential	Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
	VERY LOW	Value	1.0-1.1	1.00	1.0-0.9	1.00	100-80	80.00	0-20	5.00	100-80	85.00
		Index	1.0-1.9	1.00	1.0-1.9	1.00	1.0-1.9	1.90	1.0-1.9	1.23	1.0-1.9	1.68
	LOW	Value	1.11-1.19		0.89-0.5		79-55		21-60		79-55	
		Index	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00
	MODERATE	Value	1.2-1.5		0.49-0.3		54-30		61-80		54-30	
		Index	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00
	HIGH	Value	1.6-2.0		0.29-0.15		29-15		81-90		29-15	
		Index	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00
	VERY HIGH	Value	2.1-2.8		0.14-0.05		14-5.0		91-119		14-10	
		Index	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00
	EXTREME	Value	>2.8		<0.05		<5		>119		<10	
		Index	10	0.00	10	0.00	10	0.00	10	0.00	10	0.00
	V = value, I = index							SUB-TOTAL (Sum one index from each column):			**6.8**	

Bank Material Description:

Bank Materials

- Bedrock (Bedrock banks have very low bank erosion potential)
- Boulders (Banks composed of boulders have low bank erosion potential)
- Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)
- Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)
- Sand (Add 10 points)
- Silt Clay (+ 0: no adjustment)

BANK MATERIAL ADJUSTMENT: **10**

Stratification Comments:

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT:

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.5	10-19.5	20-29.5	30-39.5	40-45	46-50

Bank location description (circle one) Straight Reach Outside of Bend

GRAND TOTAL: **16.8**

BEHI RATING: **LOW**

Bank Erosion Hazard Rating Guide

Stream Hardee Creek- (8) **Assessment #** 6 **Date** 8/13/2014 **Crew** WAM

Bank Erosion Potential	Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
	VERY LOW	Value	1.0-1.1	1.00	1.0-0.9	1.00	100-80	90.00	0-20	5.00	100-80	95.00
		Index	1.0-1.9	1.00	1.0-1.9	1.00	1.0-1.9	1.45	1.0-1.9	1.23	1.0-1.9	1.23
	LOW	Value	1.11-1.19		0.89-0.5		79-55		21-60		79-55	
		Index	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00
	MODERATE	Value	1.2-1.5		0.49-0.3		54-30		61-80		54-30	
		Index	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00
	HIGH	Value	1.6-2.0		0.29-0.15		29-15		81-90		29-15	
		Index	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00
	VERY HIGH	Value	2.1-2.8		0.14-0.05		14-5.0		91-119		14-10	
		Index	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00
	EXTREME	Value	>2.8		<0.05		<5		>119		<10	
		Index	10	0.00	10	0.00	10	0.00	10	0.00	10	0.00
	V = value, I = index									SUB-TOTAL (Sum one index from each column):		**5.9**

Bank Material Description:

Bank Materials

- Bedrock (Bedrock banks have very low bank erosion potential)
- Boulders (Banks composed of boulders have low bank erosion potential)
- Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)
- Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)
- Sand (Add 10 points)
- Silt Clay (+ 0: no adjustment)

BANK MATERIAL ADJUSTMENT: **10**

Stratification Comments:

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT:

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.5	10-19.5	20-29.5	30-39.5	40-45	46-50

Bank location description (circle one)

Straight Reach Outside of Bend

GRAND TOTAL: **15.9**

BEHI RATING: **LOW**

Bank Erosion Hazard Rating Guide

Stream Hardee Creek (9) **Assessment #** 7 **Date** 8/13/2014 **Crew** WAM

Bank Erosion Potential	Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
	VERY LOW	Value	1.0-1.1	1.00	1.0-0.9	1.00	100-80	90.00	0-20	0.00	100-80	95.00
		Index	1.0-1.9	1.00	1.0-1.9	1.00	1.0-1.9	1.45	1.0-1.9	0.00	1.0-1.9	1.23
	LOW	Value	1.11-1.19		0.89-0.5		79-55		21-60		79-55	
		Index	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00	2.0-3.9	0.00
	MODERATE	Value	1.2-1.5		0.49-0.3		54-30		61-80		54-30	
		Index	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00	4.0-5.9	0.00
	HIGH	Value	1.6-2.0		0.29-0.15		29-15		81-90		29-15	
		Index	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00	6.0-7.9	0.00
	VERY HIGH	Value	2.1-2.8		0.14-0.05		14-5.0		91-119		14-10	
		Index	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00	8.0-9.0	0.00
	EXTREME	Value	>2.8		<0.05		<5		>119		<10	
		Index	10	0.00	10	0.00	10	0.00	10	0.00	10	0.00
	V = value, I = index								SUB-TOTAL (Sum one index from each column):		**4.7**	

Bank Material Description:

Bank Materials

- Bedrock (Bedrock banks have very low bank erosion potential)
- Boulders (Banks composed of boulders have low bank erosion potential)
- Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)
- Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)
- Sand (Add 10 points)
- Silt Clay (+ 0: no adjustment)

BANK MATERIAL ADJUSTMENT: **10**

Stratification Comments:

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT:

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.5	10-19.5	20-29.5	30-39.5	40-45	46-50

Bank location description (circle one) Straight Reach Outside of Bend

GRAND TOTAL: **14.7**

BEHI RATING: **LOW**

Channel Stability Assessment Scores

	UT1- HC (6)	UT1- HC (7)	Hardee Creek- (8)	Hardee Creek (9)
Watershed characteristics	2	7	1	1
Flow habit	3	4	1	1
Channel pattern	3	5	1	1
Entrenchment/channel confinement	1	2	1	1
Bed material	5	6	3	3
Bar development	2	3	1	1
Obstructions/debris jams	3	4	3	3
Bank soil texture and coherence	6	7	7	7
Average bankangle	1	2	1	1
Bank vegetation/protection	1	4	1	1
Bank cutting	1	2	1	1
Mass wasting/bank failure	1	1	1	1
Upstream distance to bridge				
Score	**29**	**47**	**22**	**22**
Rating*	**Excellent**	**Good**	**Excellent**	**Excellent**

Excellent (0 < Score <= 33), Good (33 < Score <= 66), Fair (99 < Score <= 99), Fair (99 < Score <= 132)

CHANNEL STABILITY ASSESSMENT FORM

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	
3. Channel pattern	Straight to meandering with low radius of curvature; primarily suspended load	Meandering, moderate radius of curvature; mix of suspended and bed loads; well-maintained engineered channel	Meandering with some braiding; tortuous meandering; primarily bed load; poorly maintained engineered channel	Braided; primarily bed load; engineered channel that is maintained	
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	
5. Bed materia Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50-70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score _____

Appendix L:

Prioritization Matrices

List of Contents:

Project Prioritization Matrix

CATEGORY	Public Health and Safety		Severity of Street Flooding (Public ROW)		Cost Effectiveness		Effect of Improvements		Water Quality - BMP		Water Quality - Erosion Control		Implementation Constraints		Grant Funding		Constructibility		TOTAL WEIGHTED SCORE
Primary System Projects																			
Portertown Road Floodplain Bench	1	10	3	30	1	10	5	30	0	0	3	18	1	6	1	6	1	3	**113**
East 10th Street Culverts	1	10	3	30	1	10	3	18	0	0	0	0	3	18	0	0	3	9	**95**
Secondary System Projects																			
Fox Haven Drive	1	10	3	30	1	10	1	6	0	0	0	0	5	30	0	0	5	15	**101**
River Hills Drive	1	10	3	30	1	10	3	18	0	0	0	0	3	18	0	0	3	9	**95**
Water Quality Projects																			
Pinebrook RSC	0	0	0	0	1	10	0	0	5	30	5	30	3	18	3	18	5	15	**121**
Oakhurst RSC	0	0	0	0	5	50	0	0	3	18	1	6	3	18	3	18	3	9	**119**
Willow Run Biroretention	0	0	0	0	1	10	0	0	3	18	0	0	3	18	3	18	3	9	**73**
Arbor Hills RSC	0	0	0	0	1	10	0	0	3	18	1	6	1	6	3	18	1	3	**61**

*Raw numbers are shown in left side of column and weighted numbers are provided in right side of column. Totals are based on weighted numbers.

Category	General Description	Score	Evaluation Criteria
Public Health and Safety	Evaluates potential impact of flooding on public health and safety. Generally, refers to flooding in and around habitable structures.	5	Flood water depth and/or velocity completely surrounds and threatens the structural integrity of habitable structures or vehicles.
			Finished Floor Flooding Occurs during the design storm.
			Erosion of stream running parallel to road threatening roadway stability or safety for Secondary
		3	Flood water surrounds structure but does not cause imminent danger.
			Crawl space and HVAC units are flooded.
		1	Yard flooding occurs and flood waters are near HVAC, crawl spaces or foundations.
			Model indicates flooding at nodes on private property or on roads/private property within a residential neighborhood.
		0	Minor yard flooding may occur but habitable structure is not directly affected.
			Model indicates no flooding at nodes on private property.
Severity of Street Flooding (City Owned)	Evaluates impact of flood depths to or through an area	5	Street spread requirements are not met and are so severe that the street becomes impassable during the design storm or street flooding has spread into private property.
			Flooding is noted on NCDOT roads as a result spread issues on adjacent city owned street.
			Roadway overtopping exceeding 6" in depth for Primary Systems.
		3	Street spread requirements are not met and the streets are passable only through the center of the street.
			Flooding noted on collector and local streets.
			Roadway overtopping 0-6" in depth for Primary Systems
		1	Spread requirements exceeded but street flooding is considered minor nuisance for traffic.
		0	Spread requirements are met.
Cost Effectiveness	Evaluates the benefit/cost of the proposed improvements	5	Project benefit ratio is greater than 1.5
			Stream Stabilization cost <$400 per linear foot
		3	Project benefit ratio is between 0.5 and 1.5
			Stream Stabilization cost <$600 per linear foot
		1	Project benefit ratio is between 0.075 and 0.5
			Stream Stabilization cost <$1,000 per linear foot
		0	Project ratio is less than 0.075
			Stream Stabilization cost >$1,000 per linear foot

Category	General Description	Score	Evaluation Criteria
Effect of Improvements	Evaluates the number of drainage issues resolved and the number of citizens positively affected	5	Multiple major drainage issues are being resolved through the proposed improvements such as street spread and increased drainage capacity.
			Proposed improvements would resolve major drainage issues for more than 5 properties.
		3	Single drainage issue is being resolved and it is considered major.
			Proposed improvements would resolve drainage issues for 3-5 properties.
		1	Single drainage issue is being resolved and it is considered major.
			Proposed improvements would resolve drainage issues for 2-3 properties.
		0	Single drainage issue is being resolved and it is considered minor.
			Proposed improvements would resolve drainage issue(s) for a single property at most.
Water Quality/Quantity	Evaluates the impact a BMP would have on water quality, water quantity and NPDES Phase II Compliance	5	Provides both water quantity and water quality benefits.
			Does not use manufactured or proprietary BMP technology.
			Incorporates some form of green solution such as infiltration, LID, sustainability etc.
			Is considered a BMP retrofit.
		3	Provides water quality benefits but does not provide water quantity benefit.
			Is considered a BMP retrofit
		1	Improvements will have minimal impacts on water quality and would primarily serve as a demonstration project.
			Is considered a BMP retrofit.
		0	Improvements will have no measurable impact on water quality and would serve only as a demonstration project.

Category	General Description	Score	Evaluation Criteria
Open Channel - Erosion Control	Evaluates the severity of erosion control issues and impact on water quality	5	Severe erosion problems are evident and are contributing significantly to water quality issues.
		3	Moderate erosion problems are evident and are contributing to water quality issues.
			>2,000 Linear feet of floodplain benching with documented erosion.
		1	Minor erosion control issues are evident and are contributing to water quality issues.
			<2,000 Linear feet of floodplain benching with documented erosion.
		0	Minor erosion control issues are evident and are not contributing to water quality issues in a significant way.
Implementation Constraints	Considers potential constraints that may either delay or make the project too difficult to construct. Some examples would include significant permitting issues, high mitigation costs, numerous easement needs, required partnering with other communities, the NCDOT, or railroads.	5	Only minor local or state permits required. Does not involve ACOE, DWQ or FEMA.
			Proposed improvements can be completed without permanent or temporary easements.
			Project can proceed independent of other stormwater improvements identified in the master plan.
		3	Requires State and Federal permits that are typically easy to obtain such as Nationwide permits, FEMA No Rise etc.
			Primarily requires temporary easements with only a few permanent easements needed to build the project.
			Improvements may have limited coordination with other projects such as DOT widening, GUC utility improvements or down stream drainage improvements. Significant delays in the schedule due to this coordination is not anticipated.
			Project can proceed independent of other stormwater improvements identified in the master plan.
			Project is self mitigating or requires very minor mitigation.
		1	Numerous permits required including federal, state and local agencies. Examples would include an individual permit or FEMA CLOMR/LOMR.
			Extensive permanent and temporary easements are required.
			Project can not proceed independent of other stormwater improvements identified in the master plan.
			Requires floodplain benching.

Category	General Description	Score	Evaluation Criteria
Grant Funding	Evaluates the availability and potential to receive grant funding	5	Project qualifies for multiple grants.
			Grant does not require significant match (20% match or less)
			City does not have an open grant from the agency providing the funding.
			Project meets all ranking criteria and will score highly in most if not all categories.
		3	Project qualifies for only one type of grant funding.
			Grant requires match between 20% and 50% range.
			City has an open grant from agency providing the funding.
			Project meets most if not all of the ranking criteria and will score high in key categories.
		1	Project qualifies for only one type of grant funding.
			Grant requires match equal to or greater than 50%.
			City has an open grant from agency providing the funding.
			Project meets some of the ranking criteria and may score high in one or two categories.
		0	Project does not qualify for any type of grant funding
Constructability	Evaluates relative constructability of the project including site constraints, traffic and neighborhood impacts, and impacts on adjacent property owners.	5	Limited to no site constraints.
			Limited to no utility conflicts.
			Limited to no impacts on adjacent property owners.
			Limited to no impacts on traffic or surround neighborhoods.
		3	Some site constraints exist but are considered fairly minor.
			Some utility conflicts exist but are routine and do not require major utility relocation.
			Some traffic and neighborhood impacts occur but are fairly minor. Examples include temporary lane closures, occasional hauling or traffic detours though adjacent neighborhoods.
		1	Site constraints exist and are fairly major.
			Utility conflicts exist and require rerouting or relocation of existing utilities.
			Traffic and neighborhood impacts occur and are fairly major. Examples included extended road closures or hauling operations.

To calculate the project benefit ratio used in evaluating the cost effectiveness, the following steps were taken for each project location:

1. The weighted scores for the Public Health and Safety, Severity of Street Flooding, and Effect of Improvements categories were added together.
2. The sum of the three categories was divided by the total project cost.
3. The quotient was multiplied by a common multiplier, 5,000, to determine the benefit ratio.
4. The value was then assigned a score based on the evaluation criteria shown below for the cost effectiveness criteria.

Score	Evaluation Criteria
5	Project benefit ratio is greater than 1.5
3	Project benefit ratio is between 0.5 and 1.5
1	Project benefit ratio is between 0.075 and 0.5
0	Project ratio is less than 0.075

5. The applicable weighting factor is then applied to the score. The final number obtained is listed in the project prioritization matrix.

Weight Factor	Criteria
10	Public Health and Safety
	Severity of Street Flooding (Town Owned)
	Cost Effectiveness
6	Effect of Improvements
	Water Quality - BMP and Erosion Control
	Implementation Constraints
	Grant Funding
3	Construction Impacts
	Constructability

The above table presents the weighting factors that will be applied to the prioritization criteria, with the reason being that some criteria are viewed as more important (i.e. deserve a higher weighting) than others. So each score of each prioritization criteria will be multiplied by the assigned weight factor for that prioritization criteria category as shown in the Priority Matrix.