

**Interstate 85 Widening Improvements
Mile Marker 80 to Mile Marker 96**

Hydrology for Existing Culverts

FINAL

Cherokee/Spartanburg Counties, South Carolina

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INFRASTRUCTURE CONSULTING & ENGINEERING

MEAD & HUNT

STV INC.

Interstate 85 Widening Improvements: Hydrology for Existing Culverts

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I. Introduction

Project Summary

The South Carolina Department of Transportation proposes to widen I-85 from near S-57 (Exit 80) on the southern terminus to just North of SC 18 (Exit 96). The study area will then extend approximately one (1) mile past SC 18 (Exit 96) to include the Gaffney Ferry Road entrance slip ramp on the northern terminus. The project includes adding a travel lane in each direction, improving various interchanges and exit ramps, and replacement of overpass bridges. ICE in association with Mead & Hunt and STV have teamed to complete the drainage and outfall field surveys, pipe inspections, and preliminary hydraulic design in order to support the Department with preparation of the design build package. The scope of this drainage study is to provide a hydrologic and hydraulic analysis on each cross drainage structure for the post construction conditions, for the widening section. While this project will also entail improvements to interchange ramps along the corridor, the main hydrologic effect of the project will be to increase the impervious surface within the median. Based on this evaluation, recommendations for retaining, replacing or other drainage alternatives for each cross drainage structure are made and listed in the I-85 Drainage Summary Tables provided herein. Supporting documentation and calculations are also provided (See Table of Contents for specifics).

II. Design Criteria

Overview

The hydrologic analysis for this project was performed in accordance with SCDOT's Requirements for Hydraulic Design Studies, dated May 26, 2009. This project includes the widening of existing interstate roadway and major improvements to associated interchange ramps. The proposed construction will not significantly alter or impact existing drainage patterns along the mainline section.

Drainage areas were delineated using survey data provided by both Mead & Hunt, Inc. and ICE, USGS Quad maps for Spartanburg and Cherokee County, LiDAR data provided by SCDOT, aerial imaging, and field visits to verify offsite flow patterns. The hydrologic methods used to determine peak discharges were selected upon watershed area and consisted of the Rational Method, the modified NRCS TR-55 Method, and USGS Regression Equations. Times of concentrations were computed using the SCS methodology outlined in the TR-55 manual, with a minimum time of concentration of five minutes. SCDOT published Rainfall Intensity Value Charts for Gaffney, SC were used to determine rainfall intensities (in/hr).

Table 2.1: Drainage Design Criteria

Drainage Design Criteria			I-85	Source
				Req. for Hydr. Design Studies (2009)
				Section
Hydrologic Method	Drainage Area	0-100 AC	Rational Method	2.2.15.1
		100-640 AC	NRCS TR-55 Method	2.2.15.2
		>640 AC	USGS Regression Equations	2.2.15.3
Freeboard for Road Subgrades			WSEL of 3' Below Edge of Pavement*	2.2.1
Design Storm	Pipes Crossing Mainline Draining Medians		10 year	2.2.3
	Pipes Crossing Both Lanes of Mainline		50 year	2.2.2
Overtopping/surge	Pipes Crossing Mainline Draining Medians (surcharge)		50 year	Per SCDOT comments
	Pipes Crossing Both Lanes of Mainline (overtopping)		100 year	Per SCDOT comments
Preferred Headwater to Culvert Barrel Height Ratio (HW/D)			1.2	2.3 (Step 6, Sec. D, pg. 61
*Assuming 2' pavement section for all roads. Elevations estimated using LiDAR				

Rational Method

Coefficients used in the rational method for calculating rainfall intensity values were provided by SCDOT.

The coefficients for Gaffney are shown below.

Table 2.2: Rainfall Intensity Coefficients

RAINFALL INTENSITY COEFFICIENTS			
Frequency (years)	a	b	c
2	238.04743	35.97679	1.03780
5	253.07858	33.58796	1.02299
10	263.15904	32.05480	1.01324
25	276.21252	30.11625	1.00075
50	285.40822	28.75527	0.99196
100	293.62644	27.51709	0.98405

The coefficients are utilized in the following equation to calculate rainfall intensities.

Rainfall intensity equation:

$$i = a / (b + tc)^c$$

The following table containing runoff factors for use with the Rational Method was obtained from SCDOT's Requirements for Hydraulic Design Studies. These values were used to obtain weighted "C" values for each drainage area per guidelines in Section 2.2.15.1.

Table 2.3 Runoff Factors for Rational Method (SCDOT Req. for Hydraulic Design Studies)

RUNOFF FACTORS FOR RATIONAL METHOD			
	Flat 0% - 2%	Rolling 2% - 10%	Hilly Over 10%
Pavements & Roofs	0.90	0.90	0.90
Earth shoulders	0.50	0.50	0.50
Drives & Walks	0.75	0.80	0.85
Gravel Pavements	0.50	0.55	0.60
City Business Areas	0.80	0.85	0.85
Unpaved Road, Sandy Soils	0.34	0.45	0.59
Unpaved Road, Silty Soils	0.35	0.47	0.61
Unpaved Road, Clay Soils	0.40	0.53	0.69
Apartment Dwelling Areas	0.50	0.60	0.70
Suburban, Normal Residential	0.45	0.50	0.55
Dense Residential Sections	0.60	0.65	0.70
Lawns, Sandy Soils	0.10	0.15	0.20
Lawns, Heavy Soils	0.17	0.22	0.35
Grass Shoulders	0.25	0.25	0.25
Side Slopes, Earth	0.60	0.60	0.60
Side Slopes, Turf	0.30	0.30	0.30
Median Areas, Turf	0.25	0.30	0.30
Cultivated Land, Clay & Loam	0.50	0.55	0.60
Cultivated Land, Sand & Gravel	0.25	0.30	0.35
Industrial Areas, Light	0.50	0.70	0.80
Industrial Areas, Heavy	0.60	0.80	0.90
Parks & Cemeteries	0.10	0.15	0.25
Playgrounds	0.20	0.25	0.30
Woodland & Forest	0.10	0.15	0.20
Meadows & Pasture Land	0.25	0.30	0.35
Unimproved Areas	0.10	0.20	0.30
Rail Yards	0.25	0.30	NA
Expressways & Freeways *	0.60*	0.70*	0.75*

* The designer can also calculate weighted 'C' values for expressways and freeways using the values in the table for pavement, side slopes and planted medians.

Revised 3/16/09

NRCS TR-55 Method

All Watersheds over 100 Acres were modeled using the modified NRCS TR-55 method. In accordance with NRCS methods, weighted curve numbers (CNs) were determined by delineating areas of different soil type and surface cover for Post-Construction conditions. The soil classifications were determined through maps obtained from the NRCS Web Soil Survey Website, which were overlaid onto the project area. Rainfall depths used in determining peak discharges through the SCS Method were obtained from the South Carolina DHEC Storm Water Management BMP Handbook. The 24-hour storm event rainfall depths for Cherokee County are shown below.

Table 2.4 South Carolina DHEC 24- Hour Rainfall Depths for Cherokee and Spartanburg Counties

Cherokee	
% ann chance (return period – yrs)	Depth (inches)
50% (2)	3.7
10% (10)	5.4
4% (25)	6.4
2% (50)	7.3
1% (100)	8.1

Spartanburg NE	
% ann chance (return period – yrs)	Depth (inches)
50% (2)	3.8
10% (10)	5.5
4% (25)	6.6
2% (50)	7.4
1% (100)	8.3

The following tables contain curve numbers for use with the TR-55 method. These were obtained from the USDA NRCS Technical Release 55, Urban Hydrology for Small Watersheds. These values were used to obtain weighted curve numbers for each drainage area per guidelines in Section 2.2.15.2.

Table 2.5 Runoff Curve Numbers for Urban Areas

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area ^{2/}	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) ^{3/} :					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ^{4/}		63	77	85	88
Artificial desert landscaping (impervious weed barrier; desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
<i>Developing urban areas</i>					
Newly graded areas (pervious areas only, no vegetation) ^{5/}		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

Table 2.6 Runoff Curve Numbers for Cultivated Agricultural Lands

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment ^{2/}	Hydrologic condition ^{3/}	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

Table 2.7 Runoff Curve Numbers for other Agricultural Lands**Table 2-2c** Runoff curve numbers for other agricultural lands ^{1/}

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. ^{2/}	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. ^{3/}	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 ^{4/}	48	65	73
Woods—grass combination (orchard or tree farm). ^{5/}	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. ^{6/}	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 ^{4/}	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

Table 2.8 Runoff Curve Numbers for Arid and Semiarid Rangelands**Table 2-2d** Runoff curve numbers for arid and semiarid rangelands ^{1/}

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition ^{2/}	A ^{3/}	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

Soils

The NRCS Web Soil Survey tool was used to obtain soil conditions for the project corridor. Please see the accompanying soil reports in the Appendices.

USGS Regression Equations

As outlined in section 2.2.15.3, areas over 640 acres are to be analyzed using USGS Regression Equations. This project was located in the Piedmont region. For rural areas the equations used are as follows:

$$\begin{aligned}
 Q_2 &= 127A^{0.66} \\
 Q_5 &= 211A^{0.64} \\
 Q_{10} &= 267A^{0.64} \\
 Q_{25} &= 347A^{0.63} \\
 Q_{50} &= 410A^{0.63} \\
 Q_{100} &= 474A^{0.63} \\
 Q_{500} &= 615A^{0.63}
 \end{aligned}$$

For Urban areas the equations used are as follows:

$$\begin{aligned}
 U_2 &= 1.36A^{0.554}IA^{1.241}Q_2^{0.323} \\
 U_5 &= 2.58A^{0.544}IA^{1.170}Q_5^{0.299} \\
 U_{10} &= 3.77A^{0.536}IA^{1.115}Q_{10}^{0.291} \\
 U_{25} &= 5.84A^{0.524}IA^{1.041}Q_{25}^{0.284} \\
 U_{50} &= 7.76A^{0.514}IA^{0.987}Q_{50}^{0.283} \\
 U_{100} &= 10.4A^{0.506}IA^{0.932}Q_{100}^{0.28} \\
 U_{500} &= 18.8A^{0.484}IA^{0.800}Q_{500}^{0.281}
 \end{aligned}$$

FEMA

There is one site that falls within a FEMA Special Flood Hazard Zone (FIRM maps are provided within each site's documentation), Cole Creek (Site B-26).

Based on a HY-8 analysis at Cole Creek (Site B-26), the 100 year storm event does not overtop I-85. Due to widening to the median, there should be no anticipated encroachments in the floodplain from this project.

Water Quality

The project will be designed to minimize short- (during construction) and long-term (post-construction) impacts to water quality in receiving streams. The SCDOT Stormwater Quality Design Manual (June 2014) provides information on requirements and design procedures. Target pollutants to be mitigated by stormwater best management practices (BMPs) are total suspended solids (TSS removal) and total maximum daily loads (TMDLs) of specific pollutants when identified specifically by SCDHEC for the receiving streams. BMPs shall be designed to incorporate features that meet the manual's requirements to the maximum extent practicable while avoiding right of way impacts.

III. Design

Design Assumptions

In addition to the design criteria described above, hydraulic design analyses were completed using the following design assumptions:

- If HW/D is:
 - <1.2 – retain if pipe condition is good
 - >1.2 Recommendation based on additional considerations listed below and best engineering judgment
- Additional considerations for crossline pipe analysis:
 - Headwater elevation allows for 1 foot of freeboard below roadway subgrade (3.0' to EOP for the purpose of this study)
 - Indication of adverse impact upstream or downstream
 - Where exit velocities exceed 12 ft/s in the 2% annual chance (50-year) event or 5 ft/s in the 10% annual chance (10-year) event, consider the need for a energy dissipation.
 - Replace all 15" pipes and recommend size.
 - SCDOT requested that peak flow estimates use combined median and offsite drainage areas. The result is a very conservative estimate of peak flow at the cross line entrance.
 - Additional pipes that were not surveyed, field located, or shown in existing plans are possible along the study route.
- Crosslines that have downstream systems (not under I-85):
 - Include one downstream link of pipe (such as one under frontage road). Model in HY-8 as a single or double broken-back culvert.
 - Use normal depth in downstream channel as tailwater when applicable
 - Assume normal depth for tailwater if pipe system continues downstream, because undersized pipes (not under I-85) can be replaced
- Crosslines that have upstream systems (not under I-85):
 - Disregard upstream system, but not upstream/median drainage area
 - Run HY-8 as a headwall at the beginning of the crossline pipe
- Crosslines with median drainage flow
 - Include median drainage flow at entrance of first culvert
 - Model the system in HY-8 as a broken back culverts in HY8 when < 0.5' drop inside structure or change in size
 - Use downstream headwater as an upstream tailwater

- Document all time of concentration assumptions.
- Design Discharge: for half-line culverts draining medians, design for 10-year peak discharge, and check for proposed inlet surcharge during the 50-year peak discharge.
- Existing cross-line box culverts will not require extension due to construction of the project.
- While this project will also entail minor improvements to interchange ramps along the corridor, the main hydrologic effect of the project will be to increase the impervious surface along the median. Due to the relatively minimal new impervious area (relative to the area of the total project basin) to be added by construction of the project, the increase in runoff from pre-construction conditions to post-construction conditions is nearly negligible. No detention should be necessary to mitigate post-construction flows.
- Widening in the median will only entail an additional lane and wide inside shoulder in each direction. A median barrier is not proposed.
- Ramps are not analyzed.
- Pipe cleaning is addressed in the overall summary spreadsheet presented in Table 1. All cross lines are analyzed as though they will be cleaned.
- Since an analysis of the storm drainage systems are not part of this study, the recommendations provided are subject to change based on final design of those systems. These recommendations are based on the assumption that all current drainage patterns and cross line locations will remain in place and utilized. Final design may result in reconfigured systems, i.e., length of pipe runs and locations of inlets.

IV. Survey & Pipe Video

Mead & Hunt, Inc. performed a video inventory survey of all accessible pipes which crossed the mainline of I-85. Evaluations and recommendations are based on visual review of the videos. A detailed structural inspection has not been performed. The findings of the survey and subsequent evaluations are included in the Pipe Conditions Report.

Mead & Hunt, Inc. located and verified sizes of the existing drainage structures and evaluated the conditions of existing cross lines. Contributing drainage areas and patterns for these structures were identified based upon the Design Criteria noted in Section II of this report.

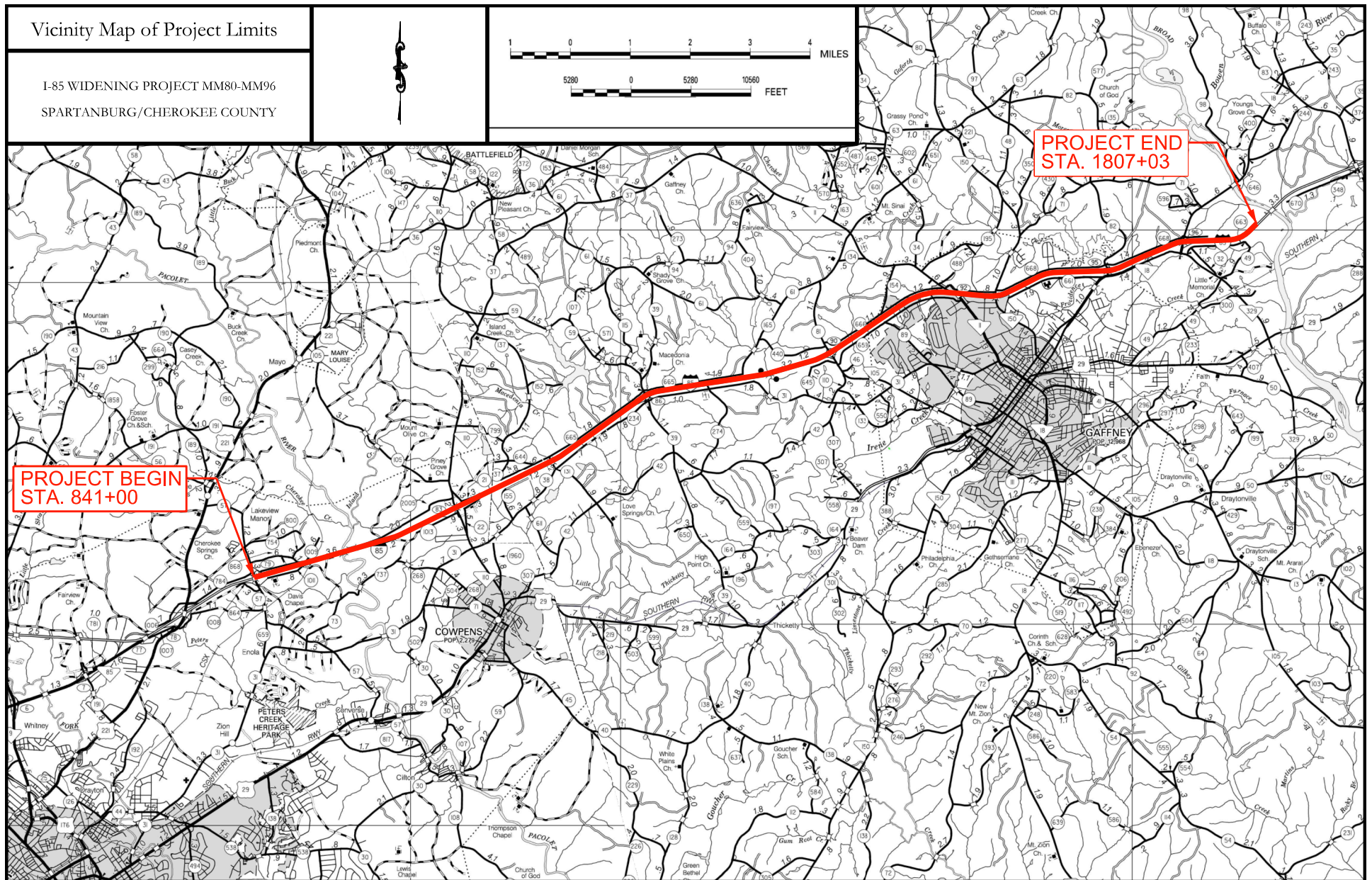
The existing drainage infrastructure will require some field verification during construction. The infrastructure shown in the attached drainage maps (See Individual Site Appendices) was put together from aerial survey data, topographic field survey, pipe video inventory survey, and field inspection. Some of the pipes shown were not field located but were drawn in by hand referencing as-builts of past projects. Pipes which were drawn in per these as-builts are assumed to still exist, and are noted as such.

V. Conclusion

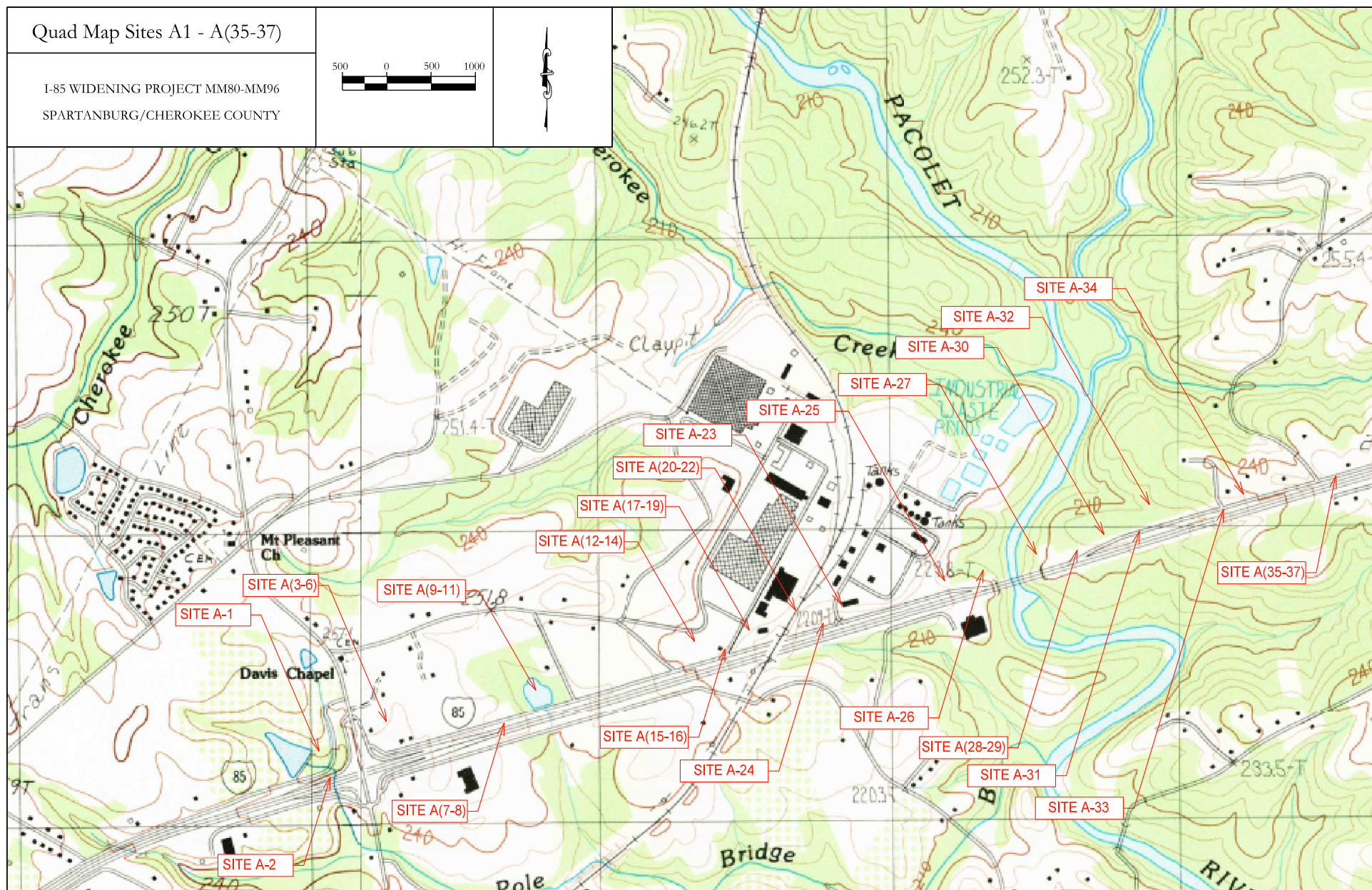
The existing drainage infrastructure of I-85 in the study area, from near S-57 (Exit 80) on the southern terminus to just North of SC 18 (Exit 96), is among the oldest in South Carolina. Over the decades this highway has been in service, the hydrology of the crossline pipes and culverts has changed with land development activity and changes in runoff estimation standard methods. So, in a number of cases crossline pipes and culverts are found to have insufficient capacity, and HW/D at headwalls exceeds the SCDOT standard of 1.2.

Recommendations for replacement or improvement of pipes and culverts in this report are a result of 1) review of hydraulic analysis data, 2) assessment of upstream impacts, 3) review of video inspections to assess physical condition, and 4) engineering judgment. Engineering judgment considers factors 1), 2), and 3) plus the relatively high construction cost and complexity of drainage infrastructure replacement in an interstate highway environment.

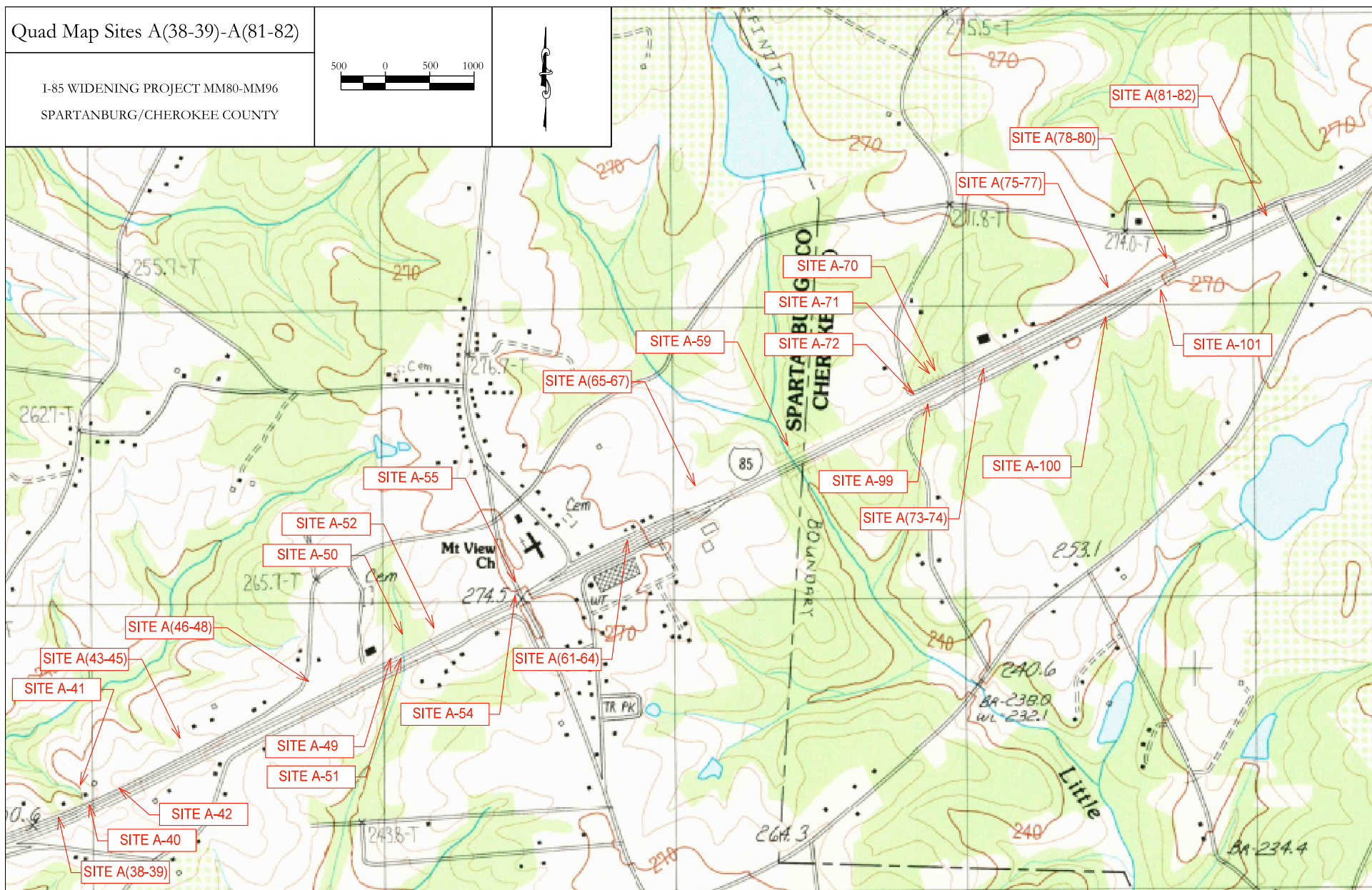
Overall Project Maps (Sections A, B, & C)



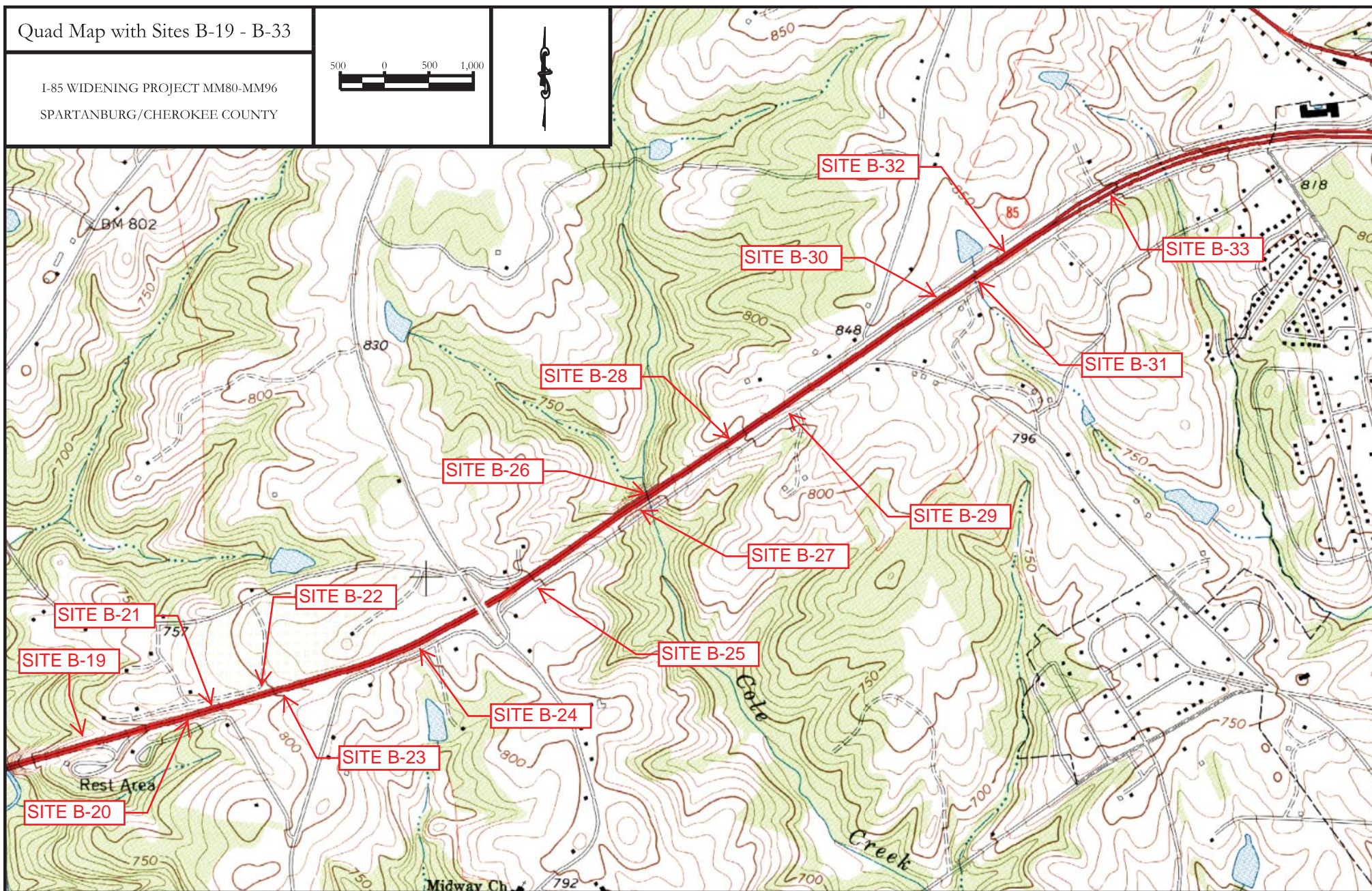
Map 1: Vicinity Map of Project Limits



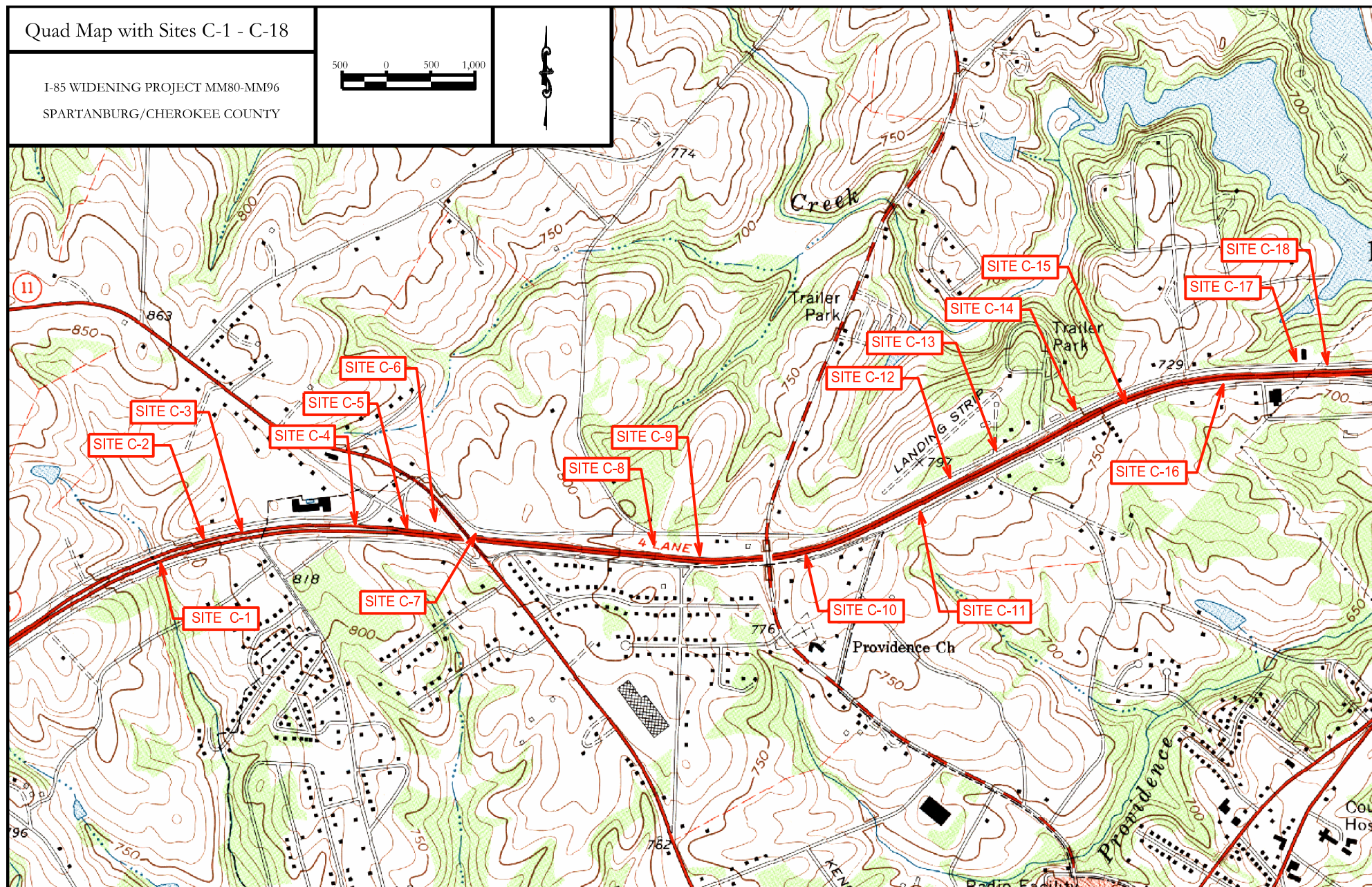
Map 2 (Section A): USGS Quadrangle Maps with Site Locations



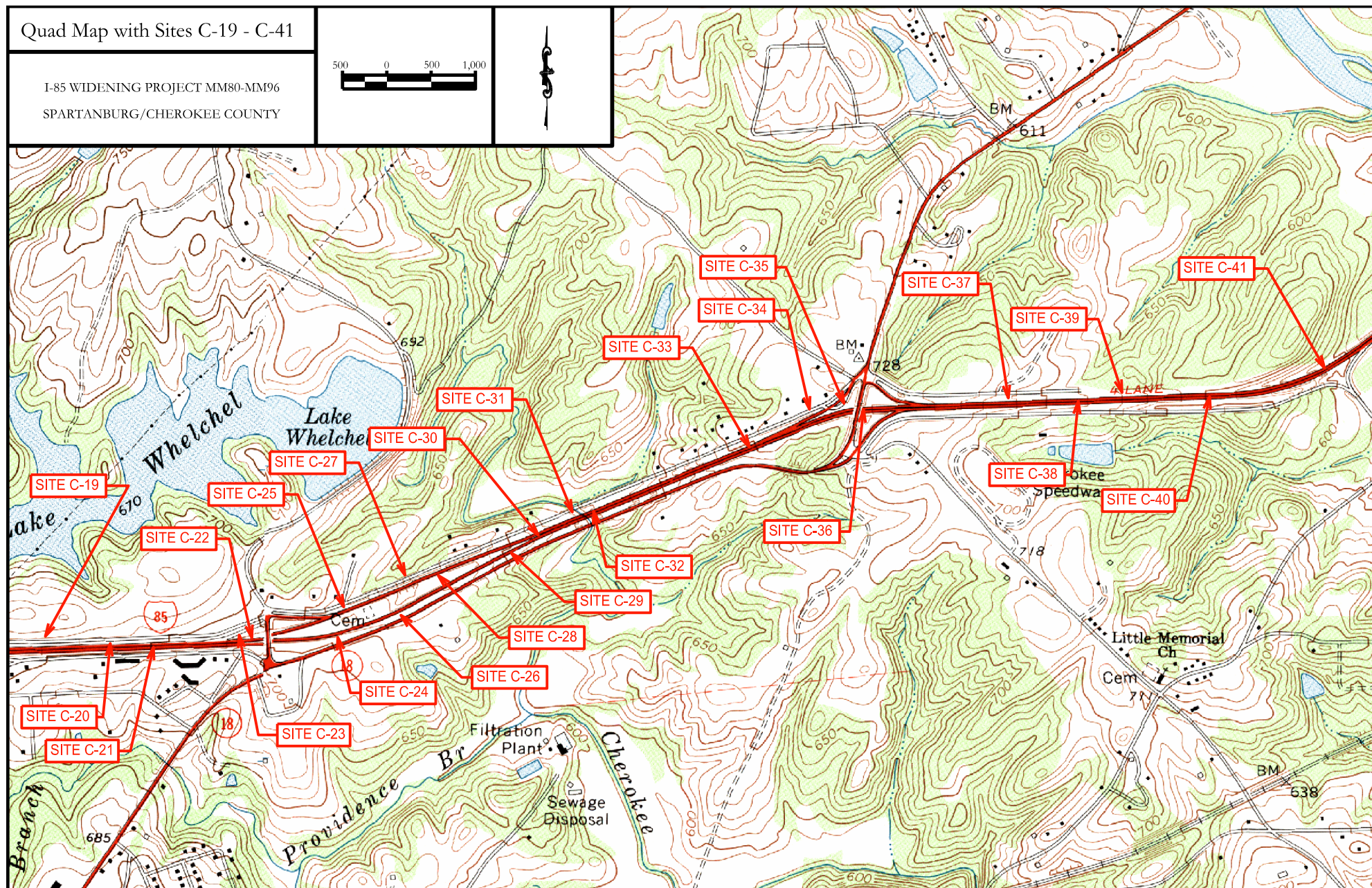
Map 2 (Section A): USGS Quadrangle Maps with Site Locations



Map 2 (Section B): USGS Quadrangle Maps with Site Locations



Map 2 (Section C): USGS Quadrangle Maps with Site Locations



Map 2 (Section C): USGS Quadrangle Maps with Site Locations

Overall Site Calculations & Spreadsheets (Sections A, B, & C)

I-85 Widening and Rehabilitation Drainage Structures

Site No.	Station	Size Verified	Shape	Drainage Area (ac.)	Rational			SCS		USGS			Design Storm	EXISTING CONDITIONS (w/ Proposed Widening)						CONDITION	RECOMMENDATIONS	Comments		
				Areas are discretized to single pipes in some cases	T _c	c	i	T _c	CN	Urban	% Imp	Rural		Q	Outlet Velocity	HW/D	HW Elevation	*Elev. Dif. From EOP to WSEL	Upstream Adverse Impacts? (Y or N)	*Overtopping ? (M, F, N)	1-Good 2-Rehab 3- Replace	Retain or Replace With "" See Comments	Crossing Information	
A-1	843+91	48	Circular	23.57	20	0.24	3.67						50-year	42	3.3	1.1	799.35	2.62	N	N				Unless noted otherwise, the upstream structure lowest top/grate/inlet is used as the local EOP elevation
A-2	844+20	42	Circular	18.77	14	0.28	4.09						50-year	42	4.4	1.1	800.91	2.30	N	N				Rim elevation used as EOP
A-3	849+22	30	Circular	22.47	15	0.48	4.06						50-year	88	22.3	2.8	806.43	0.00	Y	Y	2	Replace with 54"	Multiple pipe replacement	EOP assumed from 5-foot contours
A-4	849+99	30	Circular	22.47	15	0.48	4.06						50-year	88	14.3	4.3	813.92	0.00	Y	F	2	Replace with 54"		
A-5	850+82	30	Circular	22.47	15	0.48	4.06						50-year	88	11.9	3.7	812.38	0.00	Y	F	2	Replace with 54"		
A-6	851+76	30	Circular	22.47	15	0.48	4.06						50-year	88	7.0	1.4	813.08	0.00	Y	M	2	Replace with 54"		EOP assumed from 5-foot contours
A-7	864+78	18	Circular	2.60	5	0.58	5.05						10-year	10	12.0	1.5	805.25	4.09	N	N	3	Replace with 30"		Broken pipe. Joint failures
A-8	864+90	18	Circular	2.60	5	0.58	5.05						10-year	10	12.2	1.5	800.48	1.75	N	N	3	Replace with 30"		Joint failures.
A-9	869+23	72	Circular	70.30	18	0.37	3.77						50-year	195	6.9	1.5	779.79	12.94	N	N	1	Retain		
A-10	869+34	72	Circular	70.30	18	0.37	3.77						50-year	195	6.9	1.3	778.55	16.93	N	N		Retain		
A-11	869+46	72	Circular	70.30	18	0.37	3.77						50-year	195	10.3	1.1	777.22	11.47	N	N		Retain		Armor outfall
A-12	887+88	24	Circular	1.23	5	0.58	5.05						50-year	23	15.4	1.4	775.75	0.00	N	F	3	Replace with 42"	Multiple pipe replacement	Pipe dislocation and joint failure
A-13	887+68	24	Circular	1.07	5	0.58	5.05						50-year	23	14.1	1.7	783.58	0.00	Y	M	3	Replace with 42"		Pipe dislocation and joint failure
A-14	887+42	24	Circular	1.52	5	0.58	5.05						50-year	23	13.2	2.6	785.42	0.00	Y	M	3	Replace with 42"		Pipe dislocation and joint failure
A-15	891+36	18	Circular	0.49	11	0.58	4.42						50-year	10	12.0	1.5	760.79	1.47	N	N		Retain		Armor outfall
A-16	891+16	18	Circular	1.74	11	0.46	4.42						50-year	10	4.5	1.7	762.52	0.29	N	N		Retain		Extend last segment. See note 4.
A-17	894+48	48	Circular	18.42	5	0.39	5.37						50-year	241	16.0	3.0	742.93	0.09	N	M		Replace w/6x6 RCBC	Multiple pipe replacement	
A-18	888+67		Circular	22.62	16	0.39	3.97																	Not modeled. Flow is assumed to reach pipe 34.
A-19	895+28	48	Circular	18.42	5	0.80	2.65						50-year	241	21.9	3.5	742.32	0.00	Y	M		Replace w/6x6 RCBC	Multiple pipe replacement	
A-20	900+20	48	Circular	58.33	11	0.77	4.38						50-year	399	17.7	3.5	724.54	0.00	Y	M, F	2	Replace w/2-6x6 RCBC		Extend first segment.
A-21	900+96	60	Circular	73.26	11	0.74	4.38						50-year	399	21.4	2.9	722.29	0.00	Y	M, F	2	Replace w/2-6x6 RCBC		
A-22	901+93	60	Circular	58.33	11	0.77	4.38						50-year	399	24.0	3.3	721.26	0.00	Y	M	2	Replace w/2-6x6 RCBC		
A-23	903+75	18	Circular	3.52	16	0.47	3.91						50-year	13	10.8	2.1	725.20	0.88	N	N		Retain		Armor outfall. See note 4.
A-24	902+47	18	Circular	14.00	16	0.55	3.91						50-year	73	19.8	4.0	722.14	0.00	Y	M	3	Replace with 48"		Extend last segment.
A-25	917+00	18	Circular	0.89	5	0.90	5.05						10-year	5	8.8	0.9	706.34	4.94	N	N		Retain		
A-26	921+72	18	Circular	0.52	5	0.90	5.05						10-year	3	9.2	0.6	689.26	4.77	N	N		Retain		
A-27	927+49	18	Circular	0.51	5	0.90	5.05						10-year	3	9.8	0.6	685.71	2.90	N	N				
A-28	932+30	18	Circular	1.71	5	0.57	5.05						50-year	18	8.4	2.9	695.32		Y	M	2	Replace with 30"	Multiple pipe replacement	Pipe end not located
A-29	932+30	18	Circular	0.38	5	0.90	5.05						50-year	18	10.3	3.4	695.39	0.70	N	N	2	Replace with 30"		
A-30	933+99	18	Circular	0.46	5	0.90	5.05						50-year	4	2.4	0.7	701.78	1.05	N	N	1	Retain		
A-31	939+64	18	Circular	1.62	5	0.90	5.05						10-year	10	9.4	1.5	708.45	2.16	N	N	3	Retain		Replace due to condition: joint failures. Extend last segment.
A-32	940+88	36	Circular	3.78	9	0.58	4.62						50-year	53	8.9	1.4	698.00	9.08	N	N	1	Retain		
A-33	948+95	30	Circular	9.59	20	0.29	3.66						50-year	33	18.1	1.4	739.19	0.00	N	N	1	Retain		
A-34	952+07	18	Circular	1.37	5	0.90	5.05						10-year	8	9.8	1.2	752.52	3.00	N	N		Retain		
A-35	962+44	18	Circular	2.23	5	0.58	5.05						50-year	26	9.3	2.9	811.18	0.00	Y	M	2	Replace with 30"	Multiple pipe replacement	
A-36	961+90	18	Circular	0.82	5	0.90	5.05						50-year	26	7.5	2.3	809.52	0.00	Y	M	2	Replace with 30"		
A-37	961+35	18	Circular	0.76	5	0.58	5.05						50-year	26	17.6	2.6	809.84	0.00	Y	M	2	Replace with 30"		
A-38	974+19	18	Circular	0.92	5	0.47	5.05						50-year	8	14.4	1.2	812.85	4.83	N	N	1	Retain		
A-39	974+25	18	Circular	0.63	5	0.58	5.05						50-year	8	12.2	1.2	801.98	3.49	N	N	1	Retain		Replace to reduce outfall velocity or armor outfall
A-40	977+85	18	Circular	0.46	5	0.90																		

I-85 Widening and Rehabilitation Drainage Structures

Site No.	Station	Size Verified	Shape	Drainage Area (ac.)	Rational			SCS		USGS			Design Storm	EXISTING CONDITIONS (w/ Proposed Widening)							CONDITION	RECOMMENDATIONS	Crossing Information	Comments
				Areas are discretized to single pipes in some cases	T _c	c	i	T _c	CN	Urban	% Imp	Rural		Q	Outlet Velocity	HW/D	HW Elevation	*Elev. Dif. From EOP to WSEL	Upstream Adverse Impacts? (Y or N)	*Overtopping ? (M, F, N)	1-Good 2-Rehab 3- Replace	Retain or Replace With "" See Comments		Unless noted otherwise, the upstream structure lowest top/grate/inlet is used as the local EOP elevation
A-74	1089+59	18	Circular	8.15	16	0.50	3.98						50-year	53	9.1	2.7	848.06	0.00	Y	M	3	Replace with 42"	replacement	Extend first segment.
A-75	1105+50	18	Circular	0.99	6	0.90	4.96						50-year	15	14.6	2.6	873.34	0.00	N	N	2	Replace with 24"		
A-76	1106+00	18	Circular	0.68	5	0.58	5.05						50-year	15	15.3	2.5	877.92	0.00	N	N	2	Retain		Armor outfall. See note 4.
A-77	1106+40	18	Circular	2.38	17	0.22	3.91						50-year	15	14.6	2.1	882.08	0.00	N	F	2	Retain		Extend first segment. Armor outfall. See note 4.
A-78	1113+71	24	Circular	9.72	21	0.25	3.57						50-year	40	15.7	3.9	882.94	0.00	Y	N	2	Replace with 36"	Multiple pipe replacement	
A-79	1113+15	24	Circular	2.55	17	0.58	3.89						50-year	40	13.3	3.9	879.62	0.00	Y	N	2	Replace with 36"		
A-80	1112+63	24	Circular	1.80	20	0.90	3.66						50-year	40	13.3	4.0	877.00	7.70	N	N	2	Replace with 36"	Multiple pipe replacement	Extend last segment.
A-81	1126+20	18	Circular	5.04	18	0.41	3.81						50-year	28	10.2	3.8	900.10	0.00	Y	M	2	Replace with 30"		Extend first segment.
A-82	1126+20	18	Circular	1.88	20	0.90	3.68						50-year	28	11.6	4.0	898.82	0.00	y	M	2	Replace with 30"	Multiple pipe replacement	Extend last segment.
A-83	1158+05	30	Circular	2.71	9	0.90	4.58						50-year	81	10.2	2.2	885.41	0.00	Y	M	1	Replace with 54"		
A-84	1158+34	30	Circular	2.54	10	0.58	4.48						50-year	81	11.9	1.8	883.31	0.00	Y	M	1	Replace with 54"	Multiple pipe replacement	
A-85	1142+00	18	Circular	1.43	9	0.58	4.63																	
A-86	1157+27	24	Circular	12.77	13	0.35	4.24						50-year	81	10.0	2.9	888.34	0.00	Y	F		Replace with 54"		Not modeled. Frontage road pipe.
A-87	1157+71	30	Circular	1.27	9	0.58	4.62						50-year	81	9.5	2.0	886.29	0.00	Y	M	1	Replace with 54"		Extend first segment.
A-88	1166+81	24	Circular	1.58	8	0.58	4.64						50-year	90	10.3	2.7	867.48	0.00	Y	F	1	Replace with 54"	Multiple pipe replacement	
A-89	1166+86	24	Circular	1.25	9	0.90	4.58						50-year	90	12.8	4.1	872.16	0.00	Y	M	1	Replace with 54"		
A-90	1166+86	24	Circular	1.57	9	0.58	4.58						50-year	90	15.0	2.1	871.36	0.00	Y	M	1	Replace with 54"		
A-91	1166+86	24	Circular	14.01	15	0.56	4.00						50-year	90	10.5	1.6	871.22	0.00	N	M	1	Replace with 54"		Extend first segment.
A-92	1172+16	36	Circular	2.37	18	0.58	3.81						50-year	154	21.9	4.2	865.45	0.00	Y	F	3	Replace with 60"	Multiple pipe replacement	
A-93	1172+21	36	Circular	2.42	18	0.90	3.83						50-year	154	21.0	3.6	867.96	0.00	Y	M	3	Replace with 60"		
A-94	1172+27	36	Circular	1.84	16	0.58	3.91						50-year	154	13.4	2.8	868.70	0.00	Y	M	3	Replace with 60"		
A-95	1172+32	36	Circular	25.49	15	0.58	4.03						50-year	154	9.2	2.3	868.32	0.00	Y	M	3	Replace with 60"		
A-96	1185+29	18	Circular	0.18	5	0.58	5.05						50-year	8	11.7	1.2	892.23	0.76	N	N		Retain		Armor outfall. See note 4.
A-97	1185+13	18	Circular	0.13	5	0.90	5.05						50-year	8	4.7	1.2	893.20	2.20	N	N		Retain		
A-98	1185+04	18	Circular	1.37	14	0.50	4.10						50-year	8	4.7	1.2	894.47	1.82	N	N		Retain		
A-99	1082+73	72	Circular	2.15	7	0.56	4.77						50-year	317	15.5	1.4	813.23	2.77	N	N		Retain		Armor outfall
A-100	1105+00	18	Circular	1.15	17	0.41	3.84						50-year	19	10.6	2.9	867.20	0.00	Y	F	2	Replace with 30"		
A-101	1112+00	24	Circular	3.21	6	0.41	4.87						50-year	53	8.6	1.6	869.44	0.56	N	F	2	Replace with 36"		

- Notes:
- * Elevation at edge of pavement estimated based upon contour elevation.
 - * Overtopping: M-Mainline, F-Frontage Rd., N-No Overtopping
 - * Overtopping analysis based on results from HY8, further dynamic modeling and analysis may be needed to determine high-water level.
 - * Overtopping determined with the 50 year storm for pipes using 10 year design storm and the 100 year storm for pipes using the 50 year design storm.
 - * Analysis assumes that all runoff from each corresponding drainage area enters into pipes (i.e. sump condition) and that no bypass can occur.

I-85 Widening and Rehabilitation Drainage Structures

Site No.	Station	Size Verified	Shape	Drainage Area (ac.)	Rational			SCS		USGS			Design Storm	EXISTING CONDITIONS (w/ Proposed Widening)								RECOMMENDATIONS	Comments
					T _c	c	i	T _c	CN	Urban	% Imp	Rural		Q	Outlet Velocity	HW/D	HW Elevation	*Elev. Dif. From EOP to WSEL	Upstream Adverse Impacts? (Y or N)	*Overtopping ? (M, F, N)	1-Good 2-Rehab 3- Replace		
B-1	1184+75	18"	Circular	0.66	5	0.70	6.77	-	-	-	-	-	10	3.1	7.94	0.62	893.59	4.41	No	N	2	Retain	Clean pipe and drop inlet. Replacing pipe with a larger diameter at existing invert elevations would not make a significant improvement in the velocity and headwater elevation. High outlet velocity. Outlet stabilization may be required.
B-2	1191+75	18"	Circular	8.02	49	0.41	3.78	-	-	-	-	-	50	15.0	11.28	2.13	893.45	1.42	No	N	1	Retain	Pipe functions but does not meet minimum headwater freeboard or HW/D criteria. Replacing pipe with a larger diameter at existing invert elevations would not make a significant improvement in the velocity and headwater elevation. Pipe will need to be extended
B-3	1196+75	24"	Circular	18.91	38	0.36	4.40	-	-	-	-	-	50	36.0	14.26	2.65	892.07	4.91	Yes	F	2	Replace with 36" Pipe	Backwater would overtop adjacent roadway. High outlet velocity. Outlet stabilization may be required.
B-4	1209+25	18"	Circular	0.73	5	0.70	6.77	-	-	-	-	-	10	3.5	8.29	0.66	935.12	2.88	No	N	3	Replace with 18" Pipe	Pipe functions but does not meet velocity criteria or minimum headwater freeboard. Pipe has 3" dislocation and should be replaced. High outlet velocity. Outlet stabilization may be required.
B-5	1213+25	18"	Circular	0.55	5	0.70	8.70	-	-	-	-	-	50	4.0	7.99	0.75	936.04	1.96	No	N	3	Replace with 18" Pipe	The pipe end could not be located. Pipe should be replaced or invert excavated and re-evaluated
B-6	1219+65	18"	Circular	1.96	5	0.75	6.77	-	-	-	-	-	10	10.0	13.52	1.33	915.57	5.43	No	N	2	Retain	Seal crack at broken bell. Pipe functions but does not meet velocity criteria or HW/D criteria. Replacing pipe with a larger diameter at existing invert elevations would not make a significant improvement in the velocity and headwater elevation. High outlet velocity. Outlet stabilization may be required.
B-7	1229+55	18"	Circular	1.38	5	0.90	6.77	-	-	-	-	-	10	8.4	10.55	1.14	870.90	6.29	No	N	N/A	Retain	Pipe functions but does not meet velocity criteria. Replacing pipe with a larger diameter at existing invert elevations would not make a significant improvement in the velocity. High outlet velocity. Outlet stabilization may be required. Pipe will need to be extended
B-8	1235+50	18"	Circular	2.35	6	0.78	6.60	-	-	-	-	-	10	12.1	13.33	1.63	861.80	5.22	No	N	2	Retain	Pipe functions but does not meet velocity criteria or HW/D criteria.Replacing pipe with a larger diameter at existing invert elevations would not make a significant improvement in the velocity and headwater elevation. High outlet velocity. Outlet stabilization may be required. Pipe will need to be extended
B-9	1240+45	15"	Circular	1.09	5	0.90	6.77	-	-	-	-	-	10	6.6	7.85	1.39	866.50	4.91	No	N	N/A	Replace with 18" Pipe	The current pipe is a 15" pipe. High outlet velocity. Outlet stabilization may be required.
B-10	1244+90	30"	Circular	16.07	28	0.28	5.22	-	-	-	-	-	50	28.2	16.05	1.09	862.45	9.58	No	N	2	Retain	Clean debris from pipe. Pipe functions but does not meet velocity criteria or minimum headwater freeboard. Increasing the pipe diameter would not make a significant improvement in the pipe velocity or headwater elevation. High outlet velocity. Outlet stabilization may be required. Pipe will need to be extended
B-11	1255+00	18"	Circular	2.58	5	0.73	8.70	-	-	-	-	-	50	19.6	13.74	2.65	861.31	0.00	Yes	N	3	Replace with 30" RCP	High outlet velocity. Outlet stabilization may be required.
B-12	1264+25	18"	Circular	2.01	5	0.90	6.77	-	-	-	-	-	10	12.2	12.56	1.90	836.62	3.58	No	N	1	Retain	Pipe functions but does not meet velocity criteria or HW/D criteria. Replacing pipe with a larger diameter at existing invert elevations would not make a significant improvement in the velocity and headwater elevation. High outlet velocity. Outlet stabilization may be required.
B-13	1276+10	18"	Circular	3.24	46	0.50	3.95	-	-	-	-	-	50	7.6	11.09	1.15	834.87	1.13	No	N	2	Retain	Clean Debris from pipe. Increasing the pipe diameter will not have a significant impact on the elevation difference from EOP to WSEL. Pipe will need to be extended. Road subgrade may be less than 1' above high-water level.
B-14	1281+00	24"	Circular	1.60	10	0.71	7.66	-	-	-	-	-	50	10.5	14.68	0.85	824.43	1.57	No	N	2	Retain	Clean sediment from pipe. Pipe functions but does not meet velocity criteria or minimum headwater freeboard. Increasing the pipe diameter will not have a significant impact on the velocity. Pipe under frontage road will need to be increased to minimum 18". High outlet velocity. Outlet stabilization may be required. Road subgrade may be less than 1' above high-water level. Pipe will need to be extended
B-15	1286+70	18"	Circular	1.99	5	0.72	8.70	-	-	-	-	-	50	14.9	15.61	2.52	813.55	0.45	No	N	1	Replace with 24" Pipe	High outlet velocity. Outlet stabilization may be required. Road subgrade may be less than 1' above high-water level.
B-16	1300+00	18"	Circular	4.87	5	0.69	8.70	-	-	-	-	-	50	35.3	19.22	4.91	787.55	0.00	Yes	M & F	1	Replace with 36" Pipe	High outlet velocity. Outlet stabilization may be required.
B-17	1317+20	24"	Circular	4.89	23	0.67	5.72	-	-	-	-	-	50	22.5	8.54	1.68	732.65	9.35	No	N	3	Replace with 30" Pipe	Pipe has rebar penetrating the pipe. The pipe should be replaced.
B-18	1330+50	18"	Circular	3.16	17	0.61	6.44	-	-	-	-	-	50	14.9	15.75	2.52	724.22	5.17	No	N	1	Retain	Pipe functions but does not meet velocity criteria or HW/D criteria. Increasing the pipe diameter will not have a significant impact on velocity. Since HW/D will not cause adverse impact upstream, pipe should be retained. High outlet velocity. Outlet stabilization may be required.
B-19	1351+60	24"	Circular	5.85	28	0.55	5.23	-	-	-	-	-	50	20.3	12.31	1.49	722.67	6.64	No	N	1	Retain	Pipe functions but does not meet velocity criteria or HW/D criteria. Since HW/D will not cause adverse impact upstream and velocity is close to 12 fps, pipe should be retained. High outlet velocity. Outlet stabilization may be required.
B-20	1362+80	18"	Circular	4.67	16	0.43	6.62	-	-	-	-	-	50	15.8	18.97	2.68	765.31	2.28	Yes	F	3	Replace with 24" Pipe	Pipe is causing adverse upstream impacts. Diameter should be increased on frontage to 24". High outlet velocity. Outlet stabilization may be required.
B-21	1367+00	18"	Circular	1.17	6	0.62	8.46	-	-	-	-	-	50	7.3	9.97	1.11	776.24	5.11	No	N	3	Replace with 18" Pipe	The pipe has a severe dislocation and should be replaced
B-22	1368+50	24"	Circular	0.74	6	0.34	8.44	-	-	-	-	-	50	2.6	9.68	0.37	782.51	5.03	No	N	1	Retain	Pipe will need to be extended
B-23	1371+00	18"	Circular	4.95	32	0.58	4.87	-	-	-	-	-	50	16.8	13.61	1.95	796.41	0.00	No	N	1	Replace with 30" Pipe	The current pipe is overtopping the roadway. Increase the pipe diameter. High outlet velocity. Outlet stabilization may be required. Road subgrade may be less than 1' above high-water level.
B-24	1390+00	4'x6'	BOX	12.29	13	0.54	7.07	-	-	-	-	-	50	55.8	14.17	0.52	802.09	8.87	No	N	1	Retain	Pipe functions but does not meet velocity criteria. High outlet velocity. Outlet stabilization may be required.
B-25	1404+90	18"	Circular	4.45	7	0.46	8.30	-	-	-	-	-	50	20.6	15.49	2.44	799.53	0.00	No	N	3	Replace with 30"	Pipe is undersized. Increase the pipe diameter. High outlet velocity. Outlet stabilization may be required.
B-26	1420+00	8'x8'	BOX	915.00	n/a	n/a	n/a	-	-	No	5%	Yes	50	512.9	17.18	0.99	716.75	18.63	No	N	1	Retain	Pipe functions but does not meet velocity criteria. High outlet velocity. Outlet stabilization may be required. Box will need to be extended
B-27	1419+50	18"	Circular	9.68	5	0.65	6.70	-	-	-	-	-	10	42.0	15.26	5.17	749.92	2.76	No	M	N/A	Replace with 36" Pipe	Pipe is overtopping. Increase the pipe diameter. High outlet velocity. Outlet stabilization may be required.

I-85 Widening and Rehabilitation Drainage Structures

Site No.	Station	Size Verified	Shape	Drainage Area (ac.)	Rational			SCS		USGS			Design Storm	EXISTING CONDITIONS (w/ Proposed Widening)								RECOMMENDATIONS	Comments
					T _c	c	i	T _c	CN	Urban	% Imp	Rural		Q	Outlet Velocity	HW/D	HW Elevation	*Elev. Dif. From EOP to WSEL	Upstream Adverse Impacts? (Y or N)	*Overtopping ? (M, F, N)	1-Good 2-Rehab 3- Replace	Retain Replace With "" See Comments	
B-28	1431+00	24"	Circular	4.18	5	0.62	8.70	-	-	-	-	-	50	27.0	16.11	2.11	788.27	3.49	No	N	1	Retain	Pipe functions but does not meet velocity criteria or HW/D criteria. Replacing pipe with a larger diameter at existing invert elevations would not make a significant improvement in the velocity and headwater elevation High outlet velocity. Outlet stabilization may be required.
B-29	1438+50	18"	Circular	4.00	5	0.72	8.70	-	-	-	-	-	50	29.9	15.88	2.50	818.63	1.10	Yes	F	3	Replace with 36" Pipe	Backwater could cause flooding of the adjacent frontage road. High outlet velocity. Outlet stabilization may be required.
B-30	1458+60	24"	Circular	7.25	11	0.34	7.35	-	-	-	-	-	50	21.8	14.34	1.24	834.06	0.00	No	F	2	Replace with twin 24" Pipes	Pipe is overtopping. Due to pipe cover, we recommend replacing with 2 24" pipes. High outlet velocity. Outlet stabilization may be required. Road elevation needs to be raised, road subgrade may be less than 1' above high-water level.
B-31	1464+10	4'x6'	BOX	47.57	33	0.27	4.80	-	-	-	-	-	50	72.8	17.85	0.80	818.88	6.12	No	N	1	Retain	Pipe functions but does not meet velocity criteria. High outlet velocity. Outlet stabilization may be required.
B-32	1469+00	24"	Circular	2.66	5	0.60	8.70	-	-	-	-	-	50	16.8	14.01	1.12	828.48	2.02	No	N	2	Retain	Pipe functions but does not meet velocity criteria or minimum headwater freeboard. Increasing the diameter will not cause a significant impact in the headwater elevation or the velocity. High outlet velocity. Outlet stabilization may be required. Road subgrade may be less than 1' above high-water level.
B-33	1481+25	24"	Circular	6.67	22	0.51	5.85	-	-	-	-	-	50	23.8	14.82	1.57	812.54	0.00	Yes	N	N/A	Replace with 30" Pipe	Pipe is undersized. Increase the pipe diameter. High outlet velocity. Outlet stabilization may be required. Road subgrade may be less than 1' above high-water level.

- Notes:
- * Elevation at edge of pavement estimated based upon contour elevation.
 - * Overtopping: M-Mainline, F-Frontage Rd., N-No Overtopping
 - * Overtopping analysis based on results from HY8, further dynamic modeling and analysis may be needed to determine high-water level.
 - * Overtopping determined with the 50 year storm for pipes using 10 year design storm and the 100 year storm for pipes using the 50 year design storm.
 - * Analysis assumes that all runoff from each corresponding drainage area enters into pipes (i.e. sump condition) and that no bypass can occur.

I-85 Widening and Rehabilitation Drainage Structures

Site No.	Station	Size Verified	Shape	Drainage Area (ac.)	Rational			SCS		USGS			Design Storm	EXISTING CONDITIONS (w/ Proposed Widening)							CONDITION	RECOMMENDATIONS		Comments
					T _c	c	i	T _c	CN	Urban	% Imp	Rural		Q	Outlet Velocity	HW/D	HW Elevation	*Elev. Dif. From EOP to WSEL	Upstream Adverse Impacts? (Y or N)	*Overtopping ? (M, F, N)	1-Good 2-Rehab 3- Replace	Retain With "" Comments	Replace See	
C-1	1489+25	5'x5'	BOX	197.90				28.0	69				50 YR	614	17.01	2.9	780.73	0.0	Y	M & F	1	Replace With 3-5'x5' Box Culverts		Drainage area includes small area across the NB side of I-85, area included for analysis of site at 1489+25. High outlet velocity, outlet stabilization may be required. Sewer line attached to inner wall of culvert, will affect hydraulic capacity of culvert.
C-2	1495	18"	CIRCULAR	1.14	5.0	0.69	8.70						50 YR	8.17	5.88	1.2	797.73	2.8	N	N	3	Replace With 18" RCP		Recommend replacement with 18" RCP based on pipe video report.
C-3	1499	24"	CIRCULAR	9.10	14.5	0.51	6.80						50 YR	38.06	13.50	2.8	812.07	0.0	N	F	1	Replace With 30" RCP		High outlet velocity, outlet stabilization may be required.
C-4	1512	18"	CIRCULAR	6.85	15.7	0.68	6.61						50 YR	36.77	14.76	3.9	816.65	0.0	Y	F	2	Replace With 36" RCP		High outlet velocity, outlet stabilization may be required.
C-5	1518	18"	CIRCULAR	1.70	24.5	0.72	5.53						50 YR	8.16	16.98	1.2	807.70	2.3	N	N	2	Retain		High outlet velocity, outlet stabilization may be required.
C-6	1521	18"	CIRCULAR	6.99	21.2	0.49	5.90						50 YR	24.09	12.03	2.7	810.09	0.0	N	M	2	Replace With 30" RCP		Assuming DI 8388 does not connect to median drainage as indicated in the survey. Old plans (11.645) show a 48' length of 18" RCP pipe crossing under the ramp from DI 8388 but ending in a DI next to the SB interstate lane. Assuming this has been paved over. Inlet surcharge exceeds DI 8352 rim elevation. High outlet velocity, outlet stabilization may be required.
C-7	1525+50	15"	CIRCULAR	0.29	5.0	0.90	6.77						10 YR	1.77	7.78	0.6	807.90	2.1	N	N	2	Replace With 18" RCP		SCDOT recommends 15" pipes be replaced with a minimum of 18" RCP. High outlet velocity, outlet stabilization may be required.
C-8	1545+70	24"	CIRCULAR	17.53	28.3	0.61	5.16						50 YR	66.23	10.82	1.8	789.27	0.0	Y	F	N/A	Replace With 42" RCP		Analyzed drainage area assuming DI 10450 connects to 10445 through a paved over manhole. Pipe size assumed to be 24" under entire mainline. Used CB 19821 as inlet in HY8 analysis. Assumed DI 8388 is not connected to the system as shown in the survey. Road subgrade may be less than 1' above high-water level. High outlet velocity, outlet stabilization may be required.
C-8A	1528+50	15"	CIRCULAR	1.42	14.8	0.38	5.34						10 YR	2.84	8.70	0.8	810.32	2.7	N	N	N/A	Replace With 18" RCP		SCDOT recommends 15" pipes be replaced with a minimum of 18" RCP. High outlet velocity, outlet stabilization may be required.
C-9	1551	18"	CIRCULAR	8.83	11.5	0.51	7.31						50 YR	39.33	10.76	3.8	786.17	0.0	Y	N	N/A	Replace With 36" RCP		Survey incomplete. Used a combination of old plans and contour lines to estimate inlet location and elevation. Inlet surcharge exceeds DI 8419 rim elevation. Road subgrade may be less than 1' above high-water level.
C-10	1563	24"	CIRCULAR	4.51	16.6	0.50	6.48						50 YR	17.59	9.33	1.3	781.02	6.0	N	N	2	Retain		Recommend cleaning and installation of 22" RCP snap-liner based on pipe video report.
C-11	1577	18"	CIRCULAR	1.79	5.0	0.68	8.70						50 YR	12.74	10.46	2.0	782.85	2.1	N	N	N/A	Replace With 24" RCP		Assumed constant slope between DI 8441 and DI 8439 for tailwater analysis, since survey could not provide complete data on CB 8440 which lies in between. 100 yr storm overtops existing frontage road.
C-12	1581	24"	CIRCULAR	6.18	15.8	0.42	6.61						50 YR	20.40	14.71	1.5	776.96	4.0	N	N	1	Retain		Assumed offsite drainage is included with median drainage, contours show what looks like a culvert under the frontage road that wasn't picked up in the survey. High outlet velocity, outlet stabilization may be required.
C-13	1587+50	24"	CIRCULAR	8.56	32.6	0.31	4.81						50 YR	15.44	7.40	1.2	771.36	3.6	N	N	1	Retain		Analyzed as 24" pipe under mainline.
C-14	1597+50	18"	CIRCULAR	3.79	19.2	0.63	6.14						50 YR	17.53	11.49	3.2	756.99	0.0	N	N	2	Replace With 30" RCP		Survey indicates 18" RCP, pipe video notes show 24" RCP. Analyzed as 18" RCP, recommend to retain if existing pipe is 24", if not replace with 30" RCP.
C-15	1603	18"	CIRCULAR	1.62	5.0	0.75	8.70						50 YR	12.71	9.97	2.0	740.25	1.8	N	N	1	Retain		
C-16	1614	18"	CIRCULAR	1.47	5.0	0.90	6.77						10 YR	8.96	11.06	1.3	720.74	3.3	N	N	1	Retain		High outlet velocity, outlet stabilization may be required.
C-17	1623	18"	CIRCULAR	2.73	14.4	0.65	6.82						50 YR	14.48	14.74	2.4	717.51	3.0	N	N	2	Replace With 24" RCP		High outlet velocity, outlet stabilization may be required.
C-18	1626	18"	CIRCULAR	0.92	5.0	0.78	8.70						50 YR	7.51	11.48	1.1	713.94	3.1	N	N	1	Retain		
C-19	1636+50	18"	CIRCULAR	9.40	17.1	0.45	6.42						50 YR	32.85	18.77	4.1	711.12	0.0	N	F	1	Replace With 36" RCP		Analyzed assuming drainage area includes drainage from southside of adjacent UPS facility. High outlet velocity, outlet stabilization may be required.
C-20	1644	18"	CIRCULAR	8.28	14.9	0.71	6.74						50 YR	47.42	15.26	4.0	705.21	0.0	N	F	1	Replace With 2-30" RCP		Analyzed assuming drainage area includes drainage from southside of adjacent UPS facility. High outlet velocity, outlet stabilization may be required.
C-21	1649	24"	CIRCULAR	5.15	5.0	0.71	8.69						50 YR	37.96	11.93	2.5	700.09	0.0	N	M & F	1	Replace With 2-36" RCP		Per video notes pipe turns into corrugated metal pipe at NB frontage Rd. Analyzed assuming drainage area includes drainage from southside of adjacent UPS facility. Road subgrade may be less than 1' above high-water level. High outlet velocity, outlet stabilization may be required.
C-22	1660	15"	CIRCULAR	1.26	5.2	0.90	6.74						10 YR	7.65	6.68	2.2	689.86	1.1	Y	N	1	Replace With 18" RCP		Outlet elevation higher than inlet elevation on survey, used slope of 0.3% to find outlet elevation for analysis. SCDOT recommends 15" pipes be replaced with a minimum of 18" RCP. Road subgrade may be less than 1' above high-water level, further dynamic modeling and analysis may be needed. High outlet velocity, outlet stabilization may be required.

I-85 Widening and Rehabilitation Drainage Structures

Site No.	Station	Size Verified	Shape	Drainage Area (ac.)	Rational			SCS		USGS			Design Storm	EXISTING CONDITIONS (w/ Proposed Widening)							CONDITION	RECOMMENDATIONS		Comments
					T _c	c	i	T _c	CN	Urban	% Imp	Rural		Q	Outlet Velocity	HW/D	HW Elevation	*Elev. Dif. From EOP to WSEL	Upstream Adverse Impacts? (Y or N)	*Overtopping ? (M, F, N)		1-Good 2-Rehab 3- Replace	Retain With "" Comments	Replace See
C-23	1658	24"	CIRCULAR	14.97	32.7	0.35	4.80						50 YR	30.01	14.61	2.5	685.97	5.0	N	N	2	Replace With 36" RCP		Unknown outfall location more data needed to properly analyze crossline. Survey incomplete. Used a combination of old plans and contour lines to estimate outlet location and elevation. Based on pipe video report recommend cleaning of sediment build-up and installation of snap-liner if retained. High outlet velocity, outlet stabilization may be required.
C-24	1669+50	18"	CIRCULAR	3.73	20.5	0.30	5.98						50 YR	8.16	10.14	1.2	684.67	3.3	N	N	N/A	Retain		
C-25	1670+50	18"	CIRCULAR	6.73	21.7	0.39	5.84						50 YR	18.34	10.70	3.5	682.56	1.4	N	N	1	Replace With 30" RCP		Survey indicates 18" RCP, pipe video notes show 15" RCP. Analyzed as 18" RCP.
C-26	1677	18"	CIRCULAR	5.10	27.0	0.32	5.29						50 YR	10.31	16.33	1.5	679.95	2.0	N	N	N/A	Retain		High outlet velocity, outlet stabilization may be required.
C-27	1678+50	36"	CIRCULAR	10.90	28.0	0.41	5.19						50 YR	28.01	16.01	0.8	651.89	21.1	N	N	2	Retain		Drop Inlet 8493 at the break station looks to have an incorrect elevation on survey. Break was disregarded and system was analyzed as straight culvert with constant slope from inlet to outlet. Recommend cleaning and installation of 32" RCP snap-liner based on pipe video report. High outlet velocity, outlet stabilization may be required.
C-28	1682	18"	CIRCULAR	0.52	15.9	0.35	6.59						50 YR	1.44	0.87	0.4	664.14	4.9	N	N	2	Retain		Existing Pipe 8488 Invert lies underneath proposed widening. Analyzed assuming pipe will be extended beyond EOP. Recommendation is for existing pipe to be retained and extended.
C-29	1691	18"	CIRCULAR	2.44	21.2	0.58	4.69						10 YR	6.69	9.07	1.0	643.01	6.0	N	N	N/A	Retain		High outlet velocity, outlet stabilization may be required.
C-30	1694	18"	CIRCULAR	0.33	5.0	0.90	6.77						10 YR	2.01	3.58	0.5	625.81	10.2	N	N	N/A	Retain		Outlet invert elevation is higher than break point invert elevation by .41'. Pipe still flows under inlet control and meets Hw/D requirement. Analyzed as shown on survey.
C-31	1699	18"	CIRCULAR	0.52	5.0	0.90	6.77						10 YR	3.17	12.29	0.6	622.99	3.0	N	N	N/A	Retain		High outlet velocity, outlet stabilization may be required.
C-32	1701	30"	CIRCULAR	3.31	5.0	0.90	6.77						10 YR	20.17	12.06	0.9	621.66	3.3	N	N	N/A	Retain		High outlet velocity, outlet stabilization may be required.
C-33	1720	24"	CIRCULAR	2.12	6.9	0.90	6.44						10 YR	12.29	10.39	1.0	693.26	3.7	N	N	N/A	Retain		High outlet velocity, outlet stabilization may be required.
C-34	1728	18"	CIRCULAR	6.25	12.9	0.41	7.06						50 YR	21.57	17.47	3.3	710.05	0.0	Y	F	3	Replace With 30" RCP		Assuming pipe from invert 19800 intercepts pipe from 19803 prior to crossing under mainline. Will analyze invert 19803 as entrance of first culvert with all drainage flows combined. Recommend replacement based on pipe video report. High outlet velocity, outlet stabilization may be required.
C-35	1730	18"	CIRCULAR	1.78	5.0	0.46	8.70						50 YR	8.45	11.75	0.9	707.35	4.1	N	N	1	Retain		Used the calculated slope between DI 8555 and DI 19799 to find the outlet elevation at which the cross line pipe intercepts the downstream pipe. Used this value in HY8 analysis. Survey indicates 18" RCP, Pipe video notes show 15" RCP, analyzed as 18". If existing pipe is 15" RCP, replace with 18" RCP. High outlet velocity, outlet stabilization may be required.
C-36	1734	15"	CIRCULAR	0.93	5.0	0.90	6.77						10 YR	5.67	10.25	2.2	712.83	2.2	N	N	N/A	Replace With 24" RCP		Survey indicates 15" RCP, pipe video notes show 24" RCP, analyzed as 15" RCP. If existing pipe is 15" RCP, replace with 24" RCP; if existing pipe is 24" RCP, recommendation is to retain. HW elevation exceeds rim elevation for DI 8552.
C-37	1750	18"	CIRCULAR	2.74	5.0	0.67	8.70						50 YR	19.10	16.51	3.8	710.66	0.3	N	N	1	Replace With 30" RCP		Median drop inlet 10505 invert elevation is shown incorrectly on survey file. DI 10505 disregarded in analysis, assumed constant slope. High outlet velocity, outlet stabilization may be required.
C-38	1758	18"	CIRCULAR	1.09	5.0	0.90	6.77						10 YR	6.64	13.34	1.0	683.84	5.2	N	N	N/A	Retain		High outlet velocity, outlet stabilization may be required.
C-39	1763	18"	CIRCULAR	3.04	5.0	0.43	8.70						50 YR	13.73	13.46	2.2	666.97	8.5	N	N	1	Retain		No survey data for outfall, based on contours, assuming outlet is on opposite side of NB frontage road. High outlet velocity, outlet stabilization may be required.
C-40	1773	18"	CIRCULAR	1.78	5.0	0.82	8.70						50 YR	15.22	13.40	2.6	645.32	2.2	N	N	N/A	Replace With 24" RCP		High outlet velocity, outlet stabilization may be required.
C-41	1786+50	18"	CIRCULAR	1.87	5.0	0.90	6.77						10 YR	11.39	11.12	1.8	607.63	0.4	N	N	N/A	Replace With 24" RCP		No survey data for cross-line, found on old plans (11.347). Used contours to estimate invert elevations. High outlet velocity, outlet stabilization may be required.

Notes:
* Elevation at edge of pavement estimated based upon contour elevation.
* Overtopping: M-Mainline, F-Frontage Rd., N-No Overtopping
* Overtopping analysis based on results from HY8, further dynamic modeling and analysis may be needed to determine high-water level
* Overtopping determined with the 50 year storm for pipes using 10 year design storm and the 100 year storm for pipes using the 50 year design storm.
* Analysis assumes that all runoff from each corresponding drainage area enters into pipes (i.e. sump condition) and that no bypass can occur.

Runoff Factors Weighted Averages

Final Naming Convention	Pavements & Roofs	City Business Areas	Suburban Normal Residential	Cultivated Land	Woodland & Forest	Grass Shoulders	Water	Total Draingae Area	Composite C Values
	Runoff Factor Rolling 2% - 10%								
	0.90	0.85	0.50	0.55	0.15	0.25	0.60		
A-1	2.50				17.68	3.39		23.57	0.24
A-2	1.90				7.50	9.37		18.77	0.28
A-3	5.33		2.00	13.32	2.70	3.28		26.63	0.54
A-4	5.33		2.00	13.32	2.70	3.28		26.63	0.54
A-5	5.33		2.00	13.32	2.70	3.28		26.63	0.54
A-6	5.33		2.00	13.32	2.70	3.28		26.63	0.54
A-7	1.30					1.30		2.60	0.58
A-8	1.30					1.30		2.60	0.58
A-9	3.68	10.29		6.86	34.29	11.76	3.43	70.30	0.37
A-10	3.68	10.29		6.86	34.29	11.76	3.43	70.30	0.37
A-11	3.68	10.29		6.86	34.29	11.76	3.43	70.30	0.37
A-12	0.61					0.61		1.23	0.58
A-13	0.53					0.53		1.07	0.58
A-14	0.76					0.76		1.52	0.58
A-15	0.25					0.25		0.49	0.58
A-16	0.17			0.87		0.70		1.74	0.46
A-17	12.89			5.53				18.42	0.80
A-18	1.13		2.26	9.61	9.61			22.62	0.39
A-19	12.89			5.53				18.42	0.80
A-20	46.66					11.67		58.33	0.77
A-21	46.66					11.67		58.33	0.77
A-22	46.66					11.67		58.33	0.77
A-23	1.17					2.35		3.52	0.47
A-24	6.41					7.59		14.00	0.55
A-25	0.89							0.89	0.90
A-26	0.52							0.52	0.90
A-27	0.51							0.51	0.90
A-28	0.85					0.86		1.71	0.57
A-29	0.38							0.38	0.90

Table 2 (Section A): C-Value Spreadsheet

Runoff Factors Weighted Averages

Final Naming Convention	Pavements & Roofs	City Business Areas	Suburban Normal Residential	Cultivated Land	Woodland & Forest	Grass Shoulders	Water	Total Draingae Area	Composite C Values
	Runoff Factor Rolling 2% - 10%								
	0.90	0.85	0.50	0.55	0.15	0.25	0.60		
A-30	0.46							0.46	0.90
A-31	1.62							1.62	0.90
A-32	1.89					1.89		3.78	0.58
A-33	1.50				6.00	2.09		9.59	0.29
A-34	1.37							1.37	0.90
A-35	1.12					1.12		2.23	0.58
A-36	0.82							0.82	0.90
A-37	0.38					0.38		0.76	0.58
A-38	0.31					0.61		0.92	0.47
A-39	0.32					0.32		0.63	0.58
A-40	0.46							0.46	0.90
A-41	3.00		5.00		3.00	14.48		25.48	0.36
A-42	0.91							0.91	0.90
A-43	0.75		1.00			2.33		4.08	0.43
A-44	1.09							1.09	0.90
A-45	1.22					1.22		2.43	0.58
A-46	1.00					2.70		3.70	0.43
A-47	0.58							0.58	0.90
A-48	0.78					0.78		1.55	0.58
A-49	1.76							1.76	0.90
A-50	5.00	16.50			25.00	11.50		58.00	0.43
A-51	1.42					1.42		2.84	0.58
A-52	1.10							1.10	0.90
A-53	2.08					2.08		4.15	0.58
A-54	1.16							1.16	0.90
A-55	6.38					6.38		12.76	0.58
A-56	0.48					0.48		0.96	0.58
A-57	1.22					1.22		2.44	0.58
A-58	0.27					0.09		0.36	0.74

Table 2 (Section A): C-Value Spreadsheet

Runoff Factors Weighted Averages

Final Naming Convention	Pavements & Roofs	City Business Areas	Suburban Normal Residential	Cultivated Land	Woodland & Forest	Grass Shoulders	Water	Total Draingae Area	Composite C Values
	Runoff Factor Rolling 2% - 10%								
	0.90	0.85	0.50	0.55	0.15	0.25	0.60		
A-59									
A-60		3.28						3.28	0.85
A-61	0.83							0.83	0.90
A-62	0.64							0.64	0.90
A-63	0.68							0.68	0.90
A-64	0.30					0.30		0.60	0.58
A-65		3.72						3.72	0.85
A-66	2.85							2.85	0.90
A-67	1.23							1.23	0.90
A-68	1.86					1.86		3.72	0.58
A-69	3.70							3.70	0.90
A-70	1.66					4.98		6.64	0.41
A-71	5.00	5.00	9.65	20.13	54.42		1.69	95.89	0.35
A-72	1.11							1.11	0.90
A-73	2.16							2.16	0.90
A-74			8.15					8.15	0.50
A-75	0.99							0.99	0.90
A-76	0.34					0.34		0.68	0.58
A-77	0.20				1.98	0.20		2.38	0.22
A-78	1.10				7.52	1.10		9.72	0.25
A-79	1.28					1.28		2.55	0.58
A-80	1.80							1.80	0.90
A-81	1.26					3.78		5.04	0.41
A-82	1.88							1.88	0.90
A-83	2.71							2.71	0.90
A-84	1.27					1.27		2.54	0.58
A-85	0.72					0.72		1.43	0.58
A-86	2.00					10.77		12.77	0.35
A-87	0.64					0.64		1.27	0.58

Table 2 (Section A): C-Value Spreadsheet

Runoff Factors Weighted Averages

Final Naming Convention	Pavements & Roofs	City Business Areas	Suburban Normal Residential	Cultivated Land	Woodland & Forest	Grass Shoulders	Water	Total Draingae Area	Composite C Values
	Runoff Factor Rolling 2% - 10%								
	0.90	0.85	0.50	0.55	0.15	0.25	0.60		
A-88	0.79					0.79		1.58	0.58
A-89	1.25							1.25	0.90
A-90	0.79					0.79		1.57	0.58
A-91		0.25		13.76				14.01	0.56
A-92	1.19					1.19		2.37	0.58
A-93	2.42							2.42	0.90
A-94	0.92					0.92		1.84	0.58
A-95	2.00			23.49				25.49	0.58
A-96	0.09					0.09		0.18	0.58
A-97	0.13							0.13	0.90
A-98			1.37					1.37	0.50
A-99	1.08				0.25	0.83		2.15	0.56
A-100	0.29					0.86		1.15	0.41
A-101	0.80					2.41		3.21	0.41

Table 2 (Section A): C-Value Spreadsheet

Runoff Factors Weighted Averages																															
	Pavements & Roofs	Grass Shoulders	Unimproved Areas	Cultivated Land		Woodland & Forest			Unpaved Road, Same			Suburban, Normal F		Dense Residential S		Apartment Dwelling		Lawns Sandy Soils			Industrial Areas, Lig		Water	Grass to Pavement	Gravel Pavement	Meadows & Pasture		Total Draingae Area	Composite C Values		
				Clay & Loam	Sand & Gravel	Flat 0% 2%	Rolling 2% - 10%	Hilly Over 10%	Flat 0% 2%	Rolling 2% - 10%	Hilly Over 10%	Flat 0% 2%	Rolling 2% - 10%	Flat 0% 2%	Rolling 2% - 10%	Flat 0% 2%	Rolling 2% - 10%	Flat 0% 2%	Rolling 2% - 10%	Hilly Over 10%	Flat 0% 2%	Rolling 2% - 10%		Flat 0% 2%	Rolling 2% - 10%	Flat 0% 2%	Rolling 2% - 10%				
Runoff Factor	0.90	0.30	0.20	0.55	0.30	0.10	0.15	0.20	0.34	0.45	0.59	0.45	0.50	0.60	0.65	0.50	0.60	0.10	0.15	0.20	0.50	0.70	0.90	0.90	0.50	0.25	0.30				
Site 1 Areas	0.44	0.22																											0.66	0.70	
Site 2 Areas	2.18	0.94					2.65																				2.25	8.02	0.41		
Site 3 Areas	4.81	1.24	3.77				3.71													5.38									18.91	0.36	
Site 4 Areas	0.49	0.24																												0.73	0.70
Site 5 Areas	0.37	0.18																												0.55	0.70
Site 6 Areas	1.47	0.49																												1.96	0.75
Site 7 Areas	1.38																													1.38	0.90
Site 8 Areas	1.88	0.47																												2.35	0.78
Site 9 Areas	1.09																													1.09	0.90
Site 10 Areas	1.23	1.16					5.25													1.74								6.69	16.07	0.28	
Site 11 Areas	1.84	0.74																												2.58	0.73
Site 12 Areas	2.01																													2.01	0.90
Site 13 Areas	1.33	0.56					1.04																					0.31	3.24	0.50	
Site 14 Areas	1.15	0.23																		0.22										1.60	0.71
Site 15 Areas	1.39	0.60																												1.99	0.72
Site 16 Areas	3.20	1.67																												4.87	0.69
Site 17 Areas	3.18	0.95	0.26																	0.50										4.89	0.67
Site 18 Areas	1.84	0.49																		0.83										3.16	0.61
Site 19 Areas	2.89	1.24					0.50													1.22										5.85	0.55
Site 20 Areas	1.39	0.49	0.10																	1.55								1.14	4.67	0.43	
Site 21 Areas	0.67	0.19	0.31																											1.17	0.62
Site 22 Areas	0.12	0.21	0.41																											0.74	0.34
Site 23 Areas	2.32	2.63																												4.95	0.58
Site 24 Areas	4.83	7.46																												12.29	0.54
Site 25 Areas	1.46	2.02																		0.97										4.45	0.46
Site 26 Areas																														0.00	#DIV/0!
Site 27 Areas	5.65	3.89																		0.14										9.68	0.65
Site 28 Areas	2.22	1.96																												4.18	0.62
Site 29 Areas	2.78	1.22																												4.00	0.72
Site 30 Areas	2.18	1.41																		0.61							3.05		7.25	0.34	
Site 31 Areas	5.53	2.27	20.35				15.29													4.13										47.57	0.27
Site 32 Areas	1.35	1.31																												2.66	0.60
Site 33 Areas	2.84	1.74					0.96													1.13										6.67	0.51

From: "SCDOT Requirements for Hydraulic Design Studies"; Table 4 page 54

Table 2 (Section B): C-Value Spreadsheet

Runoff Factors Weighted Averages

	Pavements & Roofs	Side Slopes Turf	Woodland & Forest			Unpaved Road, Sandy Soils			Suburban, Normal Residential		Dense Residential Section		Apartment Dwelling Area		Lawns Sandy Soils			Industrial Areas, Light		Water	Grass to Pavement	Gravel Pavement	Meadows & Pasture Land		Total Draingae Area	Composite C Values		
			Flat 2%	0% - Rolling 2% - 10%	Hilly Over 10%	Flat 2%	0% - Rolling 2% - 10%	Hilly Over 10%	Flat 2%	0% - Rolling 2% - 10%	Flat 2%	0% - Rolling 2% - 10%	Flat 2%	0% - Rolling 2% - 10%	Flat 2%	0% - Rolling 2% - 10%	Hilly Over 10%	Flat 2%	0% - Rolling 2% - 10%		Flat 2%	0% - Rolling 2% - 10%	Flat 2%	0% - Rolling 2% - 10%			Flat 2%	0% - Rolling 2% - 10%
Runoff Factor	0.90	0.30	0.10	0.15	0.20	0.34	0.45	0.59	0.45	0.50	0.60	0.65	0.50	0.60	0.10	0.15	0.20	0.50	0.70	0.90	0.90	0.50	0.25	0.30				
Site C1 Areas																										N/A	N/A	
Site C2 Areas	0.74	0.40																								1.14	0.69	
Site C3 Areas	1.39	1.20																	2.75					3.76		9.10	0.51	
Site C4 Areas	4.60	1.56													0.26								0.43			6.85	0.68	
Site C5 Areas	1.20	0.50																								1.70	0.72	
Site C6 Areas	2.18	4.81																								6.99	0.49	
Site C7 Areas	0.29																									0.29	0.90	
Site C8 Areas	5.43	1.24								10.86																17.53	0.61	
Site C8A Areas	0.18	1.24																								1.42	0.38	
Site C9 Areas	4.31	1.24	1.90												0.42								0.96			8.83	0.51	
Site C10 Areas	1.34	0.34								1.51						1.32										4.51	0.50	
Site C11 Areas	1.14	0.65																								1.79	0.68	
Site C12 Areas	1.82	0.89		2.48																				0.99		6.18	0.42	
Site C13 Areas	1.45	1.10		5.08																				0.93		8.56	0.31	
Site C14 Areas	2.33	0.67													0.79											3.79	0.63	
Site C15 Areas	1.22	0.40																								1.62	0.75	
Site C16 Areas	1.47																									1.47	0.90	
Site C17 Areas	1.68	0.75														0.23							0.07			2.73	0.65	
Site C18 Areas	0.74	0.18																								0.92	0.78	
Site C19 Areas	3.69	0.57		0.44												4.70										9.40	0.45	
Site C20 Areas	6.08	0.43														1.77										8.28	0.71	
Site C21 Areas	3.77	0.27														1.11										5.15	0.71	
Site C22 Areas	1.26																									1.26	0.90	
Site C23 Areas	3.79	0.81														10.37										14.97	0.35	
Site C24 Areas	0.35	1.38		1.28																				0.72		3.73	0.30	
Site C25 Areas	1.44	2.93	0.36	1.28																				0.72		6.73	0.39	
Site C26 Areas	0.44	1.74			1.69																			1.23		5.10	0.32	
Site C27 Areas	2.57	4.42		0.99	1.69																			1.23		10.90	0.41	
Site C28 Areas	0.08	0.29		0.15																						0.52	0.35	
Site C29 Areas	1.17	1.22		0.05																						2.44	0.58	
Site C30 Areas	0.33																									0.33	0.90	
Site C31 Areas	0.52																									0.52	0.90	
Site C32 Areas	3.31																									3.31	0.90	
Site C33 Areas	2.12																									2.12	0.90	
Site C34 Areas	2.46	0.53													1.72								1.54			6.25	0.41	
Site C35 Areas	0.46	1.32																								1.78	0.46	
Site C36 Areas	0.93																									0.93	0.90	
Site C37 Areas	1.68	1.06																								2.74	0.67	
Site C38 Areas	1.09																									1.09	0.90	
Site C39 Areas	1.03	0.58		1.43																						3.04	0.43	
Site C40 Areas	1.54	0.24																								1.78	0.82	
Site C41 Areas	1.87																									1.87	0.90	

From: "SCDOT Requirements for Hydraulic Design Studies"; Table 4 page 54

Table 2 (Section C): C-Value Spreadsheet

																JOB: I-85 Widening Cherokee Co MM80-96							
																SUBJECT: Time of Concentration Calculations							
																CALC'D BY: GPP/SCN/SKH		DATE: 24-Mar-15					
																CHEK'D BY: GPP/SCN		DATE:					
TIME OF CONCENTRATION																							
WS	Sheet					Shallow Concentrated					Open Channel										Time Of Conc.	Time Of Conc.	
Pipe ID	Slope	Length	n	P2	Time	Slope	Length	(P)aved	V	Time	Elevation		Length	Slope	n	SS Lt	SS Rt	BW	Depth	V	Time	Tc (min)	Tc (min)
	ft/ft	ft			hr	ft/ft	ft	p/u	ft/s	hr	From	To	ft	ft/ft		z:1	z:1	ft.	ft.	ft/s	hr		>= 5 min
A-1	0.050	100	0.40	3.8	0.23	0.062	564	u	4.02	0.039	810.0	800.0	1072	0.009	0.024	3.0	3.0	0.0	1.5	4.78	0.06	19.8	20
A-2	0.100	100	0.400	3.8	0.17	0.100	100	u	5.10	0.005	825.0	800.0	1206	0.021	0.030	3.0	3.0	0.0	1.5	5.70	0.06	14.3	14
A-3 - A-6	0.075	32	0.400	3.8	0.08	0.023	765	u	2.44	0.087	820.0	809.7	371	0.028	0.024	3.0	3.0	0.0	1.5	8.26	0.01	10.7	11
A-4	0.075	32	0.400	3.8	0.08	0.023	765	u	2.44	0.087	820.0	809.7	371	0.028	0.024	3.0	3.0	0.0	1.5	8.26	0.01	10.7	11
A-5	0.075	32	0.400	3.8	0.08	0.023	765	u	2.44	0.087	820.0	809.7	371	0.028	0.024	3.0	3.0	0.0	1.5	8.26	0.01	10.7	11
A-6	0.075	32	0.400	3.8	0.08	0.023	765	u	2.44	0.087	820.0	809.7	371	0.028	0.024	3.0	3.0	0.0	1.5	8.26	0.01	10.7	11
A-7 - A-8	0.025	38	0.060	3.8	0.03	0.022	342	u	2.39	0.040	826.0	820.0	300	0.020	0.024	3.0	3.0	0.0	1.5	7.00	0.01	4.9	5
A-8	0.025	38	0.060	3.8	0.03	0.022	342	u	2.39	0.040	826.0	820.0	300	0.020	0.024	3.0	3.0	0.0	1.5	7.00	0.01	4.9	5
A-9 - A-11	0.025	100	0.150	3.8	0.14	0.026	1178	u	2.58	0.127	801.0	790.0	814	0.013	0.024	3.0	3.0	0.0	1.5	5.74	0.04	18.2	18
A-10	0.025	100	0.150	3.8	0.14	0.026	1178	u	2.58	0.127	801.0	790.0	814	0.013	0.024	3.0	3.0	0.0	1.5	5.74	0.04	18.2	18
A-11	0.025	100	0.150	3.8	0.14	0.026	1178	u	2.58	0.127	801.0	790.0	814	0.013	0.024	3.0	3.0	0.0	1.5	5.74	0.04	18.2	18
A-12 - A-14																						5.0	5
A-13																						5.0	5
A-14																						5.0	5
A-15 - A-16																						5.0	5
A-16	0.050	100	0.240	3.8	0.15	0.025	200	u	2.55	0.022	772.0	760.8	131	0.085	0.030	3.0	3.0	0.0	1.5	11.57	0.00	10.6	11
A(17,19)	0.100	100	0.150	3.8	0.08	0.064	707	u	4.07	0.048	777.5	745.0	607	0.054	0.030	3.0	3.0	0.0	1.5	9.16	0.02	8.7	9
A-18	0.025	100	0.240	3.8	0.20	0.044	340	u	3.39	0.028	810.0	756.0	1052	0.051	0.030	3.0	3.0	0.0	1.5	8.97	0.03	15.7	16
A-19	0.100	100	0.150	3.8	0.08	0.064	707	u	4.07	0.048	777.5	745.0	607	0.054	0.030	3.0	3.0	0.0	1.5	9.16	0.02	8.7	9
A-20 - A-22	0.020	100	0.011	3.8	0.02	0.005	499	p	1.44	0.096	770.0	710.4	1775	0.034	0.030	3.0	3.0	0.0	1.5	7.25	0.07	11.0	11
A-21 - A-22	0.020	100	0.011	3.8	0.02	0.005	499	p	1.44	0.096	770.0	710.4	1775	0.034	0.030	3.0	3.0	0.0	1.5	7.25	0.07	11.0	11
A-22	0.020	100	0.011	3.8	0.02	0.005	499	p	1.44	0.096	770.0	710.4	1775	0.034	0.030	3.0	3.0	0.0	1.5	7.25	0.07	11.0	11
A-23	0.020	100	0.240	3.8	0.22	0.044	510	u	3.39	0.042	724.0	719.1	247	0.020	0.030	3.0	3.0	0.0	1.5	5.60	0.01	16.4	16
A-24	0.025	100	0.011	3.8	0.02	0.010	481	p	2.07	0.064	752.5	719.1	500	0.067	0.030	3.0	3.0	0.0	1.5	10.24	0.01	5.7	6
A-25	0.020	24	0.011	3.8	0.01	0.013	275	p	2.27	0.034	730.0	711.3	279	0.067	0.030	3.0	3.0	0.0	1.5	10.25	0.01	2.8	5
A-26	0.020	22	0.011	3.8	0.01	0.039	266	u	3.17	0.023	705.0	694.0	146	0.075	0.030	3.0	3.0	0.0	1.5	10.85	0.00	2.0	5
A-27	0.020	22	0.011	3.8	0.01	0.031	261	u	2.85	0.025	690.0	688.6	191	0.007	0.030	3.0	3.0	0.0	1.5	3.38	0.02	2.8	5
A-28 - A-29	0.020	38	0.011	3.8	0.01	0.025	200	u	2.55	0.022	710.5	695.0	631	0.025	0.024	3.0	3.0	0.0	1.5	7.75	0.02	3.2	5
A-29	0.020	22	0.011	3.8	0.01	0.032	276	u	2.90	0.026	700.0	696.1	213	0.018	0.030	3.0	3.0	0.0	1.5	5.36	0.01	2.6	5
A-30	0.020	22	0.011	3.8	0.01	0.015	210	u	1.98	0.030	707.5	702.8	233	0.020	0.030	3.0	3.0	0.0	1.5	5.60	0.01	2.8	5
A-31	0.020	22	0.011	3.8	0.01	0.020	200	u	2.27	0.024	745.0	710.6	1064	0.032	0.030	3.0	3.0	0.0	1.5	7.12	0.04	4.3	5

Table 3 (Section A): Time of Concentration Spreadsheet

																JOB: I-85 Widening Cherokee Co MM80-96							
																SUBJECT: Time of Concentration Calculations							
																CALC'D BY: GPP/SCN/SKH		DATE: 24-Mar-15					
																CHEK'D BY: GPP/SCN		DATE:					
TIME OF CONCENTRATION																							
WS	Sheet					Shallow Concentrated					Open Channel										Time Of Conc.	Time Of Conc.	
Pipe ID	Slope	Length	n	P2	Time	Slope	Length	(P)aved	V	Time	Elevation		Length	Slope	n	SS Lt	SS Rt	BW	Depth	V	Time	Tc (min)	Tc (min)
	ft/ft	ft			hr	ft/ft	ft	p/u	ft/s	hr	From	To	ft	ft/ft		z:1	z:1	ft.	ft.	ft/s	hr		>= 5 min
A-32	0.030	32	0.240	3.8	0.07	0.043	200	u	3.33	0.017	798.5	707.1	1709	0.053	0.030	3.0	3.0	0.0	1.5	9.16	0.05	8.6	9
A-33	0.025	100	0.400	3.8	0.30	0.121	249	u	5.60	0.012	782.5	736.0	664	0.070	0.030	3.0	3.0	0.0	1.5	10.48	0.02	19.9	20
A-34	0.020	41	0.011	3.8	0.01	0.059	192	u	3.92	0.014	800.0	755.5	812	0.055	0.030	3.0	3.0	0.0	1.5	9.26	0.02	2.8	5
A-35 - A-37	0.020	100	0.011	3.8	0.02	0.024	200	p	3.15	0.018	825.0	810.5	628	0.023	0.030	3.0	3.0	0.0	1.5	6.01	0.03	3.9	5
A-36	0.020	22	0.011	3.8	0.01	0.053	270	u	3.72	0.020	820.0	808.7	395	0.029	0.030	3.0	3.0	0.0	1.5	6.70	0.02	2.5	5
A-37	0.020	22	0.011	3.8	0.01	0.010	200	u	1.61	0.034	815.0	809.2	294	0.020	0.030	3.0	3.0	0.0	1.5	5.57	0.01	3.3	5
A-38 - A-39	0.035	100	0.011	3.8	0.01	0.080	154	u	4.56	0.009											0.00	1.5	5
A-39	0.020	22	0.011	3.8	0.01	0.032	236	u	2.88	0.023	820.0	805.5	269	0.054	0.030	3.0	3.0	0.0	1.5	9.20	0.01	2.2	5
A-40	0.020	22	0.011	3.8	0.01	0.015	200	u	1.96	0.028	813.0	809.9	206	0.015	0.030	3.0	3.0	0.0	1.5	4.83	0.01	2.7	5
A-41	0.020	100	0.240	3.8	0.22	0.030	864	u	2.79	0.086	820.0	786.9	433	0.076	0.030	3.0	3.0	0.0	1.5	10.95	0.01	19.0	19
A-42	0.020	22	0.011	3.8	0.01	0.023	200	u	2.46	0.023	832.5	815.9	631	0.026	0.030	3.0	3.0	0.0	1.5	6.43	0.03	3.3	5
A-43 - A-45	0.050	100	0.240	3.8	0.15	0.087	222	u	4.75	0.013											0.00	9.9	10
A-44	0.020	22	0.011	3.8	0.01	0.047	200	u	3.51	0.016	851.3	835.6	810	0.019	0.030	3.0	3.0	0.0	1.5	5.53	0.04	3.7	5
A-45	0.020	22	0.011	3.8	0.01	0.008	318	u	1.43	0.062	850.0	825.9	642	0.038	0.030	3.0	3.0	0.0	1.5	7.68	0.02	5.4	5
A-46 - A-48	0.050	100	0.150	3.8	0.10	0.033	324	u	2.93	0.031	849.0	837.7	229	0.049	0.030	3.0	3.0	0.0	1.5	8.79	0.01	8.5	9
A-47	0.020	22	0.011	3.8	0.01	0.015	200	u	2.00	0.028	851.0	845.0	325	0.019	0.030	3.0	3.0	0.0	1.5	5.40	0.02	3.0	5
A-48	0.045	68	0.240	3.8	0.12	0.033	135	u	2.94	0.013	840.0	833.3	301	0.022	0.030	3.0	3.0	0.0	1.5	5.93	0.01	8.6	9
A-49	0.020	22	0.011	3.8	0.01	0.010	170	u	1.61	0.029	845.0	834.1	814	0.013	0.030	3.0	3.0	0.0	1.5	4.59	0.05	5.0	5
A-50	0.050	100	0.800	3.8	0.40	0.037	750	u	3.09	0.067	845.0	815.9	879	0.033	0.030	3.0	3.0	0.0	1.5	7.21	0.03	30.0	30
A-51	0.020	22	0.011	3.8	0.01	0.100	250	u	5.10	0.014	840.0	812.3	414	0.067	0.030	3.0	3.0	0.0	1.5	10.24	0.01	1.8	5
A-52	0.020	22	0.011	3.8	0.01	0.028	165	u	2.68	0.017	875.0	847.6	802	0.034	0.030	3.0	3.0	0.0	1.5	7.32	0.03	3.2	5
A-53	0.020	22	0.011	3.8	0.01	0.015	200	u	1.98	0.028	885.0	850.0	1603	0.022	0.030	3.0	3.0	0.0	1.5	5.85	0.08	6.6	7
A-54	0.020	22	0.240	3.8	0.07	0.010	200	u	1.65	0.034	883.0	875.5	760	0.010	0.030	3.0	3.0	0.0	1.5	3.94	0.05	9.2	9
A-55	0.015	100	0.240	3.8	0.25	0.015	496	u	1.98	0.069	882.5	879.8	691	0.004	0.030	3.0	3.0	0.0	1.5	2.46	0.08	23.6	24
A-56	0.020	22	0.011	3.8	0.01	0.015	200	u	1.98	0.028	825.0	816.2	112	0.079	0.030	3.0	3.0	0.0	1.5	11.10	0.00	2.2	5
A-57	0.020	22	0.011	3.8	0.01	0.024	212	u	2.48	0.024	830.0	777.9	713	0.073	0.030	3.0	3.0	0.0	1.5	10.70	0.02	2.9	5
A-58	0.020	22	0.011	3.8	0.01	0.025	100	u	2.55	0.011	890.0	887.9	191	0.011	0.030	3.0	3.0	0.0	1.5	4.15	0.01	1.75	5.0
A-59	0.020	100	0.170	3.8	0.17	0.008	1244	u	1.45	0.238	915.0	785.5	7399	0.017	0.030	3.0	3.0	0.0	1.5	5.24	0.39	47.8	48
A-60	0.010	100	0.011	3.8	0.02	0.009	200	u	1.52	0.036	889.1	884.9	466	0.009	0.024	3.0	3.0	0.0	1.5	4.68	0.03	5.3	5
A-61 - A-64	0.020	22	0.011	3.8	0.01	0.016	200	u	2.03	0.027	889.3	887.9	90	0.016	0.030	3.0	3.0	0.0	1.5	4.94	0.01	2.3	5
A-62																							

Table 3 (Section A): Time of Concentration Spreadsheet

																JOB: I-85 Widening Cherokee Co MM80-96							
																SUBJECT: Time of Concentration Calculations							
																CALC'D BY: GPP/SCN/SKH				DATE: 24-Mar-15			
																CHEK'D BY: GPP/SCN				DATE:			
TIME OF CONCENTRATION																							
WS	Sheet					Shallow Concentrated					Open Channel										Time Of Conc.	Time Of Conc.	
Pipe ID	Slope	Length	n	P2	Time	Slope	Length	(P)aved	V	Time	Elevation		Length	Slope	n	SS Lt	SS Rt	BW	Depth	V	Time	Tc (min)	Tc (min)
	ft/ft	ft			hr	ft/ft	ft	p/u	ft/s	hr	From	To	ft	ft/ft		z:1	z:1	ft.	ft.	ft/s	hr		>= 5 min
A-63	0.020	30	0.011	3.8	0.01	0.026	200	u	2.62	0.021	892.1	881.6	220	0.048	0.026	3.0	3.0	0.0	1.5	9.85	0.01	2.1	5
A-64	0.020	30	0.011	3.8	0.01	0.026	200	u	2.62	0.021	892.1	881.6	220	0.048	0.026	3.0	3.0	0.0	1.5	9.85	0.01	2.1	5
A-65 - A-67	0.020	30	0.011	3.8	0.01	0.026	200	u	2.62	0.021	892.1	881.6	220	0.048	0.026	3.0	3.0	0.0	1.5	9.85	0.01	2.1	5
A-66	0.020	30	0.011	3.8	0.01	0.026	200	u	2.62	0.021	892.1	881.6	220	0.048	0.026	3.0	3.0	0.0	1.5	9.85	0.01	2.1	5
A-67	0.010	100	0.240	3.8	0.29	0.039	280	u	3.17	0.025	881.0	857.2	616	0.039	0.030	3.0	3.0	0.0	1.5	7.77	0.02	20.2	20
A-68	0.010	100	0.240	3.8	0.29	0.039	280	u	3.17	0.025	881.0	857.2	616	0.039	0.030	3.0	3.0	0.0	1.5	7.77	0.02	20.2	20
A-69	0.020	32	0.011	3.8	0.01	0.031	200	u	2.85	0.019	878.5	857.2	683	0.031	0.030	3.0	3.0	0.0	1.5	6.98	0.03	3.2	5
A-70	0.020	38	0.011	3.8	0.01	0.025	200	u	2.55	0.022	873.0	857.2	631	0.025	0.030	3.0	3.0	0.0	1.5	6.26	0.03	3.5	5
A-71	0.020	30	0.011	3.8	0.01	0.007	200	u	1.33	0.042	915.0	785.5	1311	0.099	0.030	3.0	3.0	0.0	1.5	12.44	0.03	4.7	5
A-72	0.010	100	0.240	3.8	0.29	0.073	317	u	4.35	0.020	840.4	825.0	322	0.048	0.030	3.0	3.0	0.0	1.5	8.64	0.01	19.2	19
A-73 - A-74	0.010	100	0.170	3.8	0.22	0.020	202	u	2.27	0.025	898.0	809.7	3761	0.023	0.030	3.0	3.0	0.0	1.5	6.07	0.17	25.0	25
A-74	0.020	30	0.011	3.8	0.01	0.015	200	u	2.00	0.028	844.9	835.7	598	0.015	0.024	3.0	3.0	0.0	1.5	6.14	0.03	3.7	5
A-75 - A-77	0.020	30	0.011	3.8	0.01	0.019	200	u	2.20	0.025	874.0	848.0	1405	0.019	0.024	3.0	3.0	0.0	1.5	6.74	0.06	5.4	5
A-76	0.020	100	0.240	3.8	0.22	0.059	308	u	3.92	0.022	860.0	844.1	474	0.034	0.030	3.0	3.0	0.0	1.5	7.25	0.02	15.6	16
A-77	0.020	43	0.011	3.8	0.01	0.009	376	u	1.56	0.067	882.0	877.8	312	0.014	0.030	3.0	3.0	0.0	1.5	4.60	0.02	5.7	6
A-78 - A-80	0.020	22	0.011	3.8	0.01	0.010	100	u	1.61	0.017	880.0	877.8	100	0.022	0.030	3.0	3.0	0.0	1.5	5.91	0.00	1.7	5
A-79	0.020	75	0.400	3.8	0.26	0.080	210	u	4.56	0.013												16.5	17
A-80	0.020	100	0.400	3.8	0.33	0.053	300	u	3.72	0.022	879.0	875.1	50	0.078	0.030	3.0	3.0	0.0	1.5	11.07	0.00	21.2	21
A-81 - A-82	0.020	100	0.240	3.8	0.22	0.010	200	u	1.61	0.034	898.0	875.7	636	0.035	0.030	3.0	3.0	0.0	1.5	7.41	0.02	16.7	17
A-82	0.020	100	0.240	3.8	0.22	0.010	200	u	1.63	0.034	896.5	884.7	1126	0.010	0.030	3.0	3.0	0.0	1.5	4.05	0.08	19.8	20
A-83 - A-84	0.020	100	0.240	3.8	0.22	0.009	81	u	1.56	0.014	909.0	894.4	1050	0.014	0.030	3.0	3.0	0.0	1.5	4.67	0.06	17.8	18
A-84	0.020	100	0.240	3.8	0.22	0.010	200	u	1.62	0.034	909.0	898.2	1060	0.010	0.030	3.0	3.0	0.0	1.5	3.99	0.07	19.6	20
A-85	0.020	30	0.240	3.8	0.08	0.015	200	u	2.00	0.028	894.5	883.9	692	0.015	0.030	3.0	3.0	0.0	1.5	4.89	0.04	9.0	9
A-86 - A-87	0.020	30	0.240	3.8	0.08	0.019	200	u	2.25	0.025	903.5	882.1	1134	0.019	0.030	3.0	3.0	0.0	1.5	5.43	0.06	10.0	10
A-87	0.020	30	0.240	3.8	0.08	0.008	200	u	1.40	0.040	909.0	900.9	394	0.021	0.030	3.0	3.0	0.0	1.5	5.69	0.02	8.6	9
A-88 - A-91	0.040	100	0.240	3.8	0.17	0.047	318	u	3.51	0.025	900.0	882.6	472	0.037	0.030	3.0	3.0	0.0	1.5	7.61	0.02	12.5	13
A-89	0.020	30	0.240	3.8	0.08	0.015	200	u	1.98	0.028	901.5	884.9	701	0.024	0.030	3.0	3.0	0.0	1.5	6.09	0.03	8.6	9
A-90	0.020	30	0.240	3.8	0.08	0.020	200	u	2.26	0.025	878.5	865.3	656	0.020	0.030	3.0	3.0	0.0	1.5	5.62	0.03	8.4	8
A-91	0.020	30	0.240	3.8	0.08	0.015	200	u	2.00	0.028	880.5	870.2	692	0.015	0.030	3.0	3.0	0.0	1.5	4.83	0.04	9.1	9
A-92 - A-95	0.020	30	0.240	3.8	0.08	0.017	200	u	2.09	0.027	881.5	869.4	728	0.017	0.030	3.0	3.0	0.0	1.5	5.11	0.04	9.0	9
A-93	0.020	100	0.240	3.8	0.22	0.083	457	u	4.65	0.027	876.0	868.0	229	0.035	0.030	3.0	3.0	0.0	1.5	7.39	0.01	15.3	15

Table 3 (Section A): Time of Concentration Spreadsheet

																	JOB: I-85 Widening Cherokee Co MM80-96						
																	SUBJECT: Time of Concentration Calculations						
																	CALC'D BY: GPP/SCN/SKH		DATE: 24-Mar-15				
																	CHEK'D BY: GPP/SCN		DATE:				
TIME OF CONCENTRATION																							
WS	Sheet					Shallow Concentrated					Open Channel										Time Of Conc.	Time Of Conc.	
Pipe ID	Slope	Length	n	P2	Time	Slope	Length	(P)aved	V	Time	Elevation		Length	Slope	n	SS Lt	SS Rt	BW	Depth	V	Time	Tc (min)	Tc (min)
	ft/ft	ft			hr	ft/ft	ft	p/u	ft/s	hr	From	To	ft	ft/ft		z:1	z:1	ft.	ft.	ft/s	hr		>= 5 min
A-94	0.020	100	0.240	3.8	0.22	0.008	200	u	1.45	0.038	892.5	863.0	953	0.031	0.030	3.0	3.0	0.0	1.5	6.97	0.04	17.7	18
A-95	0.020	100	0.240	3.8	0.22	0.023	200	u	2.45	0.023	890.5	866.0	1074	0.023	0.030	3.0	3.0	0.0	1.5	5.97	0.05	17.5	18
A-96 - A-98	0.020	100	0.240	3.8	0.22	0.028	217	u	2.68	0.022	887.5	864.9	773	0.029	0.030	3.0	3.0	0.0	1.5	6.77	0.03	16.4	16
A-97	0.050	100	0.240	3.8	0.15	0.035	938	u	3.03	0.086	874.0	866.9	253	0.028	0.030	3.0	3.0	0.0	1.5	6.65	0.01	14.9	15
A-98																						5.0	5
A-99																						5.0	5
A-100	0.020	100	0.240	3.8	0.22	0.029	160	u	2.77	0.016												14.1	14
A-101	0.080	63	0.240	3.8	0.09	0.020	200	u	2.27	0.024	842.0	805.2	408	0.090	0.030	3.0	3.0	0.0	1.5	11.89	0.01	7.3	7
405	0.020	100	0.240	3.8	0.22	0.010	200	u	1.61	0.035	882.7	877.8	499	0.010	0.030	3.0	3.0	0.0	1.5	3.93	0.04	17.4	17
410	0.067	32	0.240	3.8	0.05	0.020	200	u	2.28	0.024	893.0	866.2	752	0.036	0.030	3.0	3.0	0.0	1.5	7.47	0.03	6.4	6

Slope in ft/ft.
Length in feet.
n is TR55 method for Sheet and Shallow concentrated flow, Mannings method for open channel flow.
(P)aved refers to paved or unpaved velocity.
V is velocity in ft/s.
Tt is TR55 travel time in hours.
Tc is TR55 time of concentration in minutes.

Table 3 (Section A): Time of Concentration Spreadsheet

																JOB: I-85 Widening Cherokee Co MM80-96							
																SUBJECT: Time of Concentration Calculations							
																CALC'D BY: CAB		DATE: 01-Jun-15					
																CHEK'D BY: KJB		DATE: 01-Jul-15					
TIME OF CONCENTRATION																							
WS	Sheet					Shallow Concentrated					Open Channel										Time Of Conc.	Time Of Conc.	
ID	Slope	Length	n	P2	Time	Slope	Length	(P)aved	V	Time	Elevation		Length	Slope	n	SS Lt	SS Rt	BW	Depth	V	Time	Tc (min)	Tc (min)
	ft/ft	ft			hr	ft/ft	ft		ft/s	hr	To	From	ft	ft/ft		z:1	z:1	ft.	ft.	ft/s	hr		>= 5 min
1	0.016	28	0.150	3.7	0.06						893.8	893.0	115	0.007	0.03	5.0	5.0	0.0	1.5	3.48	0.01	4.1	5.0
2	0.002	100	0.400	3.7	0.79	0.032	350	u	2.89	0.034												49.5	49.5
3	0.019	100	0.800	3.7	0.59	0.066	626	u	4.15	0.042	894.0	886.8	125	0.058	0.03	3.0	3.0	0.0	1.0	7.27	0.00	38.3	38.3
4	0.021	9	0.011	3.7	0.00	0.360	38	u	9.68	0.001	939.2	936.4	225	0.012	0.03	3.0	3.0	0.0	2.0	5.27	0.01	0.9	5.0
5	0.021	9	0.011	3.7	0.00	0.360	40	u	9.68	0.001	939.0	937.8	156	0.007	0.03	3.0	3.0	0.0	2.0	4.15	0.01	0.9	5.0
6	0.021	10	0.011	3.7	0.00	0.360	33	u	9.68	0.001	937.8	916.9	613	0.034	0.03	1.0	1.0	1.0	1.0	5.95	0.03	1.9	5.0
7	0.060	50	0.011	3.7	0.01						916.6	873.7	942	0.045	0.01	1.0	1.0	1.0	2.0	24.71	0.01	1.1	5.0
8	0.048	39	0.240	3.7	0.07						863.9	861.2	253	0.011	0.03	5.0	5.0	0.0	0.8	2.76	0.03	5.9	5.9
9	0.021	25	0.011	3.7	0.01						875.7	867.4	622	0.013	0.01	1.3	1.3	1.3	1.3	11.97	0.01	1.2	5.0
10	0.050	100	0.800	3.7	0.40	0.036	638	u	3.06	0.058	860.0	859.7	32	0.009	0.03	4.0	4.0	0.0	1.0	2.87	0.00	27.8	27.8
11	0.021	12	0.011	3.7	0.00	0.230	26	u	7.74	0.001	875.6	859.9	615	0.026	0.03	6.0	6.0	0.0	2.0	7.87	0.02	1.6	5.0
12	0.021	39	0.011	3.7	0.01			u	0.00	0.000	859.2	838.3	872	0.024	0.01	1.5	1.5	1.5	1.5	18.29	0.01	1.3	5.0
13	0.011	100	0.800	3.7	0.74	0.060	355	u	3.95	0.025	840.4	833.2	126	0.058	0.03	3.0	3.0	0.0	1.0	7.26	0.00	46.1	46.1
14	0.029	80	0.240	3.7	0.16	0.032	8	u	2.89	0.001												9.6	9.6
15	0.021	11	0.011	3.7	0.00	0.050	15	u	3.61	0.001	824.1	805.3	624	0.030	0.03	3.0	3.0	0.0	1.0	5.25	0.03	2.2	5.0
16	0.021	14	0.011	3.7	0.00	0.205	20	u	7.31	0.001	813.7	780.2	1285	0.026	0.03	5.0	5.0	0.0	4.0	12.56	0.03	2.0	5.0
17	0.018	100	0.410	3.7	0.35	0.048	321	u	3.53	0.025												22.8	22.8
18	0.034	100	0.410	3.7	0.27	0.140	165	u	6.04	0.008	726.4	725.4	10	0.095	0.03	4.0	4.0	0.0	2.0	15.00	0.00	16.9	16.9
19	0.039	100	0.800	3.7	0.44	0.082	252	u	4.62	0.015	735.3	733.5	25	0.072	0.03	5.0	5.0	0.0	1.0	8.29	0.00	27.6	27.6
20	0.016	100	0.240	3.7	0.24	0.052	91	u	3.68	0.007	774.7	765.7	292	0.031	0.03	4.0	4.0	0.0	1.0	5.37	0.02	15.7	15.7
21	0.190	100	0.240	3.7	0.09	0.044	100	u	3.38	0.008	778.8	776.8	33	0.062	0.03	6.0	6.0	0.0	1.5	10.15	0.00	5.9	5.9
22	0.120	70	0.240	3.7	0.08	0.039	206	u	3.19	0.018	787.4	784.6	53	0.053	0.03	6.0	6.0	0.0	1.5	9.35	0.00	6.0	6.0
23	0.003	100	0.240	3.7	0.47	0.033	122	u	2.93	0.012	812.5	795.8	1019	0.016	0.03	4.0	4.0	0.0	2.0	6.23	0.05	31.8	31.8
24	0.040	100	0.240	3.7	0.17						812.8	805.3	587	0.013	0.03	5.0	5.0	0.0	1.0	3.49	0.05	12.9	12.9
25	0.210	100	0.240	3.7	0.09	0.031	123	u	2.84	0.012	807.3	796.8	359	0.029	0.03	8.0	8.0	0.0	2.0	8.45	0.01	6.6	6.6
26	Peak Calculated Using USGS Regression																						
27	0.086	32	0.240	3.7	0.05						798.7	733.0	1636	0.040	0.03	4.0	4.0	0.0	2.5	11.32	0.04	5.4	5.4
28	0.021	15	0.011	3.7	0.00	0.088	16	u	4.79	0.001	816.6	787.4	693	0.042	0.03	10.0	10.0	0.0	2.0	10.15	0.02	1.4	5.0
29	0.021	11	0.011	3.7	0.00	0.021	18	u	2.33	0.002	848.7	814.9	1232	0.027	0.03	10.0	10.0	0.0	2.5	9.51	0.04	2.5	5.0
30	0.045	100	0.240	3.7	0.16	0.055	375	u	3.78	0.028												11.2	11.2
31	0.009	100	0.240	3.7	0.31	0.024	2076	u	2.50	0.231	820.3	815.7	137	0.034	0.03	4.0	4.0	0.0	1.5	7.38	0.01	32.8	32.8
32	0.021	11	0.011	3.7	0.00	0.130	36	u	5.82	0.002	832.3	828.9	497	0.007	0.03	8.0	8.0	0.0	1.0	2.56	0.05	3.5	5.0
33	0.073	100	0.800	3.7	0.35	0.087	146	u	4.76	0.009	820.0	809.4	164	0.065	0.03	3.0	3.0	0.0	1.0	7.69	0.01	21.6	21.6

Slope in ft/ft.
Length in feet.
n is TR55 method for Sheet and Shallow concentrated flow, Mannings method for open channel flow.
(P)aved refers to paved or unpaved velocity.
V is velocity in ft/s.
Tt is TR55 travel time in hours.
Tc is TR55 time of concentration in minutes.

Table 3 (Section B): Time of Concentration Spreadsheet

JOB: I-85 Widening Cherokee Co MM80-96

SUBJECT: Time of Concentration Calculations

CALC'D BY: RS DATE: 06-Aug-15

CHEK'D BY: DATE:

TIME OF CONCENTRATION																							
WS	Sheet					Shallow Concentrated					Open Channel										Time Of Conc.	Time Of Conc.	
ID	Slope	Length	n	P2	Time	Slope	Length	(P)aved	V	Time	Elevation		Length	Slope	n	SS Lt	SS Rt	BW	Depth	V	Time	Tc (min)	Tc (min)
	ft/ft	ft			hr	ft/ft	ft		ft/s	hr	To	From	ft	ft/ft		z:1	z:1	ft.	ft.	ft/s	hr		>= 5 min
C1	0.025	100	0.41	3.7	0.31	0.047	941	u	3.50	0.075	825.0	770.0	2369	0.023	0.040	1.0	1.0	3.0	3.0	7.66	0.09	28.3	28.3
C2	0.045	22	0.015	3.7	0.01	0.047	32	u	3.50	0.003	811.0	800.0	385	0.029	0.050	4.0	4.0	0.0	1.0	3.11	0.03	2.5	5.0
C3	0.025	100	0.240	3.7	0.20	0.028	326	u	2.70	0.034	812.0	809.2	74	0.038	0.050	2.0	4.0	0.0	1.0	3.51	0.01	14.5	14.5
C4	0.012	83	0.240	3.7	0.23				0.00	0.000	825.0	807.7	650	0.027	0.015	4.0	4.0	0.0	0.5	6.30	0.03	15.7	15.7
C5	0.005	100	0.240	3.7	0.39	0.009	114	u	1.53	0.021	810.0	808.2	31	0.058	0.050	4.0	4.0	0.0	0.5	2.79	0.00	24.5	24.5
C6	0.015	100	0.240	3.7	0.25	0.044	51	u	3.38	0.004	815.0	810.0	446	0.011	0.050	4.0	4.0	0.0	0.5	1.23	0.10	21.2	21.2
C7	0.016	32	0.015	3.7	0.01			u	0.00	0.000	810.5	809.4	184	0.006	0.015	6.0	6.0	0.0	0.5	3.02	0.02	1.7	5.0
C8	0.010	100	0.400	3.7	0.44	0.036	366	u	3.06	0.033	792.0	789.3	396	0.007	0.030	10.0	10.0	0.0	0.5	1.62	0.07	28.3	28.3
C8A	0.020	100	0.240	3.7	0.22	0.012	163	u	1.77	0.026	812.5	811.5	94	0.011	0.050	4.0	4.0	0.0	0.5	1.21	0.02	14.8	14.8
C9	0.040	100	0.130	3.7	0.10	0.018	229	u	2.13	0.030	781.5	780.0	209	0.007	0.050	6.0	6.0	0.0	0.5	0.99	0.06	11.5	11.5
C10	0.020	100	0.240	3.7	0.22	0.025	181	u	2.55	0.020	788.5	778.4	410	0.030	0.050	4.0	2.0	0.0	1.0	3.13	0.04	16.6	16.6
C11	0.046	62	0.015	3.7	0.01				0.00	0.000	789.0	784.2	561	0.009	0.015	0.0	24.0	0.0	0.5	3.55	0.04	3.3	5.0
C12	0.050	100	0.400	3.7	0.23	0.048	252	u	3.53	0.020	780.0	776.8	128	0.025	0.050	2.0	4.0	0.0	1.0	2.86	0.01	15.8	15.8
C13	0.010	100	0.400	3.7	0.44	0.044	366	u	3.38	0.030	780.0	776.5	433	0.008	0.050	2.0	4.0	0.0	1.0	1.62	0.07	32.6	32.6
C14	0.025	100	0.400	3.7	0.30	0.011	45	u	1.69	0.007	761.0	754.5	118	0.055	0.050	4.0	2.0	0.0	1.0	4.24	0.01	19.2	19.2
C15	0.021	24	0.015	3.7	0.01	0.110	14	u	5.35	0.001	754.5	740.5	526	0.027	0.050	4.0	4.0	0.0	1.0	3.00	0.05	3.4	5.0
C16	0.046	62	0.015	3.7	0.01				0.00	0.000	744.0	722.3	1136	0.019	0.015	21.7	0.0	0.0	0.5	5.28	0.06	4.3	5.0
C17	0.037	81	0.400	3.7	0.22				0.00	0.000	720.0	719.5	95	0.005	0.050	4.0	2.0	0.0	1.0	1.31	0.02	14.4	14.4
C18	0.020	12	0.015	3.7	0.00	0.056	18	u	3.82	0.001	718.0	715.4	336	0.008	0.050	4.0	4.0	0.0	1.0	1.62	0.06	3.8	5.0
C19	0.080	100	0.400	3.7	0.19	0.038	133	u	3.15	0.012	720.0	713.5	800	0.008	0.030	2.0	4.0	0.0	1.0	2.71	0.08	17.1	17.1
C20	0.078	90	0.410	3.7	0.18	0.000	0	u	0.00	0.000	714.0	705.8	761	0.011	0.030	2.0	4.0	0.0	1.0	3.12	0.07	14.9	14.9
C21	0.010	100	0.015	3.7	0.03	0.066	213	p	5.22	0.011	706.0	701.0	462	0.011	0.030	2.0	4.0	0.0	1.0	3.13	0.04	5.0	5.0
C22	0.021	30	0.015	3.7	0.01				0.00	0.000	700.0	689.0	1093	0.010	0.015	24.0	24.0	0.0	0.5	3.95	0.08	5.2	5.2
C23	0.010	100	0.410	3.7	0.45	0.050	529	u	3.61	0.041	693.0	690.0	342	0.009	0.050	2.0	4.0	0.0	1.0	1.69	0.06	32.7	32.7
C24	0.040	100	0.400	3.7	0.25	0.005	205	u	1.13	0.050	703.0	685.2	493	0.036	0.050	4.0	4.0	0.0	1.0	3.50	0.04	20.5	20.5
C25	0.040	100	0.400	3.7	0.25	0.005	205	u	1.13	0.050	703.0	677.3	734	0.035	0.050	4.0	4.0	0.0	1.0	3.44	0.06	21.7	21.7
C26	0.015	100	0.400	3.7	0.37	0.043	300	u	3.35	0.025	692.0	677.7	551	0.026	0.050	4.0	4.0	0.0	1.0	2.96	0.05	27.0	27.0
C27	0.015	100	0.400	3.7	0.37	0.043	300	u	3.35	0.025	692.0	649.0	962	0.045	0.050	4.0	4.0	0.0	1.0	3.89	0.07	28.0	28.0
C28	0.040	100	0.400	3.7	0.25	0.031	32	u	2.84	0.003	666.2	665.0	77	0.016	0.050	6.0	2.0	0.0	1.0	2.28	0.01	15.9	15.9
C29	0.070	87	0.400	3.7	0.18				0.00	0.000	664.0	654.0	800	0.013	0.050	6.0	2.0	0.0	0.5	1.29	0.17	21.2	21.2
C30	0.021	43	0.015	3.7	0.01				0.00	0.000	652.0	639.9	364	0.033	0.015	24.0	0.0	0.0	0.5	6.99	0.01	1.6	5.0
C31	0.021	56	0.015	3.7	0.01				0.00	0.000	635.7	630.0	196	0.029	0.015	24.0	24.0	0.0	0.5	6.72	0.01	1.4	5.0
C32	0.021	40	0.015	3.7	0.01				0.00	0.000	696.6	656.0	929	0.044	0.015	24.0	24.0	0.0	0.5	8.24	0.03	2.6	5.0
C33	0.060	66	0.015	3.7	0.01				0.00	0.000	713.8	701.4	1360	0.009	0.015	24.0	0.0	0.0	0.5	3.66	0.10	6.9	6.9
C34	0.045	100	0.240	3.7	0.16	0.021	193	u	2.34	0.023	710.0	702.2	237	0.033	0.050	2.0	4.0	0.0	0.5	2.06	0.03	12.9	12.9
C35	0.030	90	0.015	3.7	0.02	0.064	296	u	4.08	0.020												2.3	5.0
C36	0.021	29	0.015	3.7	0.01	0.005	151	p	1.49	0.028	727.2	713.7	630	0.021	0.015	24.0	24.0	0.0	0.5	5.76	0.03	4.0	5.0
C37	0.021	30	0.015	3.7	0.01	0.018	56	p	2.73	0.006	725.0	710.0	788	0.019	0.015	24.0	24.0	0.0	0.5	5.44	0.04	3.3	5.0
C38	0.021	32	0.015	3.7	0.01				0.00	0.000	710.6	688.6	738	0.030	0.015	24.0	24.0	0.0	0.5	6.80	0.03	2.4	5.0
C39	0.060	98	0.015	3.7	0.02	0.030	179	u	2.79	0.018	668.0	666.0	69	0.029	0.050	5.0	5.0	4.0	0.5	2.55	0.01	2.4	5.0
C40	0.021	38	0.015	3.7	0.01				0.00	0.000	670.2	644.9	953	0.027	0.015	24.0	0.0	0.0	0.5	6.25	0.04	3.2	5.0
C41	0.026	60	0.015	3.7	0.01				0.00	0.000	646.5	609.7	1351	0.027	0.015	0.0	16.9	0.0	0.5	6.25	0.06	4.5	5.0

Slope in ft/ft.
Length in feet.
n is TR55 method for Sheet and Shallow concentrated flow, Mannings method for open channel flow.
(P)aved refers to paved or unpaved velocity.
V is velocity in ft/s.
Tt is TR55 travel time in hours.
Tc is TR55 time of concentration in minutes.

Table 3 (Section C): Time of Concentration Spreadsheet

JOB:	I-85 Widening Cherokee Co MM80-96		
SUBJECT:	Runoff Discharge Calculations		
CALC'D BY:	GPP/SCN/SKH	DATE:	26-Mar-15
CHEK'D BY:	GPP/SCN	DATE:	

Rational Method									
Outfall ID	Area Pre	Tc' (min)	C _{value}	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q25 (cfs)	Q50 (cfs)	Q100 (cfs)

A-1	23.57	20	0.24	21	25	28	35	42	47
A-2	18.77	14	0.28	21	25	28	35	42	48
A-3 - A-6	26.63	11	0.54	63	75	84	107	128	146
A-4	26.63	11	0.54	63	75	84	107	128	146
A-5	26.63	11	0.54	63	75	84	107	128	146
A-6	26.63	11	0.54	63	75	84	107	128	146
A-7 - A-8	2.60	5	0.58	8	9	10	13	16	18
A-8	2.60	5	0.58	8	9	10	13	16	18
A-9 - A-11	70.30	18	0.37	98	116	129	163	195	221
A-10	70.30	18	0.37	98	116	129	163	195	221
A-11	70.30	18	0.37	98	116	129	163	195	221
A-12 - A-14	1.23	5	0.58	4	4	5	6	7	8
A-13	1.07	5	0.58	3	4	4	5	6	7
A-14	1.52	5	0.58	4	5	6	8	9	10
A-15 - A-16	0.49	11	0.58	1	1	2	2	3	3
A-16	1.74	11	0.46	4	4	5	6	7	8
A(17,19)	18.42	9	0.80	69	80	90	114	138	157
A-18	22.62	16	0.39	39	42	47	59	71	80
A-19	18.42	9	0.80	69	80	90	114	138	157
A-20 - A-22	58.33	11	0.77	197	234	261	331	399	454
A-21 - A-22	58.33	11	0.77	197	234	261	331	399	454
A-22	58.33	11	0.77	197	234	261	331	399	454
A-23	3.52	16	0.47	6	8	8	11	13	15
A-24	14.00	16	0.55	30	35	40	50	60	68
A-25	0.89	5	0.90	4	5	5	7	8	10
A-26	0.52	5	0.90	2	3	3	4	5	6
A-27	0.51	5	0.90	2	3	3	4	5	5
A-28 - A-29	1.71	5	0.57	5	6	7	8	10	12
A-29	0.38	5	0.90	2	2	2	3	4	4
A-30	0.46	5	0.90	2	2	3	4	4	5
A-31	1.62	5	0.90	7	9	10	13	15	17
A-32	3.78	9	0.58	10	12	13	17	21	23
A-33	9.59	20	0.29	10	12	13	17	20	23
A-34	1.37	5	0.90	6	7	8	11	13	15
A-35 - A-37	2.23	5	0.58	6	8	9	11	13	15
A-36	0.82	5	0.90	4	4	5	6	8	9
A-37	0.76	5	0.58	2	3	3	4	5	5
A-38 - A-39	0.92	5	0.47	2	3	3	4	4	5
A-39	0.63	5	0.58	2	2	2	3	4	4
A-40	0.46	5	0.90	2	2	3	4	4	5

Table 4 (Section A): Discharge Spreadsheet

JOB:	I-85 Widening Cherokee Co MM80-96		
SUBJECT:	Runoff Discharge Calculations		
CALC'D BY:	GPP/SCN/SKH	DATE:	26-Mar-15
CHEK'D BY:	GPP/SCN	DATE:	

Rational Method									
Outfall ID	Area Pre	T _c ' (min)	C _{value}	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q25 (cfs)	Q50 (cfs)	Q100 (cfs)
A-41	25.48	19	0.36	35	41	45	57	69	78
A-42	0.91	5	0.90	4	5	6	7	9	10
A-43 - A-45	4.08	10	0.43	8	9	10	13	16	18
A-44	1.09	5	0.90	5	6	7	8	10	12
A-45	2.43	5	0.58	7	8	9	12	14	16
A-46 - A-48	3.70	9	0.43	7	9	10	12	15	17
A-47	0.58	5	0.90	3	3	4	5	5	6
A-48	1.55	9	0.58	4	5	5	7	8	10
A-49	1.76	5	0.90	8	10	11	14	17	19
A-50	58.00	30	0.43	77	91	101	127	152	171
A-51	2.84	5	0.58	8	10	11	14	17	19
A-52	1.10	5	0.90	5	6	7	9	10	12
A-53	4.15	7	0.58	12	14	15	20	24	27
A-54	1.16	9	0.90	5	6	6	8	10	11
A-55	12.76	24	0.58	25	30	33	41	50	56
A-56	0.96	5	0.58	3	3	4	5	6	7
A-57	2.44	5	0.58	7	8	9	12	15	17
A-58	0.36	5	0.74	1.3	1.6	1.8	2	3	3
A-59	715.40	48	SCS 71	377.0		778.0	1086	1354	1636
A-60	3.28	5	0.85	14	17	19	24	29	33
A-61 - A-64	0.83	5	0.90	4	5	5	6	8	9
A-62	0.64	5	0.90	3	3	4	5	6	7
A-63	0.68	5	0.90	3	4	4	5	6	7
A-64	0.60	5	0.58	2	2	2	3	4	4
A-65 - A-67	3.72	20	0.85	12	14	15	19	23	26
A-66	2.85	20	0.90	9	11	12	15	19	21
A-67	1.23	5	0.90	6	7	7	10	12	13
A-68	3.72	5	0.58	11	13	14	18	22	26
A-69	3.70	5	0.90	17	20	23	29	35	40
A-70	6.64	19	0.41	10	12	13	17	20	23
A-71	95.89	25	0.35	113	133	148	186	223	252
A-72	1.11	5	0.90	5	6	7	9	10	12
A-73 - A-74	2.16	5	0.90	10	12	13	17	20	23
A-74	8.15	16	0.50	16	19	21	27	32	37
A-75 - A-77	0.99	6	0.90	4	5	6	8	9	10
A-76	0.68	5	0.58	2	2	3	3	4	5
A-77	2.38	17	0.22	2	2	3	3	4	5
A-78 - A-80	9.72	21	0.25	9	10	11	14	17	19
A-79	2.55	17	0.58	6	7	8	9	11	13
A-80	1.80	20	0.90	6	7	8	10	12	13

Table 4 (Section A): Discharge Spreadsheet

JOB:	I-85 Widening Cherokee Co MM80-96		
SUBJECT:	Runoff Discharge Calculations		
CALC'D BY:	GPP/SCN/SKH	DATE:	26-Mar-15
CHEK'D BY:	GPP/SCN	DATE:	

Rational Method									
Outfall ID	Area Pre	Tc' (min)	C _{value}	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q25 (cfs)	Q50 (cfs)	Q100 (cfs)

A-81 - A-82	5.04	18	0.41	8	9	10	13	16	18
A-82	1.88	20	0.90	6	7	8	10	12	14
A-83 - A-84	2.71	9	0.90	11	13	15	19	23	26
A-84	2.54	10	0.58	7	8	9	11	13	15
A-85	1.43	9	0.58	4	5	5	6	8	9
A-86 - A-87	12.77	13	0.35	19	23	25	32	38	44
A-87	1.27	9	0.58	3	4	4	6	7	8
A-88 - A-91	1.58	8	0.58	4	5	6	7	9	10
A-89	1.25	9	0.90	5	6	7	9	10	12
A-90	1.57	9	0.58	4	5	6	7	8	10
A-91	14.01	15	0.56	31	37	41	52	62	71
A-92 - A-95	2.37	18	0.58	5	6	7	9	10	12
A-93	2.42	18	0.90	8	10	11	14	17	19
A-94	1.84	16	0.58	4	5	5	7	8	9
A-95	25.49	15	0.58	59	70	78	99	119	135
A-96 - A-98	0.18	5	0.58	1	1	1	1	1	1
A-97	0.13	5	0.90	1	1	1	1	1	1
A-98	1.37	14	0.50	3	3	4	5	6	6
A-99	2.15	7	0.56	6	7	8	10	12	14
A-100	1.15	17	0.41	2	2	2	3	4	4
A-101	3.21	6	0.41	6	8	9	11	13	15

- Notes:
1. For cross pipe systems with multiple drainage areas, the longest time of concentration calculated has been used for flow calculations associated with the entire pipe group.
 2. Coefficient "c" updated on June 22, 2015.

Table 4 (Section A): Discharge Spreadsheet

JOB: I-85 Widening Cherokee Co MM80-96										
JBJECT: Runoff Discharge Calculations										
CALC'D BY: CAB					DATE: 30-Apr-15					
CHEK'D BY: KJB					DATE: 01-Jul-15					
Rational Method										
Outfall ID	Station	Area Pre	Tc (min)	C _{value}	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q25 (cfs)	Q50 (cfs)	Q100 (cfs)
B-1	1184+75	0.66	5.0	0.70	2.3	2.8	3.1	4.0	4.8	5.5
B-2	1191+75	8.02	49.5	0.41	7.8	9.1	10.1	12.6	15.0	16.9
B-3	1196+75	18.91	38.3	0.36	18.6	21.8	24.1	30.2	36.0	40.7
B-4	1209+25	0.73	5.0	0.70	2.6	3.1	3.5	4.4	5.4	6.1
B-5	1213+25	0.55	5.0	0.70	2.0	2.3	2.6	3.3	4.0	4.6
B-6	1219+65	1.96	5.0	0.75	7.4	8.9	10.0	12.7	15.3	17.5
B-7	1229+55	1.38	5.0	0.90	6.3	7.5	8.4	10.7	13.0	14.8
B-8	1235+50	2.35	5.9	0.78	9.0	10.8	12.1	15.4	18.6	21.3
B-9	1240+45	1.09	5.0	0.90	5.0	5.9	6.6	8.5	10.2	11.7
B-10	1244+90	16.07	27.8	0.28	14.4	16.9	18.8	23.6	28.2	31.9
B-11	1255+00	2.58	5.0	0.73	9.5	11.3	12.7	16.2	19.6	22.4
B-12	1264+25	2.01	5.0	0.90	9.1	10.9	12.2	15.6	18.9	21.6
B-13	1276+10	3.24	46.1	0.50	4.0	4.6	5.1	6.4	7.6	8.6
B-14	1281+00	1.60	9.6	0.71	5.1	6.1	6.8	8.7	10.5	11.9
B-15	1286+70	1.99	5.0	0.72	7.2	8.6	9.7	12.3	14.9	17.1
B-16	1300+00	4.87	5.0	0.69	17.1	20.4	22.9	29.2	35.3	40.3
B-17	1317+20	4.89	22.8	0.67	11.4	13.4	14.9	18.8	22.5	25.4
B-18	1330+50	3.16	16.9	0.61	7.5	8.8	9.8	12.4	14.9	16.9
B-19	1351+60	5.85	27.6	0.55	10.3	12.2	13.5	17.0	20.3	22.9
B-20	1362+80	4.67	15.7	0.43	7.9	9.4	10.4	13.2	15.8	18.0
B-21	1367+00	1.17	5.9	0.62	3.6	4.2	4.8	6.1	7.3	8.4
B-22	1368+50	0.74	6.0	0.34	1.2	1.5	1.7	2.1	2.6	2.9
B-23	1371+00	4.95	31.8	0.58	8.6	10.1	11.2	14.1	16.8	19.0
B-24	1390+00	12.29	12.9	0.54	27.7	32.8	36.7	46.4	55.8	63.5
B-25	1404+90	4.45	6.6	0.46	10.0	11.9	13.4	17.0	20.6	23.5
B-26	1420+00	915.00	n/a	n/a	160.6	264.9	335.2	434.1	512.9	593.0
B-27	1419+50	9.68	5.4	0.65	31.4	37.4	42.0	53.5	64.7	74.0
B-28	1431+00	4.18	5.0	0.62	13.1	15.6	17.5	22.3	27.0	30.9
B-29	1438+50	4.00	5.0	0.72	14.5	17.3	19.4	24.7	29.9	34.2
B-30	1458+60	7.25	11.2	0.34	10.8	12.8	14.3	18.1	21.8	24.9
B-31	1464+10	47.57	32.8	0.27	37.3	43.8	48.6	60.9	72.8	82.2
B-32	1469+00	2.66	5.0	0.60	8.1	9.7	10.9	13.9	16.8	19.2
B-33	1481+25	6.67	21.6	0.51	12.0	14.2	15.8	19.9	23.8	27.0

Table 4 (Section B): Discharge Spreadsheet

JOB:	I-85 Widening Cherokee Co MM80-96	
SUBJECT:	Runoff Discharge Calculations	
CALC'D BY:	RS	DATE: 06-Aug-15
CHEK'D BY:		DATE:

Rational Method									
Outfall ID	Area Pre	Tc (min)	C _{value}	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q25 (cfs)	Q50 (cfs)	Q100 (cfs)
C1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C2	1.14	5.0	0.69	4.0	4.7	5.3	6.8	8.2	9.3
C3	9.10	14.5	0.51	19.0	22.5	25.1	31.7	38.1	43.2
C4	6.85	15.7	0.68	18.4	21.7	24.2	30.6	36.8	41.7
C5	1.70	24.5	0.72	4.1	4.9	5.4	6.8	8.2	9.2
C6	6.99	21.2	0.49	12.2	14.3	16.0	20.1	24.1	27.3
C7	0.29	5.0	0.90	1.3	1.6	1.8	2.3	2.7	3.1
C8	17.53	28.3	0.61	33.8	39.7	44.1	55.4	66.2	74.9
C8A	1.42	14.8	0.38	2.2	2.5	2.8	3.6	4.3	4.9
C9	8.83	11.5	0.51	19.4	23.1	25.8	32.7	39.3	44.8
C10	4.51	16.6	0.50	8.8	10.4	11.6	14.7	17.6	20.0
C11	1.79	5.0	0.68	6.2	7.4	8.3	10.5	12.7	14.6
C12	6.18	15.8	0.42	10.2	12.1	13.5	17.0	20.4	23.2
C13	8.56	32.6	0.31	7.9	9.3	10.3	12.9	15.4	17.4
C14	3.79	19.2	0.63	8.8	10.4	11.6	14.6	17.5	19.9
C15	1.62	5.0	0.75	6.1	7.3	8.2	10.5	12.7	14.5
C16	1.47	5.0	0.90	6.7	8.0	9.0	11.4	13.8	15.8
C17	2.73	14.4	0.65	7.2	8.5	9.5	12.0	14.5	16.5
C18	0.92	5.0	0.78	3.6	4.3	4.9	6.2	7.5	8.6
C19	9.40	17.1	0.45	16.5	19.5	21.7	27.4	32.8	37.3
C20	8.28	14.9	0.71	23.7	28.0	31.2	39.5	47.4	53.9
C21	5.15	5.0	0.71	18.4	21.9	24.6	31.4	38.0	43.4
C22	1.26	5.2	0.90	5.7	6.8	7.6	9.7	11.8	13.5
C23	14.97	32.7	0.35	15.4	18.1	20.0	25.1	30.0	33.9
C24	3.73	20.5	0.30	4.1	4.9	5.4	6.8	8.2	9.2
C25	6.73	21.7	0.39	9.3	10.9	12.2	15.3	18.3	20.8
C26	5.10	27.0	0.32	5.3	6.2	6.9	8.6	10.3	11.7
C27	10.90	28.0	0.41	14.3	16.8	18.6	23.4	28.0	31.7
C28	0.52	15.9	0.35	0.7	0.9	1.0	1.2	1.4	1.6
C29	2.44	21.2	0.58	5.1	6.0	6.7	8.4	10.1	11.4
C30	0.33	5.0	0.90	1.5	1.8	2.0	2.6	3.1	3.5
C31	0.52	5.0	0.90	2.4	2.8	3.2	4.0	4.9	5.6
C32	3.31	5.0	0.90	15.0	18.0	20.2	25.7	31.1	35.5
C33	2.12	6.9	0.90	9.2	11.0	12.3	15.6	18.9	21.6
C34	6.25	12.9	0.41	10.7	12.7	14.2	17.9	21.6	24.5
C35	1.78	5.0	0.46	4.1	4.9	5.5	7.0	8.5	9.7
C36	0.93	5.0	0.90	4.2	5.0	5.7	7.2	8.7	10.0
C37	2.74	5.0	0.67	9.2	11.0	12.4	15.8	19.1	21.8
C38	1.09	5.0	0.90	5.0	5.9	6.6	8.5	10.2	11.7
C39	3.04	5.0	0.43	6.6	7.9	8.9	11.4	13.7	15.7
C40	1.78	5.0	0.82	7.4	8.8	9.9	12.6	15.2	17.4
C41	1.87	5.0	0.90	8.5	10.1	11.4	14.5	17.6	20.1

Table 4 (Section C): Discharge Spreadsheet

Individual Site Appendix (Sections A, B, & C)

Pipe Conditions Report